Nortel Multiservice Switch 15000/20000

Planning Site Requirements

NN10600-125

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Contents

What's new

There were no new features added to this document:

Other changes made to this document include the following:

- Updated the chapters Planning considerations (page 15) and Power and grounding preparation (page 95) with information showing that the 25-amp BIMs are supported on the Multiservice Switch 15000.

Attention: To ensure that you are using the most current version of an NTP, check the current NTP list in NN10600-000 *Nortel Multiservice Switch 7400/15000/20000 What's New*.

Safety information

The safety information in this section applies to all activities of site planning and preparation and to the installation and maintenance of a Nortel Multiservice Switch 15000 or Multiservice Switch 20000. Where procedures occur throughout the documentation suite, the appropriate safety information is repeated.

Follow all warnings and cautions provided with this product, as well as the safety procedures identified by your company. Some procedures must be performed by qualified personnel. Where indicated, contact your Nortel technical support representative.

Navigation

Personal safety

Symbols are used in this document to indicate the need for personal safety. For procedures involving tasks that risk personal injury, a WARNING is provided at the procedure or the step in the procedure where task-specific safety information is required. The following are examples of personnel safety warnings for Nortel Multiservice Switch equipment.

WARNING

Risk of injury when handling a frame

Never place a foot or a hand under any part of a NEBS 2000 frame while it is being tilted or moved. Always move it with three or four people. The weight of a shipped frame with one Multiservice Switch 15000 or Multiservice Switch 20000 is approximately 419 kg (926 pounds); with two switches the weight is approximately 612 kg (1,344 pounds). For additional protection, wear safety boots with steel toes.

WARNUNG

Verletzungsgefahr beim Gestelltransport

Stellen Sie niemals einen Fuß unter das Gestell, wenn dieses bewegt oder gekippt wird, und greifen Sie nicht unter das Gestell. Die Einheit muß mit vier Personen von der Transportpalette genommen werden. Ein Gestell wiegt mit einem Multiservice Switch 15000 oder Multiservice Switch 20000 ca. 420 kg, mit zwei Multiservice Switch-Einheiten ca. 610 kg. Tragen Sie zu Ihrem zusätzlichen Schutz Sicherheitsschuhe mit Stahlkappen.

DANGER

Risk of injury by electrocution

When a breaker interface module (BIM) is unseated, regardless of toggling breakers on or off, the capacitors inside a BIM need time to discharge. Wait 15 seconds before re-seating the BIM or removing it from the breaker interface panel (BIP).

WARNUNG

Verletzungsgefahr

Die Speisestromzuführungen zu jedem BIM sind für bis zu 100 A ausgelegt. Wenn ein BIM vom BIP getrennt wird, benötigen die Kondensatoren im BIM 15 Sekunden zur Entladung. Lassen Sie das BIM während dieser Zeit freigeschaltet und innerhalb des BIP.

DANGER

Risk of injury or damage by electricity

When toggling off power breakers on a breaker interface module (BIM) or in the circuit up to it, or removing a fuse from the circuit up to it, always put tape over the breaker or fuse cavity. The tape indicates it was manually toggled off, and not tripped by the system. This prevents accidental activation of the power circuit, especially if power cables are being handled.

WARNUNG

Schäden oder Verletzungen durch Elektrizität

Wenn die Leistungstrennschalter an einem Trennschalterkopplungsmodul (BIM) oder im zuführenden Stromkreis geöffnet bzw. Sicherungen aus dem Stromkreis entfernt werden, decken Sie den Trennschalter oder den Sicherungssteckplatz mit Klebeband ab. Das Klebeband signalisiert, daß er manuell ausgeschaltet und nicht vom System ausgelöst wurde. Damit verhindern Sie eine versehentliche Aktivierung der Stromversorgung, besonders beim Hantieren mit Netzkabeln.

Safe equipment handling

Safe equipment handling includes Personal safety (page 9), safely moving the NEBS 2000 frame that houses one or two Nortel Multiservice Switches, preventing damage by electrostatic discharge (ESD), and following regulatory safety activities for the installation and maintenance of equipment. The symbol used in this document for safe equipment handling is:

CAUTION

Loss of service

For procedures involving tasks that risk damaging equipment, a CAUTION is provided at the procedure or the step in the procedure where task-specific safety information is required.

ACHTUNG

Betriebsstörungen

Mit diesem Hinweis sind Vorgänge oder Arbeitsschritte gekennzeichnet, bei denen die Gefahr von Geräteschäden besteht. Es werden jeweils situationsspezifische Informationen gegeben.

Moving the frame safely

The size and weight of a partially or fully provisioned Multiservice Switch 15000 or Multiservice Switch 20000 requires equipment to move it from the receiving area to the location where it is to be anchored to the floor.

For the safe handling of a frame, see the procedure to move one in NN10600-130 *Nortel Multiservice Switch 15000/20000 Hardware Installation, Maintenance, and Upgrade*.

Avoiding equipment damage from static electricity

Damage to electronic components can occur from the discharge of static electricity when a hand touches a circuit module. To avoid equipment damage by electrostatic discharge (ESD), wear a wrist strap. Nortel recommends also using conductive carpet flooring with conductive shoes, or heel “grounders”. The symbols used in this document to avoid equipment damage by ESD are:

CAUTION
Risk of equipment damage by ESD
Unpack a circuit card or module only minutes before it is to be inserted in its slot in a shelf. The packaging protects the circuitry from electrostatic discharge (ESD).

ACHTUNG
Geräteschäden durch elektrostatische Entladung
Nehmen Sie Schaltkarten oder Module erst unmittelbar vor dem Einsetzen in den Steckplatz im Multiservice Switch 15000 oder Multiservice Switch 20000 aus der Verpackung. Die Verpackung schützt die Schaltungen vor elektrostatischer Entladung.

CAUTION
Risk of damage to equipment by ESD
Although the electronic components of a Multiservice Switch are not touched directly by hand, handling any part of it or its frame can generate electrostatic discharge (ESD) that is transferred to ESD-sensitive hardware inside the switch. Always ground yourself using an approved anti-ESD method before and while handling any tools or hardware on or near the equipment. You can plug the provided wrist strap (part number A0378999) into an anti-ESD jack on the lower left mounting ear of either cooling unit (row of fans).

ACHTUNG

Geräteschäden durch elektrostatische Entladung

Obgleich die Elektronikbauteile eines Multiservice Switch 15000 oder Multiservice Switch 20000 nie direkt mit der Hand berührt werden, kann durch Berühren anderer Bestandteile oder des Gestells elektrostatische Entladung entstehen, die auf interne, elektrostatisch gefährdete Hardware-Komponenten des Multiservice Switch übertragen wird und zu Störungen führen kann. Vermeiden Sie elektrostatische Entladung, indem Sie sich nach einer anerkannten Methode erden, bevor und während Sie am oder in der Nähe des Multiservice Switch mit Werkzeug oder Hardware hantieren. Stecken Sie das mitgelieferte Armband (Artikelnummer A0378999) in die dafür vorgesehene Buchse im unteren linken Flansch eines Kühlaggregats (Lüfterreihe).

Installing the equipment safely

Installing the equipment safely applies mostly to anchoring the frame securely to the floor and properly connecting the appropriate power and ground cables.

Before anchoring the frame to the floor, ensure that there is a minimum of 76.2 cm (30 inches) in the front and 61 cm (24 inches) in the rear of the bay. The minimum is required to enable personnel to safely do various installation, maintenance, or upgrade tasks. For example, replacing a fan controller module requires the maintenance technician to bend over and reach into a cooling unit to access an upper or lower fan controller module. This can be done safely and without damage to equipment by complying to the minimum allowance. The minimum is also enough to do other maintenance tasks, such as replacing an air filter or replacing a plug-in card or module.

CAUTION

Risk of service degradation or equipment damage

While drilling into the floor to create anchor holes, vacuum the dust. Use a vacuum with an induction-wound motor to prevent EMI from affecting nearby electronic circuitry. Dust can prevent the proper seating of cards or modules or prematurely increase the arrestance of the cooling air through the fan filters.

ACHTUNG

Leistungsbeeinträchtigung oder Geräteschäden

Entfernen Sie den Bohrstaub, der beim Setzen der Verankerungslöcher anfällt, sofort mit einem Staubsauger. Verwenden Sie einen Staubsauger mit Induktionsmotor, damit in der Nähe befindliche Elektronikbaugruppen keinen elektromagnetischen Störungen ausgesetzt sind. Der Bohrstaub kann dazu führen, daß die Module nicht richtig sitzen und daß sich der Lüfterfilter vorzeitig zusetzt.

CAUTION

Risk of damage by fire

In the bottom rear center of the frame, each removable plate (drip tray, part number P0870734) may have two knockout disks. Each knockout disk must remain intact and unbent unless a power conduit from a raised floor will be routed through it. Leaving an opening reduces the fire-proofing of the switch.

ACHTUNG

Geräteschäden

Die Ausbrechöffnungen in der Platte, die sich auf der Rückseite jedes Gestells unten in der Mitte befindet, sollten nur dann geöffnet werden, wenn eine Stromleitung von einem Montageboden durchgeführt werden muß. Unnötige Öffnungen vermindern die Feuersicherheit der Schaltereinheit.

CAUTION

Risk of equipment damage by fire

To remove a conduit knockout disk from the bottom rear center plate, remove the plate to a bench. Knock out a disk at the bench so that the plate is not bent. A bent plate leaves an opening which reduces the fire proofing effect of the switch.

ACHTUNG

Geräteschäden

Wenn Sie aus der unteren mittleren Rückwandplatte eine Durchführungsöffnung ausbrechen wollen, legen Sie die Platte auf einen geeigneten Werktisch. Achten Sie darauf, daß die Platte beim Ausbrechen der Scheibe nicht verbogen wird. Eine verbogene Platte läßt im montierten Zustand eine Spaltöffnung an den Kanten frei. Dadurch verschlechtert sich die Feuersicherheit der Schalteinheit.

Storing and transporting circuit cards

Care is required to store or transport circuit modules.

Store each circuit module in its own antistatic material and transportation package to avoid physical or ESD damage or the accumulation of dust on contacts. Be careful not to damage the module while packaging it.

Store packaged circuit modules in areas where the relative humidity is less than 95% and the temperature is less than 70 degrees Celsius (158 Fahrenheit). This significantly reduces the chances of warping the circuit board and corrosion of electrical contacts. The nominal storage humidity is 55% and the nominal storage temperature is 20 degrees Celsius (68 Fahrenheit).

Compliance with electrical and safety standards

Each Nortel Multiservice Switch 15000 and Multiservice Switch 20000 complies with North American and international regulatory safety requirements for the handling and the installation of equipment. For a complete list of standards, see Standards and compliance considerations (page 127).

Planning considerations

Plan the location and installation of aNortel Multiservice Switch 15000 or Multiservice Switch 20000 node using all the information in this section. It is important that you review all considerations because site requirements vary depending on specific installation options.

- Prerequisites of planning considerations (page 15)
- Task flow of planning considerations (page 15)

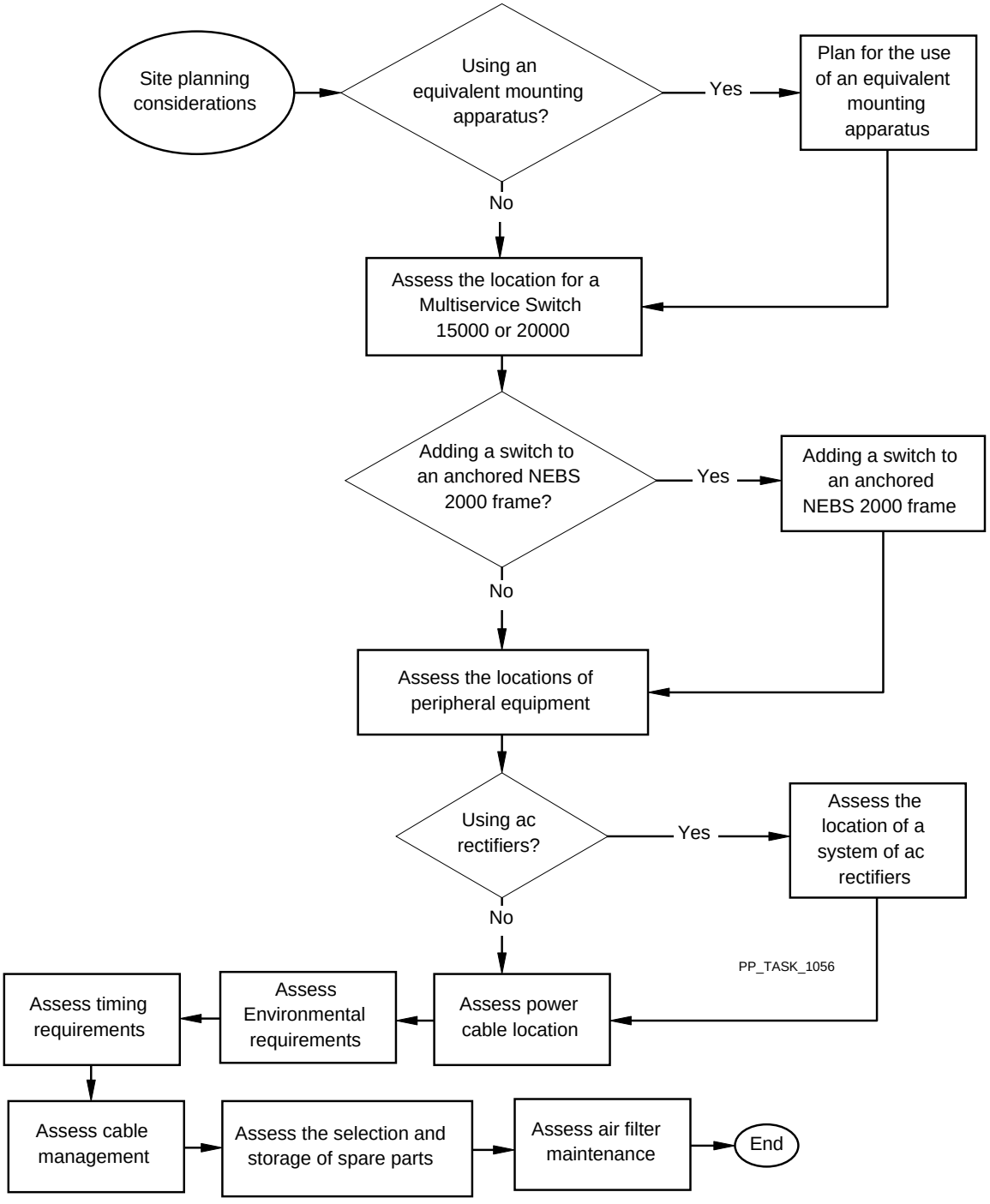
Prerequisites of planning considerations

You need to know what equipment has been ordered, especially by its name as opposed to its part number or product engineering code (PEC).

Task flow of planning considerations

This task flow shows the sequence in which to plan for the installation of a Multiservice Switch 15000 or Multiservice Switch 20000 and accessories, and peripheral hardware. To link to any procedure, go to Task flow navigation (page 17).

Task flow of planning considerations



Task flow navigation

The following references in the task flow are listed here alphabetically:

- Adding a switch to an anchored NEBS 2000 frame (page 18)
- Assess air filter maintenance (page 19)
- Assess cable management (page 21)
- Assess environmental requirements (page 33)
- Assess power cable location (page 37)
- Assess spare parts storage and selection (page 38)
- Assess the location for a Multiservice Switch 15000 or Multiservice Switch 20000 (page 41)
- Assess the location of a system of ac rectifiers (page 58)
- Assess the locations of peripheral equipment (page 60)
- Assess timing requirements (page 66)
- Plan for the use of an equivalent mounting apparatus (page 67)

Adding a switch to an anchored NEBS 2000 frame

With packages NTQH03 or NTQS03, a second Nortel Multiservice Switch 15000 or Multiservice Switch 20000 can be added to a NEBS 2000 frame that is already anchored. The addition can occur as a re-deployment or as a new installation without affecting the service of a switch mounted in the lower position of the frame. Use the requirements and considerations for planning the installation of Multiservice Switch equipment as indicated throughout this document. For example, some of the unit weights or power consumptions of the plug-in cards and modules for a Multiservice Switch 15000 is different from those for a Multiservice Switch 20000. For the differences, see

- Equipment size and weight (page 43)
- Power distribution and consumption (page 100)

When two Multiservice Switches are installed in the same NEBS 2000 frame, they share the same BIP. The power ratings of the BIMs must be matched to the power demands of the shelf assembly. If you wish to add a Multiservice Switch 20000 to a frame that already has a Multiservice Switch 15000 mounted in it, or wish to add a Multiservice Switch 15000 to a frame that already has a Multiservice Switch 20000 mounted in it, see the table Combinations of BIM pairs in a BIP (page 19) to plan a safe installation involving equipment with different power ratings.

A label on the cover of the cable channel that runs across the front of the shelf assembly identifies the type of switch in the lower position as either a Multiservice Switch 15000 or Multiservice Switch 20000. On older models of Multiservice Switch 15000, the cover is blank. The type of shelf indicates which version of the BIP you have.

Combinations of BIM pairs in a BIP

Shelf type	PEC of a BIP with 2 BIMs	PECs of the BIM pairs that can be installed
Multiservice Switch 15000	NT6C62	two or four 20-amp NT6C60PA for one or two Multiservice Switch 15000s or two 20-amp NT6C60PA for a Multiservice Switch 15000 in the lower half of the NEBS 2000 frame and two 25-amp AP6C67PA for a Multiservice Switch 20000 in the upper half of the NEBS 2000 frame
	AP6C68	two or four 25-amp AP6C67PA for one or two nodes or two 25-amp AP6C67PA for a Multiservice Switch 20000 in the lower half of the NEBS 2000 frame and two 20-amp NT6C60PA for a Multiservice Switch 15000 in the upper half of the NEBS 2000 frame
Multiservice Switch 20000	AP6C68	two or four 25-amp AP6C67PA for one or two Multiservice Switch 20000s or two 25-amp AP6C67PA for a Multiservice Switch 20000 in the lower half of the NEBS 2000 frame and two 20-amp NT6C60PA for a Multiservice Switch 15000 in the upper half of the NEBS 2000 frame

Assess air filter maintenance

The air filter for each Multiservice Switch must be replaced at three-month intervals, or more often, to ensure that the plug-in processor cards, fabric cards, and modules do not fail or degrade their performance due to the accumulation of dust. In order to validate the equipment warranties, you may have to replace the filter more often than three months from the power-up date of the switch, and just as periodically thereafter. Upper and lower air filters require the same interval of replacement.

When choosing the anchored position of a Multiservice Switch in a mounting apparatus, minimize the mount of particulates that the filters trap by ensuring that the switch is not located near room ventilation or in the path of air exhaust from other equipment. See also Cooling considerations (page 70).

Vacuuming around the equipment will reduce the amount of particulates drawn into the air filters, which improves their cooling efficiency over time, but will not change the interval of replacing an air filter. For information about vacuuming and the special equipment, refer to “Equipment vacuuming” in NN10600-130 *Nortel Multiservice Switch 15000/20000 Hardware Installation, Maintenance, and Upgrade*.

The frequency of replacing an air filter and the date of the actual replacement for each switch must be recorded. A one page form is provided in NN10600-130 *Nortel Multiservice Switch 15000/20000 Hardware Installation, Maintenance, and Upgrade*, for you to use to record air filter replacement. Nortel Networks recommends that you keep a hardcopy of the form near the equipment for convenience in recording maintenance tasks.

When a plug-in card or module is returned to Nortel Networks for warranty service, you may be asked to provide a copy of the air filter replacement form to validate the warranty. Equipment that failed due to accumulated particulates will void that equipment's warranty.

Order a supply of replacement air filters for each switch to prepare for the frequency of replacement. The part numbers for the available packages are listed in NN10600-120 *Nortel Multiservice Switch 15000/20000 Hardware Description*, the chapter of field replaceable units (FRUs).

Assess cable management

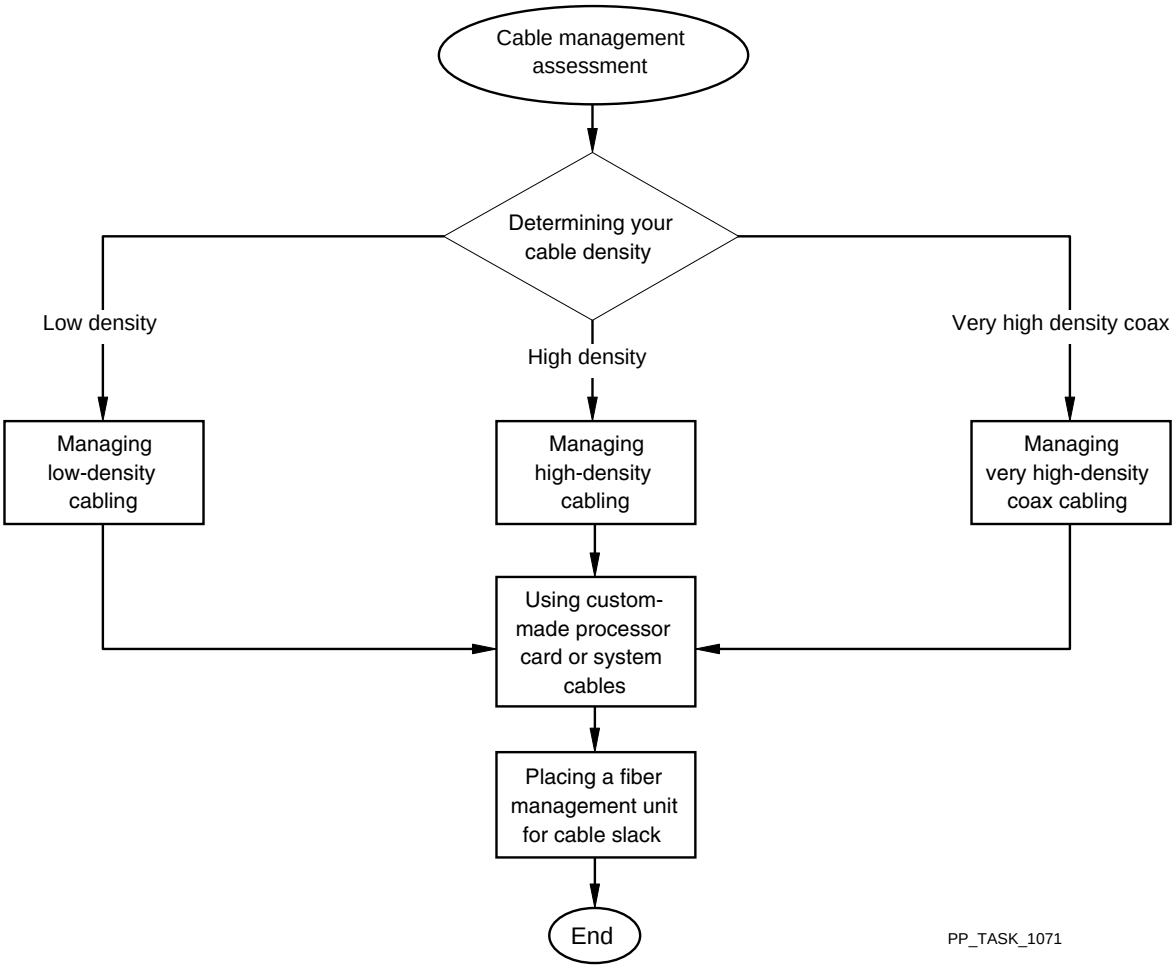
Assess cable management to determine how your site will support the cabling required for a equipment.

- Task flow of cable management assessment (page 21)

Task flow of cable management assessment

This task flow shows you the sequence of criteria needed for you to appropriately assess cable management requirements. To link to any procedure, go to Task flow navigation (page 17).

Task flow of cable management assessment



Task flow navigation

The following references are listed alphabetically:

- Determining your cable density (page 22)
- Managing low-density cabling (page 26)
- Managing high-density cabling (page 24)
- Managing very high-density coax cabling (page 27)
- Placing a fiber management unit for cable slack (page 28)
- Using custom-made processor card or system cables (page 30)

Determining your cable density

A Nortel Multiservice Switch 15000 or Multiservice Switch 20000 supports low-density cable management and, through the use of additional cable management brackets, high-density, and very high-density cable management. You must determine current and future cabling requirements. By calculating the immediate and future cable requirements, you can determine whether the basic cable management brackets will accommodate your cable density, or whether you will need to add the optional additional cable management brackets. The two kinds of high-density cable management brackets are:

- the high-density cable management bracket pairs for fiber, or mini-coax, or both
- the extended cable management brackets for 8W8 mini-coax or standard coax

The brackets and their intended uses are described in NN10600-120 *Nortel Multiservice Switch 15000/20000 Hardware Description*.

The couplers that are part of fiber optical Y-splitter cable assemblies (for example, with NTHW44 FPs) must not reside inside any type of cable management bracket that is provided with or for the NEBS 2000 frame. The presence of a coupler inside a bracket will occupy space that should be used for other cables sharing the same routing path.

Use the table Determining cable density by the number and type of cards (page 23) to identify which brackets you will need.

The table Diameters of processor card cables (page 23) identifies the area of individual and clustered cables.

Determining cable density by the number and type of cards

Cable density	Number of FP types
Low	• less than five 12-port DS3s or E3s are in one cage (one row of a shelf) • less than nine 12-port DS3s or E3s are in one NEBS 2000 frame • fewer than 15 to 28 FPs of any type occupy one or two switches in one NEBS 2000 frame • less than ten 16-port OC-3/STM-1s using MT-RJ cables in one NEBS 2000 frame • less than eleven 16-port OC-3/STM-1s using LC cables in one NEBS 2000 frame
High	• greater than five 12-port DS3s or E3s are in one cage (one row of a shelf) • 15 to 28 FPs of any type occupy one or two switches in one NEBS 2000 frame • greater than ten 16-port OC-3/STM-1s using MT-RJ cables in one NEBS 2000 frame • greater than eleven 16-port OC-3/STM-1s using LC cables in one NEBS 2000 frame
Very high (coax cables only)	• greater than nine 12-port DS3s or E3s are in one NEBS 2000 frame • a shelf full of 12-port DS3s or E3s in one NEBS 2000 frame

Diameters of processor card cables

Type of cable	Diameter per cable	Cross-sectional area
control cable, with DB9 connector	5.0 or 6.0 mm	__.__ mm^2
fiber, simplex multimode or single-mode with SC connectors	2.9 mm	9.0 mm^2
fiber, simplex multimode or single-mode with LC connectors	2.0 mm	4.0 mm^2
fiber, simplex multimode or single-mode with MT-RJ connectors	2.9 mm	9.0 mm^2
fiber, duplex multimode or single-mode with SC connectors	5.8 mm	18.0 mm^2
fiber, duplex multimode or single-mode with LC connectors	4.0 mm	8.0 mm^2
coax, standard size	__.__ mm	__.__ mm^2
mini-coax 8w8, single cable	3.0 mm	9.0 mm^2
mini-coax 8w8, cluster of 8 cables	10.5 mm	113.0 mm^2

To calculate the area of the cables, multiply the total number of cables by the value of the cross-sectional area for that cable type. Calculate the area for each type of cable on your shelf. If the sum of the areas is less that 1400 mm^2 than you have a low-density cabling. If the sum is greater than 1400 mm^2, but not greater than 2800 mm^2, you have a high-density cabling.

For example, the area of cables for five 16-port OC-3/STM-1 FPs (NTHW21 with MT-RJ connectors) which have a cross-sectional area of 9.0 mm^2 can be calculated as follows:

```
<total number of FPs> * <number of cables> * <cross-
sectional area> = total area of cable bundle

5 * 16 * 9.0 mm2 = 720.0 mm2
```

The total area, for this example, is 720.0 mm^2. Since the total area is less that 1400 mm^2, this configuration is a low-density cabling situation.

Depending on the number and type of processor cards (CPs and FPs) that are provided with a switch, or to be added later, the basic cable management brackets may need to be doubled or replaced to accommodate a high-density cabling. A pair of plastic cable management brackets are used to accommodate both coax and fiber high-density. The optional left-side or right-side extended cable management brackets support very high-density coax cabling. The extended brackets are needed when a shelf assembly has high-capacity electrical FPs, for example, when greater than nine 12-port DS3s are provisioned in a NEBS 2000 frame or equivalent. High-density optical brackets are needed when a shelf assembly has high-capacity optical FPs such as the 16-port OC-3/STM-1 FPs.

Managing high-density cabling

To plan cable management for switches with high-density cabling, do the following:

- review background information on managing telecom cables in NN10600-120 *Nortel Multiservice Switch 15000/20000 Hardware Description*
- review the description of high-density cable management brackets in NN10600-120 *Nortel Multiservice Switch 15000/20000 Hardware Description*
- review cable and connection specifications for the types of cables you are planning to install. Cable specifications are listed in NN10600-120 *Nortel Multiservice Switch 15000/20000 Hardware Description*
- review basic cable handing guidelines listed in the best practices section of NN10600-130 *Nortel Multiservice Switch 15000/20000 Hardware Installation, Maintenance, and Upgrade*

- ensure that the installer is familiar with the task flows and procedures for routing high-density cables listed in NN10600-130 *Nortel Multiservice Switch 15000/20000 Hardware Installation, Maintenance, and Upgrade*

Example high-density routing calculation

This example of a high-density routing calculation demonstrates how the capacity of cable management brackets and troughs are determined for a switch populated with 16-port-OC-3 FPs. Two versions of this FP are discussed.

Attention: The following section is an example of routing capacity calculations. The calculations for any specific site will vary depending on the type and number of high-capacity FPs used.

The following FPs are used in this example.

NTHW21AB - 16-port card containing:

- MT-RJ Fiber connectors
- 2 fibers per jacket = 16 fiber cables per card
- 8 cards per shelf creating 128 cables per shelf (16 x 8)
- total area of 128 fiber cables = 904.96 mm^2

NTHW31AB - 16-port card containing:

- LC fiber connectors
- 1 fiber per jacket with 32 fiber cables per card
- 8 cards per shelf creating 256 fiber cables per shelf (32 x 8)
- total area of 256 fiber cables = 803.84 mm^2

The total area in the cable trough under the fiber organizer is 2232.88 mm^2

The approximate area available in the molded plastic cable management brackets is

- 35 x 21 = 735 mm^2 in the first bracket compartment
- 26 x 21 = 546 mm^2 in the second compartment
- 18 x 21 = 378 mm^2 in the third compartment

Therefore the approximate area available in a fiber management bracket is 1659 mm^2. To ensure proper cable management, any area greater that 1400 mm^2, but less that 2800 mm^2, is considered high-density.

To determine the capacity required for NTHW21:

1 Calculate the number of fibers. In this example uses 16 MT-RJ fibers per card with a fiber diameter of 3 mm. Eight cards are in the lower half of the shelf containing 128 fibers and 6 cards are in the upper half of the shelf containing 96 fibers. Therefore the total number of 224 fibers will need to be installed

2 Calculate the capacity of the cable management bracket. In a packed scenario, using a single cable bracket (P0937935), the first compartment holds 87 fibers, the second 64 fibers, and the third 40 fibers for a total of 187 fibers. In an unpacked scenario, the first compartment holds 77 fibers, the second 56, and the third 35 for a total of 168 fibers.

Based on this calculation, a single cable bracket (P0937935) will handle the fibers from only one-half of a shelf (a cage) containing NTHW21 cards.

To determine the capacity required for NTHW31:

1 Calculate the number of fibers. In this example uses 32 LC fibers per card. Eight cards are in the lower half of the shelf containing 256 fibers and 6 cards are in the upper half of the shelf containing 192 fibers. Therefore the total number or 448 fibers will need to be installed.

2 Calculate the capacity of the cable management bracket. In a single cable bracket (P0937935) the first compartment holds 170 fibers, the second compartment holds 120 fibers, and the third 80 fibers for a total of 370 fibers.

Based on this calculation, a single cable bracket (P0937935) will handle the fibers from only one-half of a shelf containing NTHW31 cards.

Managing low-density cabling

To plan cable management for switches with low-density cabling, do the following:

- review background information on managing telecom cables in NN10600-120 *Nortel Multiservice Switch 15000/20000 Hardware Description*
- review cable and connection specifications for the types of cables you are planning to install. Cable specifications are listed in NN10600-120 *Nortel Multiservice Switch 15000/20000 Hardware Description*
- review basic cable handing guidelines listed in the best practices section of NN10600-130 *Nortel Multiservice Switch 15000/20000 Hardware Installation, Maintenance, and Upgrade*
- ensure that the installer is familiar with the task flows and procedures for routing cables listed in NN10600-130 *Nortel Multiservice Switch 15000/20000 Hardware Installation, Maintenance, and Upgrade*

Managing very high-density coax cabling

To plan cable management for switches with very high-density coax cabling, do the following:

- review the explanation of the use of extended cable management brackets and study the cable routing example provided at the end of this section

Attention: Using extended cable management brackets expands the footprint of a switch. Review the material in Assess the location for a Multiservice Switch 15000 or Multiservice Switch 20000 (page 41) to determine the allowance that must be made to accommodate these brackets.

- review background information on managing telecom cables in NN10600-120 *Nortel Multiservice Switch 15000/20000 Hardware Description*
- review the description of the extended cable management brackets in NN10600-120 *Nortel Multiservice Switch 15000/20000 Hardware Description*
- review cable and connection specifications for the types of cables you are planning to install. Cable specifications are listed in NN10600-120 *Nortel Multiservice Switch 15000/20000 Hardware Description*
- review basic cable handing guidelines listed in the best practices section of NN10600-130 *Nortel Multiservice Switch 15000/20000 Hardware Installation, Maintenance, and Upgrade*
- ensure that the installer is familiar with the task flows and procedures for routing high-density cables listed in NN10600-130 *Nortel Multiservice Switch 15000/20000 Hardware Installation, Maintenance, and Upgrade*

Using cable management brackets

For high-density cabling that involves coax or 8W8 mini-coax cables, the basic cable management brackets can be replaced by the optional left-side or right-side extended cable management brackets for coax or a pair of molded plastic brackets for fiber.

The kit number for a left-side extended bracket (facing the front of the frame) is NTRU0368 and the right-side is NTRU0369. All the hardware to install one bracket is included in each kit.

High-density brackets are two molded plastic brackets each with part number P0937935.

You must choose the number of optional extended brackets you will need because the brackets cannot be installed before the frame is shipped. The number of needed brackets is determined by:

- the volumes of either kind of cable, for example, a switch fully populated with 12-port DS3s is 348 mini-coax cables and two switches is 700 FP cables
- the direction you plan to route the cables, up over the frame or down under the floor, or both
- the starting point as a lower switch, an upper switch, or both

Up to four extended cable management brackets fit on each side of the NEBS 2000 frame. The bracket installation procedure identifies where the brackets are fastened to the frame.

After choosing the number of brackets for each side of the frame, ensure that the footprint of the frame is marked on the floor to accommodate the extended brackets, especially if the frame is installed adjacent another frame. See When joining NEBS 2000 frames together (page 78) and Marking the footprint and the anchor holes on the floor (page 85).

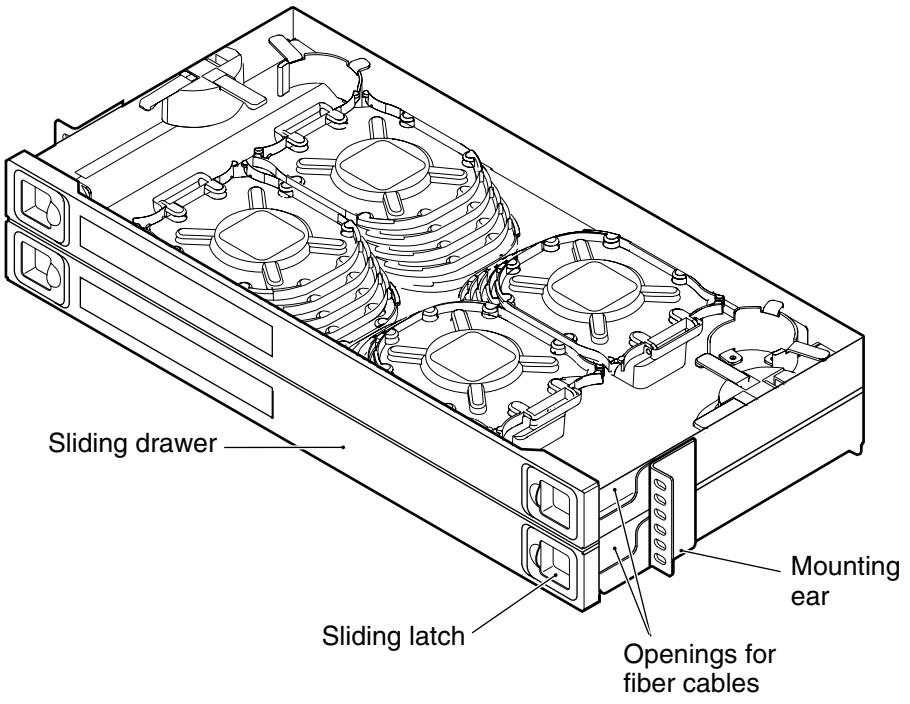
For cable management on a switch, all coax cables are typically routed to the front right side of the NEBS 2000 frame (facing the front of the switch) and all fiber and CP cables are typically routed to the left. Depending on the number of DS3 or E3 FPs, cable management can be made easier to install, maintain, add to, or upgrade when the optional extended cable management brackets are used.

To develop a cable routing plan, for specific FP types, such as 16-port OC-3 FPs, review the guidelines for routing high-density cables in NN10600-130 *Nortel Multiservice Switch 15000/20000 Hardware Installation, Maintenance, and Upgrade*.

Placing a fiber management unit for cable slack

Fiber cable slack can be managed near a switch by installing one or more optional dual-drawer fiber management units in the same or an adjacent NEBS 2000 frame. The product engineering code (PEC) of the fiber unit is NTHW50. See the figure A dual-drawer fiber management unit (page 29).

A dual-drawer fiber management unit



Each fiber shelf includes two latched drawers that accommodate up to 20 fiber cables. Up to six fiber units can fit into either the front or the rear of a NEBS 2000 frame that has a switch mounted in the lower half. The fiber units can be mounted at both the front and the rear of the frame. When installing them at the rear, the cable path from the FP faceplates may not be practical.

The couplers that are part of fiber optical Y-splitter cable assemblies (for example, for NTHW44 FPs) must not reside inside the NTHW50 when managing cable slack from the FPs. The presence of a coupler inside a unit increases the risk of losing traffic because the space to add or remove cables will be more confined and congested.

All fiber units must have separate mounting holes except when shared with a cable management bracket.

A switch that is fully provisioned with only 4-port OC-3s would require three fiber management units, that is:

14 FPs x 8 connections per FP = 112 cables
112 divided by 40 = 2.8, which means three 2-drawer fiber units

Based on the number of fiber ports your configuration will initially have or might expand to, determine how many fiber units you will need. Then consider where to locate the fiber units relative to the location of the switch. Wherever you plan to locate the fiber management unit, ensure that it does not constrict the access of the fiber cables into it, or unavoidably exceed the bend radius limitations.

Attention: After at least one fiber management unit is installed in the upper half of a NEBS 2000 frame, adding a second switch would require relocating the fiber management unit. Relocation means removing the fiber optical connections from service at both ends of the cable path, and disconnecting one end to remove the cables from the fiber unit. Consider installing the fiber management unit in a 21-inch (53.34-cm) mounting apparatus that is anchored near the switch.

Attention: Nortel Networks recommends that a fiber management unit not be installed in a 23-inch (58.42-cm) EIA rack that already houses a switch because of weight limitations.

Consider leaving fiber management trays empty in sequence to accommodate cards in those slots that presently contain only filler cards. When a processor card is added to the slot, the tray would be available for the fiber optical cable, if that is the type of card that is installed. Also, the preferred method of replacing a fiber cable is to route and connect a parallel cable to another tray, then cut the connectors off the cable being replaced and leave it installed. Removing a fiber cable from a cluster can disrupt traffic passing through cables sharing the same path.

For more description about an NTHW50, see NN10600-120 *Nortel Multiservice Switch 15000/20000 Hardware Description*.

Using custom-made processor card or system cables

For each installation, it is your responsibility to measure, cut, and assemble cables for:

- power and ground up to the power distribution unit (the BIP)
- the signaling cables for function processor (FP) cards and some control processor (CP) cards

The specifications for the power-and-grounding cables are in Power and grounding preparation (page 95). The specifications of each card cable and system cable is included in NN10600-120 *Nortel Multiservice Switch 15000/20000 Hardware Description*. At each card or module description, cable assemblies are indicated as prefabricated cables that are available from or

provided by Nortel Networks, or as cables to be or that can be custom-made. When both specifications and prefabricated cables are provided, Nortel Networks supports the option of you providing your own cables.

Attention: Some cable assemblies for a Multiservice Switch 15000 or Multiservice Switch 20000 identify only the prefabricated version and do not provide specifications for custom-making the cable. In these cases, it is not recommended to make your cable (for example, the proprietary mini-coax cables with 8W8 connectors).

Prefabricated cable assemblies are typically included for the following:

- power from the BIP to the shelf and cooling units
- the CPs
- building integrated timing supply (BITS) -- an interface cable as opposed to an end-to-end connection

Prefabricated cable assemblies are optionally available for the following:

- the electrical FP cards (for example, with DS3, E3, or E1 interfaces) and their termination panels
- the polyvalent and ETSI power-and-ground kits

Specifications of cable assemblies (cable and connectors) are offered by Nortel Networks for:

- power up to the BIP
- the fiber optical connections to FP cards
- some Ethernet connections to CP or FP cards
- external alarms

Plan to manage slack cable for fiber optical FP cards using the NTHW50 fiber cable management units as described in Placing a fiber management unit for cable slack (page 28). Otherwise use your own equipment that is rated for the type and volume of cables.

Plan to manage slack cable for electrical FP cards as directed from Determining your cable density (page 22).

The position of the coupler on each fiber optical Y-splitter cable is critical for having effective cable management on a switch. Plan the length of each installed cable so that its coupler:

- will not reside across the front of the shelf
- will not reside in a drawer of the fiber management unit (NTHW50)

- resides on the side of the NEBS 2000 frame or equivalent mounting apparatus, or beyond, but not on any of the cable management brackets

Grounding FP interface cables is indicated for each type of FP in NN10600-120 *Nortel Multiservice Switch 15000/20000 Hardware Description*.

Assess environmental requirements

This section contains information on the physical environment required to operate a Nortel Multiservice Switch 15000 or Multiservice Switch 20000 node. These topics include:

- Operational environment (page 33)
- Power dissipation (page 35)
- Bulk heat dissipation (page 36)
- Prerequisites for your earthquake zone and application (page 36)

Operational environment

Multiservice Switch equipment should be installed in a climate controlled environment.

The switch hardware complies with the Telcordia NEBS GR-63-CORE, and ETS 300-019-1-3, class 3.1E for operating temperature.

The ranges for temperature, humidity, and other environmental values are listed in the following tables:

- Operational environment specifications for a Multiservice Switch 15000 or Multiservice Switch 20000 (page 33)
- Operational environment specifications for a Multiservice Switch 15000 VSS (page 34)
- Operational environment specifications for a Multiservice Switch 15000 with a SER 5500 switch (page 34)

Operational environment specifications for a Multiservice Switch 15000 or Multiservice Switch 20000

Parameter	Range
Normal operating temperature	5 to 40 degrees Celsius (41 to 104 degrees Fahrenheit)
Normal operating humidity	10% to 90% relative humidity (non-condensing)
Short term operating temperature	-5 to 50 degrees Celsius (23 to 122 degrees Fahrenheit)
Short term operating humidity	5% to 90% relative humidity at 25 degrees Celsius (77 degrees Fahrenheit)
Rate of temperature change	60 degrees Celsius (140 degrees Fahrenheit) or less per hour

(1 of 2)

Operational environment specifications for a Multiservice Switch 15000 or Multiservice Switch 20000 (continued)

Parameter	Range
Storage temperature	-40 to 70 degrees Celsius (-40 to 158 degrees Fahrenheit)
Earthquake	up to zone 4
Altitude	60 m (197 ft) below sea level to 4,000 m 13,123.36 ft) above sea level
Vibration	0.1 G (1 m/s2) over the range 5 - 200 Hz

(2 of 2)

Operational environment specifications for a Multiservice Switch 15000 VSS

Parameter	Range
Normal operating temperature	10 to 40 degrees Celsius (50 to 104 degrees Fahrenheit)
Storage temperature	-40 to 70 degrees Celsius (-40 to 158 degrees Fahrenheit)
Normal operating humidity	10% to 90% relative humidity (non-condensing)
Storage humidity	10% to 80% relative humidity non-condensing (5.2 kPa pressure maximum)
Rate of temperature change	60 degrees Celsius (140 degrees Fahrenheit) or less per hour
Altitude	60 m (197 ft) below sea level to 4,000 m 13,123.36 ft) above sea level

Operational environment specifications for a Multiservice Switch 15000 with a SER 5500 switch

Parameter	Range
Normal operating temperature	0 to 40 degrees Celsius (32 to 104 degrees Fahrenheit)
Normal operating humidity	10% to 90% relative humidity (non-condensing)
Short term operating temperature	-5 to 50 degrees Celsius (23 to 122 degrees Fahrenheit)
Rate of temperature change	60 degrees Celsius (140 degrees Fahrenheit) or less per hour

(1 of 2)

Operational environment specifications for a Multiservice Switch 15000 with a SER 5500 switch (continued)

Parameter	Range
Altitude	60 m (197 ft) below sea level to 4,000 m 13,123.36 ft) above sea level
Storage temperature	-40 to 70 degrees Celsius (-40 to 158 degrees Fahrenheit)
	(2 of 2)

For information about how temperature affects the performance of hardware before and during maintenance activities, refer to checking ambient room temperature in the common procedures of general maintenance in NN10600-130 *Nortel Multiservice Switch 15000/20000 Hardware Installation, Maintenance, and Upgrade*.

Power dissipation

Power dissipation is the amount of heat (in Watts) generated by electronic and mechanical equipment. It is important to ensure that your ventilation system is able to accommodate the power dissipation from all of the equipment in a single location.

The thermal design of a Multiservice Switch 15000 or Multiservice Switch 20000 provides 3000 W power dissipation per shelf. For this calculation, a shelf is defined as a double card cage of 9 times ~53-mm wide modules. Since a NEBS 2000 frame can accommodate two shelves in addition to the fabric cards, BIP, and cooling units, the total power dissipation for a fully provisioned frame (two shelves) is up to 6000 W. The dissipation for one shelf is calculated as

16 slots at 150 W each + 2 fabric cards at 75 W each + 2 cooling units + BIP = 2700 W for a frame housing one shelf (one Multiservice Switch 15000 or Multiservice Switch 20000)

The exact power dissipation of an individual shelf will vary, depending on the number of function processors installed in the shelf. To calculate a switch's total power dissipation, add the total watts for each individual part (values for each part are shown in the table Power budget for a Multiservice Switch 15000 or Multiservice Switch 20000 shelf assembly (fully provisioned) (page 36). To determine the power dissipation for a frame, add the totals for each shelf.

Power budget for a Multiservice Switch 15000 or Multiservice Switch 20000 shelf assembly (fully provisioned)

Unit	Per unit Watts	Quantity	Total Watts
Fabric slot in a Multiservice Switch 15000	75	2	150
Fabric slot in a Multiservice Switch 20000	150	2	300
Expansion slots 0E and 1E (currently unused)	150	2	300
FP or CP slots	150	16	2400
Fan unit	30	3	90
These are maximum design values. Actual card dissipation will be somewhat less depending on implementation.			

Bulk heat dissipation

The heat dissipation of a single Nortel Multiservice Switch 15000 or Multiservice Switch 20000 shelf is 2580 W/m^2, and with two shelves is 5160 W/m^2. These are maximum ratings. Typical ratings are less.

Prerequisites for your earthquake zone and application

Check your site survey and requirements to determine the type of building construction and safety considerations for an earthquake zone. Due to the small footprint of the proportionately tall NEBS 2000 frame, and the top-heavy center of gravity when two switches are installed in the frame, anchors will be required for both earthquake and non-earthquake applications. Refer to NN10600-120 *Nortel Multiservice Switch 15000/20000 Hardware Description* for the available anchor kits in the chapter on mounting apparatuses.

Assess power cable location

This section provides the following information about how to determine the location of input power cables feeding Nortel Multiservice Switch equipment:

- Ceiling requirements (page 37)
- Flooring requirements (page 37)

Other floor criteria to consider when choosing an overhead or underfloor route for the power cables is described in Assess the location of a system of ac rectifiers (page 58).

Ceiling requirements

Consider the following before installing a NEBS 2000 frame.

- The room should be clear of potential obstructions such as beams, columns, heating and air conditioning ducts, water pipes, lights and video monitors.
- There should be no sprinklers in the room; however, other appropriate fire protection should be available such as a fire extinguisher.
- The minimum ceiling clearance must be 2.5 m (8.25 ft).

Flooring requirements

The flooring can be one of the following types:

- raised subflooring, ideally with a clearance of 45.5 cm (18 in.), and a subfloor cable management system
- non-raised floor such as concrete, which typically means installing conduit according to your local electrical codes

Assess spare parts storage and selection

Assess which spare parts of various equipment you plan to have available for replacements. Having a spares maximizes your ability to maintain the equipment. To have a spare available for the quickest use, you must provide a means of storage for the items.

Spare processor cards

Having compatible or equivalent spare processor cards as replacements for your in-service cards ensures that you can continue service. (The definition of compatible and spare cards is in NN10600-130 *Nortel Multiservice Switch 15000/20000 Hardware Installation, Maintenance, and Upgrade*, the section on processor card compatibility.)

Verifying that each spare card operates with a specific PCR software version prior to being put into service ensures a quicker replacement and increases the probability that the replacement card provides service upon insertion.

When you plan to upgrade from one version of PCR to another, you must ensure that all in-service cards and their spares on the floor are still valid vintages. compatible or equivalent and have not yet become obsolete. If you have spare processor cards, which have already been verified as operational and compatible, or equivalent spare cards for the cards already in-service, replacing a failed card is quicker.

Spare processor cards should be stored in the same room as the switch so that the influence of imbalanced humidity is minimized. Otherwise you must wait an hour to acclimatize a card before inserting it into a slot.

Spare fabric cards

Fabric cards operate in a load-sharing mode. Having a spare fabric card on site reduces the risk of operating without a backup. The switch cannot handle traffic when both fabrics are out of service.

When planning to use a fabric card NTHR16EA in a Multiservice Switch 15000:

- the shelf assembly must have CP3 processor cards
- the switch software must contain either the fabric feature or the fabric patch that enables the operation of the fabric and suspends the alarm that indicates a version mismatch

The software loads containing the patch are indicated in NN10600-120 *Nortel Multiservice Switch 15000/20000 Hardware Description* in the section on fabrics.

Spare fabric cards should be stored in the same room as the switch so that the influence of imbalanced humidity is minimized. Otherwise you must wait an hour to acclimatize a card before inserting it into a slot.

Spare cooling units or cooling unit parts

When you have a spare cooling unit available as a replacement, you can:

- very safely and very quickly replace the cooling unit faster than you can replace some of its components (for example, a temperature sensor inside a lower cooling unit)
- minimize the impact of a failed component on overall cooling and reduce the amount of time the remaining fans operate at the higher rpm speed
- change the failed component on the removed cooling unit without jeopardizing safety or the time-sensitive removal of a failed component on a live cooling unit

Since there are two versions available for the lower (rear) cooling units, and two for the upper, you must ensure that your spare parts match the cooling unit they fit. The parts of the lower (rear) cooling unit NTHR51AA are not interchangeable with the parts of NTHR51AB. The parts of the upper (front) cooling unit NTHR52AA are not interchangeable with the parts of NTHR52AB. The parts of the temperature sensor bracket assembly NTHR68AA and not interchangeable with NTHR68AB, except a sensor from an AA can be used on an AB.

You can replace an entire cooling unit with either version. The performance of the versions is the same.

You can replace a temperature sensor bracket assembly with either version. The performance of the versions is the same.

For spare air filters, see Assess air filter maintenance (page 19).

Kits of spare parts for a Multiservice Switch 15000 or Multiservice Switch 20000

Hardware kits are available to provide sets of spare parts for a Multiservice Switch 15000 or Multiservice Switch 20000. For a Multiservice Switch 15000, the kits are:

- NTQS29AA
- NTQS29AB

For a Multiservice Switch 20000, the kits are:

- NTQH29AA
- NTQH29AB

- NTQH29AC
- NTQH29AD

The parts of each kit are listed in the chapter on field replaceable units (FRUs) in NN10600-120 *Nortel Multiservice Switch 15000/20000 Hardware Description*.

Assess the location for a Multiservice Switch 15000 or Multiservice Switch 20000

To assess the location for one or two Nortel Multiservice Switch 15000 or Multiservice Switch 20000 nodes in a NEBS 2000 frame, consider whether the system will always be a stand-alone network node, or if hardware might be added later. If the frame will contain two nodes, consider installing another frame to house the sparing panels or fanout panels to be used in conjunction with the function processors (FP).

This section includes:

- General guidelines for placing the equipment (page 41)
- Equipment size and weight (page 43)
- Front and rear access to switch hardware (page 56)

The marking of actual footprint measurements, including allowance for add-on options, is described in Site preparation of the floor (page 73).

General guidelines for placing the equipment

Observe these general guidelines when deciding where to place the NEBS 2000 frame that houses the switches.

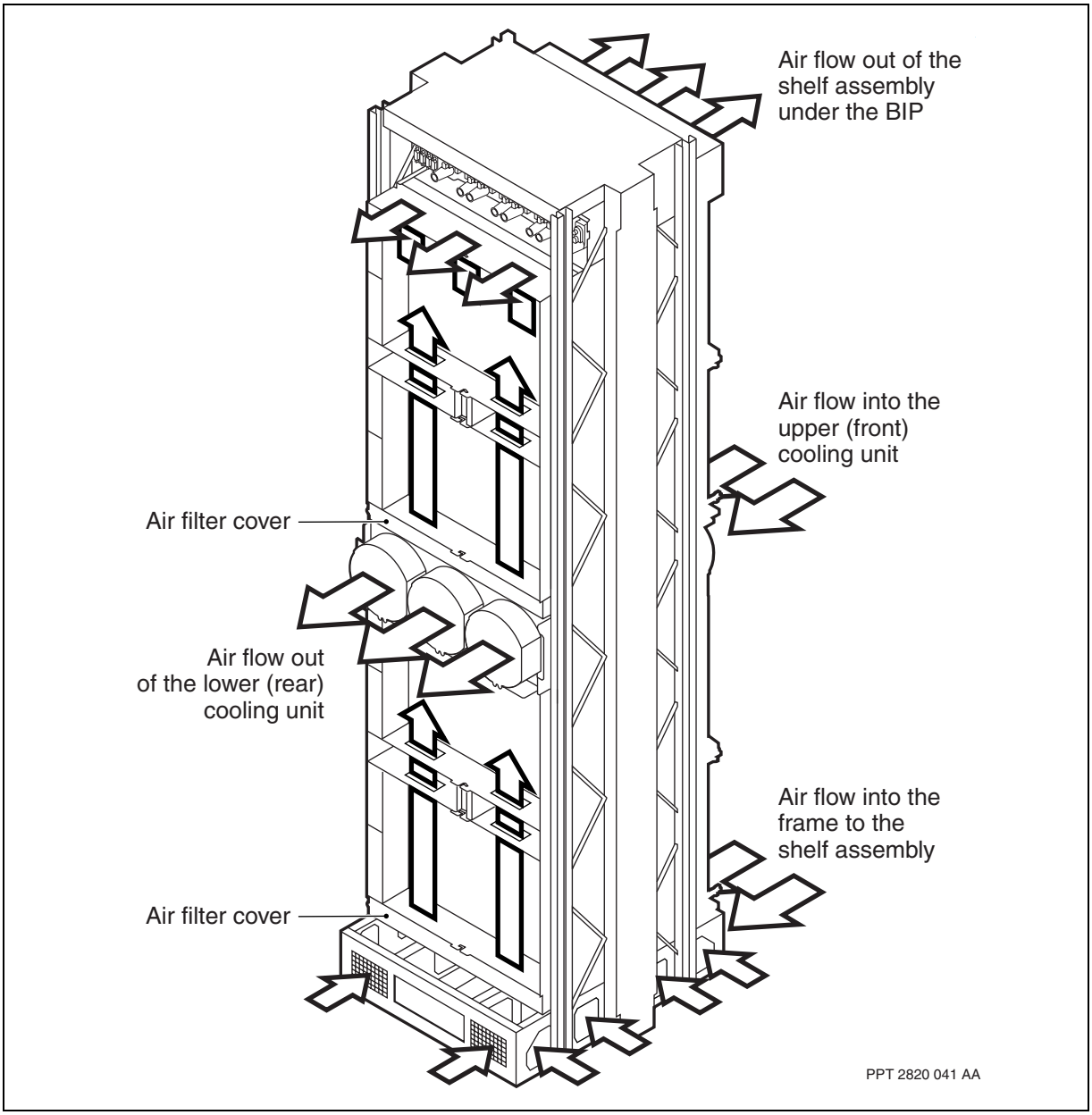
- The area must be stable and free of excess movement and jarring.
- Locate the frame in a location where its cooling unit fans will not intake exhaust air from other equipment, or blow exhaust air onto other equipment. A switch in the lower frame position pulls air from the base of the frame and pushes it to the rear middle of the frame, while in the upper frame position pulls air from the middle front of the frame and pushes it to the upper frame, mostly the rear.
- Ensure all power cables, cords, and traffic (signaling) cables can be safely routed and fastened. Refer to Assess cable management (page 21).
- If the optional extended cable management brackets were ordered, the position of the frame will need to accommodate the added width on one or both sides of the frame. Coordinate this with Assess cable management (page 21).
- Allow an extra 10 cm (4 inches) if you plan to add one or two side panels.
- If the optional side panel kit NTPX4050 was ordered, the footprint of the frame will be slightly wider as described in Front and rear access to switch hardware (page 56) and included in the procedure Marking the footprint and the anchor holes on the floor (page 85).
- If the optional door kit NTQS37AA or NTQS37AB was ordered, you must accommodate that the footprint of the frame will be deeper and that you will need clearance for the door to swing open as described in Front and

rear access to switch hardware (page 56) and included in the procedure Marking the footprint and the anchor holes on the floor (page 85).

- Consider if a second frame can be positioned beside the first frame at the time of the installation, or afterwards, for adding sparing or fanout panels, or fiber management units (NTHW50) to support proper cable and fiber routing, and connection. Coordinate this with Assess the locations of peripheral equipment (page 60).
- Ensure the area in front of and behind the mounting apparatus has sufficient air flow to assist cooling the equipment.
- Ensure the area is free of excess heat, dust, smoke, and electrostatic discharge (ESD).
- Since a NEBS 2000 frame or an MFA150 framework with batteries has a small footprint relative to its mass and weight, plan to use anchors to secure the frame to the floor for either earthquake or non-earthquake applications.

Also consider the location of the frame relative to the location of the hardware to which it connects, namely the equipment identified in all other sections of this chapter.

Airflow directions of upper and lower cooling units in an NTRU04



Equipment size and weight

Before installing the NEBS 2000 frame, ensure that the room selected for it can accommodate the size, weight, and environmental (thermal and humidity) requirements of the equipment in the frame.

Dimensions without packaging material

Determine if the dimensions of the frame can fit through the site up to the footprint where the frame is to be anchored. A Network Building Equipment System (NEBS) frame is 60 cm (23.62 in.) wide by 60 cm (23.62 in.) deep by 212.5 cm (83.66 in.) tall.

For the frame footprint, the width is increased by an additional 75 mm (2.95 in.) on each side when the optional extended brackets for cable management (part number P0902826) are installed. It is also recommended that you allow 1 cm between the outermost reach of the extended brackets so that cables can be passed between the brackets and whatever equipment is beside them. These additional dimensions are addressed in Marking the footprint and the anchor holes on the floor (page 85).

Weights with one or two switches

This section provides information to help you calculate the weight of a frame populated with a Multiservice Switch 15000 or Multiservice Switch 20000, and additional equipment. Knowing the weight enables you to determine the following:

- which tool you need to safely move the frame
- whether the floor, especially a raised floor, can safely support the weight of all the installed equipment

The weight of an anchored NEBS 2000 frame containing one or two provisioned switches varies according to

- the type and number of all plug-in cards and modules
- all of the standard and optional add-on parts
- the type and lengths of cables that are supported by the frame within the NEBS footprint

Calculate the installed weight of your switch hardware by doing the following.

1 Use one of the following tables to determine the pre-installed base weight.

Base weight of a NEBS 2000 frame shipped with one Multiservice Switch 15000 (page 45)

Base weight of a NEBS 2000 frame shipped with two Multiservice Switch 15000s (page 46)

Base weight of a NEBS 2000 frame shipped with one Multiservice Switch 20000 (page 47)

Base weight of a NEBS 2000 frame shipped with two Multiservice Switch 20000s (page 48)

Weights of a NEBS 2000 frame with a Multiservice Switch 15000 VSS (page 52)

Weights of a NEBS 2000 frame with a Multiservice Switch 15000 and SER 5500 switch (page 53)

Weights of Multiservice Switch 15000 parts that are installed in a 23-inch EIA rack (page 53)

Weights of Multiservice Switch 20000 parts that are installed in a 23-inch EIA rack (page 54)

Optional and to-be-determined weights for a Multiservice Switch 15000 or Multiservice Switch 20000 in a 23-inch EIA rack (page 55)

2 Use the table Weights of optional or additional Multiservice Switch 15000 or Multiservice Switch 20000 equipment (page 49) to add to the base weight all the hardware parts that are to be installed after anchoring.

Attention: The plug-in cards that are listed in this table (CPs, FPs, and blanks) are already included as a average total card weight in the tables Base weight of a NEBS 2000 frame shipped with one Multiservice Switch 20000 (page 47) and Base weight of a NEBS 2000 frame shipped with two Multiservice Switch 20000s (page 48). A Multiservice Switch 20000 is shipped with all plug-in cards partially installed.

Considerations about the weight of the system are described in Checking the floor (page 77).

Base weight of a NEBS 2000 frame shipped with one Multiservice Switch 15000

Name of the hardware part	PEC or part number	Quantity	Weight kg (lbs)
frame, NEBS 2000, 600 mm x 600 mm	NTRU04	1	181.4 (400)
breaker interface panel (BIP) with 2 BIMs	NT6C62	1	11.7 (25.8)

(1 of 2)

Base weight of a NEBS 2000 frame shipped with one Multiservice Switch 15000 (continued)

Name of the hardware part	PEC or part number	Quantity	Weight kg (lbs)
breaker interface panel (BIP) with 2 BIMs	AP6C68	1	11.7 (25.8)
cabling strain relief bar (back of BIP)	P0911981	1	0.9 (2.0)
shelf (lower) assembly with:	NTHR50 or NTHW99	1	99.0 (218)
alarm/BITS module	NTHR12, 13, or 14	1	
MAC address module	NTHR11	1	
PIMs	NTHR15	4	
cables:			
BIP alarm cable assembly (lower shelf)	NTHR56	1	0.3 (0.65)
Cooling unit alarm cable (upper or lower shelf)	NTHR57	1	0.3 (0.66)
power distribution cable (for lower shelf)	NTHR54	1	1.9 (4.2)
power distribution cable (upper or lower cooling unit)	NTHR66	1	0.2 (0.4)
top frame cover kit front or rear	NTRU0185	1 kit	2.3 (5.0)
cable cover kit (2 covers) front or rear	NTRU0120	1 kit	5.3 (11.6)
cooling unit (lower)	NTHR51AA or NTHR51AB	1	9.1 (20)
cable management brackets, metal	P0879577	2	0.91 (2.0)
cable management brackets, moulded plastic	P0937935	28	0.98 (2.16)
TOTAL WEIGHT	n/a	n/a	314.3 (692.9)

(2 of 2)

Base weight of a NEBS 2000 frame shipped with two Multiservice Switch 15000s

Name of the hardware part	PEC or part number	Quantity	Weight kg (lbs)
frame, NEBS 2000, 600 mm x 600 mm	NTRU04	1	181.4 (400)
breaker interface panel (BIP) with 4 BIMs	NT6C61	1	15.7 (34.6)
breaker interface panel (with 4 BIMs)	AP6C67	1	16.0 (35.4)
cabling strain relief bar (back of BIP)	P0911981	1	0.9 (2.0)
shelf assemblies (upper and lower) with:	NTPN70	2	231.8 (510)
alarm/BITS module	NTHR12, 13, or 14	2	
MAC address module	NTHR11	2	
PIMs	NTHR15	8	

(1 of 2)

Base weight of a NEBS 2000 frame shipped with two Multiservice Switch 15000s (continued)

Name of the hardware part	PEC or part number	Quantity	Weight kg (lbs)
Cables:			
cooling unit alarm cable (upper or lower shelf)	NTHR57	2	0.3 (0.66)
BIP alarm cable assembly (lower shelf)	NTHR56	1	0.3 (0.65)
BIP alarm cable assembly (upper shelf)	NTHR55	1	0.23 (0.5)
power distribution cable (for lower shelf)	NTHR54	1	1.9 (4.2)
power distribution cable (for upper shelf)	NTHR53	1	1.1 (2.4)
power distribution cable (upper and lower cooling unit)	NTHR66	2	0.4 (0.8)
cooling unit (lower)	NTHR51AA or NTHR51AB	1	9.1 (20.0)
cooling unit (upper)	NTHR52AA or NTHR52AB	1	8.63 (19.0)
top frame cover kit front or rear	NTRU0185	1 kit	2.3 (5.0)
cable cover kit (2 covers)	NTRU0120	1 kit	5.3 (11.6)
cable management brackets, metal	P0879577	2	0.91 (2.0)
cable management brackets, moulded plastic	P0937935	28	0.98 (2.16)
TOTAL WEIGHT	n/a	n/a	461.3 (1017.0)

(2 of 2)

Base weight of a NEBS 2000 frame shipped with one Multiservice Switch 20000

Name of the hardware part	PEC or part number	Quantity	Weight kg (lbs)
frame, NEBS 2000, 600 mm x 600 mm	NTRU04	1	181.4 (400)
breaker interface panel (BIP) with 2 BIMs	AP6C68	1	11.7 (25.8)
cabling strain relief bar (back of BIP)	P0911981	1	0.9 (2.0)
shelf (lower) assembly with:	NTPN70	1	33.6 (74.0)
alarm/BITS module	NTPN12 or 13	1	
MAC address module	NTPN11	1	
PIMs	NTPN15	4	
fabrics	NTPN02	2	10.9 (24.0)
control processor (CP) cards	NTHW06	2	10.0 (22.0)
see the weights of your selection of FP cards in the table Weights of optional or additional Multiservice Switch 15000 or Multiservice Switch 20000 equipment (page 49) for card-specific weights	various	1 to 14	x.x (y.y)

(1 of 2)

Base weight of a NEBS 2000 frame shipped with one Multiservice Switch 20000 (continued)

Name of the hardware part	PEC or part number	Quantity	Weight kg (lbs)
system cables:			
cooling unit alarm cable (upper or lower shelf)	NTHR57	1	0.3 (0.66)
BIP alarm cable assembly (lower shelf)	NTHR56	1	0.3 (0.65)
power distribution cable (for lower shelf)	NTHR54	1	1.9 (4.2)
power distribution cable (upper or lower cooling unit)	NTHR66	1	0.2 (0.4)
cooling unit (lower)	NTHR51AA or NTHR51AB	1	9.1 (20.0)
top frame cover kit front or rear	NTRU0185	1 kit	2.3 (5.0)
cable cover kit (2 covers)	NTRU0120	1 kit	5.3 (11.6)
cable management brackets, metal	P0879577	2	0.91 (2.0)
cable management brackets, moulded plastic	P0937935	28	0.98 (2.16)
TOTAL WEIGHT	n/a	n/a	269.8 (594.8)

(2 of 2)

Base weight of a NEBS 2000 frame shipped with two Multiservice Switch 20000s

Name of the hardware part	PEC or part number	Quantity	Weight kg (lbs)
frame, NEBS 2000, 600 mm x 600 mm	NTRU04	1	181.4 (400)
breaker interface panel (with 4 BIMs)	AP6C67	1	16.0 (35.4)
cabling strain relief bar (back of BIP)	P0911981	1	0.9 (2.0)
shelf assemblies (upper and lower) with:	NTPN70	2	67.2 (148.0)
		2	
Alarm/BITS module	NTPN12 or 13	2	
MAC address module	NTPN11	8	
PIMs	NTPN15		
fabrics	NTPN02	4	21.8 (48.0)
control processor (CP) cards	NTHW06	4	20.0 (44.0)
see the weights of your selection of FP cards in the table Weights of optional or additional Multiservice Switch 15000 or Multiservice Switch 20000 equipment (page 49) for card-specific weights	various	1 to 28	x.x (y.y)

(1 of 2)

Base weight of a NEBS 2000 frame shipped with two Multiservice Switch 20000s (continued)

Name of the hardware part	PEC or part number	Quantity	Weight kg (lbs)
cables:			
cooling unit alarm cable (upper or lower shelf)	NTHR57	2	0.3 (0.66)
BIP alarm cable assembly (lower shelf)	NTHR56	1	0.3 (0.65)
BIP alarm cable assembly (upper shelf)	NTHR55	1	0.23 (0.5)
power distribution cable (for lower shelf)	NTHR54	1	1.9 (4.2)
power distribution cable (for upper shelf)	NTHR53	1	1.1 (2.4)
power distribution cable (both cooling units)	NTHR66	2	0.4 (0.8)
cooling unit (lower)	NTHR51AA or NTHR51AB	1	9.1 (20.0)
cooling unit (upper)	NTHR52AA or NTHR52AB	1	8.63 (19.0)
top frame cover kit front or rear	NTRU0185	1 kit	2.3 (5.0)
cable cover kit (2 covers)	NTRU0120	1 kit	5.3 (11.6)
cable management brackets, metal	P0879577	2	0.91 (2.0)
cable management brackets, moulded plastic	P0937935	28	0.98 (2.16)
TOTAL WEIGHT	n/a	n/a	338.8 (746.9)

(2 of 2)

Weights of optional or additional Multiservice Switch 15000 or Multiservice Switch 20000 equipment

Name of the hardware part	PEC or part number	Quantity	Weight kg (lbs)
anchor kits contribute low partial weight	NTRUnnnn	2, 3, 4 kits	0.0 (0.0)
adapter brackets for installing 19-inch wide EIA equipment into a NEBS 2000 frame	NTHW14	2	__.__ (__.__)
cable management extension bracket (left or right) -- replace a P0879577 or P0937935	NTRU0368 NTRU0369	1	1.4 (3.0)
cable cover kit (front or rear kit used with cable management extension brackets)	NTRU0366	1	7.3 (16)

(1 of 4)

Weights of optional or additional Multiservice Switch 15000 or Multiservice Switch 20000 equipment (continued)

Name of the hardware part	PEC or part number	Quantity	Weight kg (lbs)
cables:			
power input cable (1/0 AWG)	customer-supplied	0.3 m (1 ft)	0.15 (0.32)*
mini-coax FP cable (upper shelf)		0.3 m (1 ft)	0.09 (0.19)*
fiber optic FP cable		0.3 m (1 ft)	0.025
FP control port cable (upper shelf)		1	(0.06)*
FP control port cable (lower shelf)		1	0.1 (0.2)
CP Ethernet cable assembly kit	NT0479	1	0.16 (0.35
E1 balanced to unbalanced BITS conversion kit for an NTPN13	NTPN81	1	0.43 (0.95) 0.3 (0.66)
Attention: * multiply this weight by the number of meters (feet) of cable that fall within the perimeter of the switch, are supported by the NEBS 2000 frame, and the quantity of cables.			
conduit junction box, overhead	NTHR78	1	1.4 (3.0)
door-mounting hardware: cosmetic extension filler door door catches and hinges extension brackets, lower left and right kickplate extension top brandline cover, plain or illuminated top extension bracket	NTQS37AA or NTQS37AB	1	25.4 (56.0)
ETSI power-and-ground assembly kit	A0834149	1	3.1 (6.85)
fiber management unit, dual-drawer	NTHW50	1	8.25 (18.2)
multiport aggregate device	NT0421 or NT0486	1	2.0 (4.4)
polyvalent power-and-ground assembly kit	A0834143	1	2.1 (4.65)
side panel, extended	NTPX4050	1	18.1 (40.0)
side panel, regular	NTRU0128	1	12.27 (27.0)
temperature sensor bracket assembly for an NTHR52AA	NTHR68AA	1	0.459 (1.01)
temperature sensor bracket assembly for an NTHR52AB	NTHR68AB	1	0.459 (1.01)
(2 of 4)			

Weights of optional or additional Multiservice Switch 15000 or Multiservice Switch 20000 equipment (continued)

Name of the hardware part	PEC or part number	Quantity	Weight kg (lbs)
processor cards:			
2pGpDsk	NTHW10	1	4.90 (10.8)
4pGe	NTHW49	1	5.6 (12.5) *
CP2 (include in the base weights)	any	1	0.0
CP3 (include in the base weights)	any	1	0.0
DS1	NTHW91	1	5.63 (12.4)
2pDS3cTDM	NTHR31	1	5.22 (11.5)
4pDS3ChAtm	NTHR91	1	5.22 (11.5)
4pDS3ChAtm	NTHR23	1	5.45 (12.0)
12pDS3Atm	NTHW92	1	4.9 (10.8)
32pE1TDM	any	1	5.5 (12.1) !
E3		1	
processor cards continued:			
4pOC3MmAtm	NTHR17		5.63 (12.4)
4pOC3SmIrAtm	NTHR21	1	5.58 (12.3)
4pOC3TDM	NTHW70	1	6.1 (13.4)
16pOC3SmIrAtm	NTHW21	1	5.90 (13.0)
16pOC3SmIrAtm	NTHW31	1	5.5 (12.1) !
16pOC3PosAtm	NTHW44	1	5.9 (13.0) *
processor cards continued:			
1pOC12SmLrAtm	NTHR29	1	5.45 (12.0)
4pOC12SmIrAtm	NTHW11 or	1	5.63 (12.4)
4pMRPosAtm	NTHW86	1	5.0 (11.0) *
1pOC48ChSmIrAtm	NTHW46	1	5.49 (12.1)
STM-1	NTHW01	1	5.5 (12.1) !
STM-4	any	1	5.5 (12.1) !
VpnXc	any	1	5.5 (12.1) !
Vsp2 (VSP2)	any	1	5.3 (11.6)
2pGeMmSrVsp3 (VSP3)	NTHW87	1	6.1 (13.4)
2pOC3ChSmIrVsp3 (VSP3-o)	NTHW84	1	6.94 (15.3)
Blank processor card (aka filler module)	NTHW77 NTHR64	1	2.22 (4.9)
Attention: Processor card weights with ! are estimated. Weights with * include all SFPs (NTTP0x).			
fabrics, Multiservice Switch 15000	NTHR16	2	13.6 (30.0)
fanout panel, DS3 or E3, 12-port	NTHW52	1	1.0 (2.2)
sparing panel assembly for DS3 or E3, 3-port	NTFP99AA	1	__._ (__.__)
sparing panel assembly for DS3, 4-port	NTHR79	1	__._ (__.__)
(3 of 4)			

Weights of optional or additional Multiservice Switch 15000 or Multiservice Switch 20000 equipment (continued)

Name of the hardware part	PEC or part number	Quantity	Weight kg (lbs)
sparing panel assembly for DS3 or E3, including:	NTQS31	1	11.0 (24.3)
sparing panel module			
sparing panel relay module	NTHR37	1	
sparing panel control module	NTHR39	12	
	NTHR42	1	
frame spacer kit	NTRU0365	1	2.5 (5.5)
spaced frame junction kit	NTRU0370	1	1.1 (2.5)
top cover (panel) kit	NTRU0185	1	2.3 (5.0)
top cover (panel) kit, brandlining	NTHW51	1	2.3 (5.0)
shelf filler panels			
front of frame, 1000 mm (3.3 ft)	NTHR76	1	6.8 (15)
rear of frame, 800 mm (2.6 ft)	NTHR77	1	6.8 (15)
side panel kit (includes 2 panels)	NTRU0128	1 kit	12.9 (28.4)
BIM fillers for the BIP	P0887704	2	0.2 (0.44)

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Weights of a NEBS 2000 frame with a Multiservice Switch 15000 VSS

Number of shelves	Status of shelf	Weight	Hardware included with the weight
two	shipped in a frame	395 kg (562 lbs)	a NEBS 2000 frame, a BIP with 2 BIMs, one Multiservice Switch 15000 shelf assembly and all rear plug-in modules and no cards or fabrics, one Multiservice Switch 7400 shelf assembly with cooling unit and filter
two	installed completely	588 kg (982 lbs)	the same hardware as shipped in a frame plus: for the Multiservice Switch 7400 • 3 power supplies • one or two CPs • 14 FPs for the Multiservice Switch 15000 • two CPs • 14 FPs • 2 fabric cards

Weights of a NEBS 2000 frame with a Multiservice Switch 15000 and SER 5500 switch

Number of shelves	Status of shelf	Weight	Hardware included with the weight
two	shipped in a frame	383 kg (535 lbs)	a NEBS 2000 frame, a BIP with 2 BIMs, one Multiservice Switch 15000 with rear plug-in modules and no front cards or fabrics, and one SER 5500 switch with no cards
two	installed completely	569 kg (940 lbs)	the same as shipped in a frame plus: for the SER 5500 • all line cards • 14 FPs • 2 fabric cards for the Multiservice Switch 15000 • two CPs • 14 FPs • 2 fabric cards

Weights of Multiservice Switch 15000 parts that are installed in a 23-inch EIA rack

Name of the hardware part	PEC or part number	Quantity	Weight kg (lbs)
adapter brackets (front) for installing hardware into a 23-inch EIA rack	P0918821 P0918822	2	10.2 (22.4)
adapter brackets (rear) for installing hardware into a 23-inch EIA rack	P0918823 P0918824	8	1.6 (3.52)
breaker interface panel (BIP) with 2 BIMs	NT6C62	1	11.7 (25.8)
breaker interface panel (BIP) with 2 BIMs	AP6C68	1	11.7 (25.8)
cabling strain relief bar (back of BIP)	P0911981	1	0.9 (2.0)
shelf (lower) assembly with: Alarm/BITS module MAC address module PIMs	NTHR50 or NTHW99 NTHR12, 13, or 14 NTHR11 NTHR15	1 1 1 4	99.0 (218)
fabrics	NTHR16	2	13.6 (30.0)

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Weights of Multiservice Switch 15000 parts that are installed in a 23-inch EIA rack (continued)

Name of the hardware part	PEC or part number	Quantity	Weight kg (lbs)
cables			
BIP alarm cable assembly (lower shelf) Cooling unit alarm cable (upper or lower shelf) Power distribution cable (upper or lower cooling unit)	NTHR56 NTHR57 NTHR66	1 1 1	0.3 (0.65) 0.3 (0.66) 0.2 (0.4)
cooling unit (upper)	NTHR52AA or NTHR52AB	1	8.63 (19.0)
cable management brackets, metal	P0879577	2	0.91 (2.0)
cable management brackets, moulded plastic	P0937935	28	0.98 (2.16)
TOTAL WEIGHT	n/a	n/a	**148.32 (326.59)**

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Weights of Multiservice Switch 20000 parts that are installed in a 23-inch EIA rack

Name of the hardware part	PEC or part number	Quantity	Weight kg (lbs)
adapter brackets (front) for installing hardware into a 23-inch EIA rack	P0918821 P0918822	2	10.2 (22.4)
adapter brackets (rear) for installing hardware into a 23-inch EIA rack	P0918823 P0918824	8	1.6 (3.52)
breaker interface panel (BIP) with 2 BIMs	AP6C68	1	11.7 (25.8)
cabling strain relief bar (back of BIP)	P0911981	1	0.9 (2.0)
shelf (lower) assembly with: Alarm/BITS module MAC address module PIMs	NTPN70 NTPN12 or 13 NTPN11 NTPN15	1 1 1 4	33.6 (74.0)
fabrics	NTPN02	2	10.9 (24.0)
cables			
BIP alarm cable assembly (lower shelf) Cooling unit alarm cable (upper or lower shelf) Power distribution cable (upper or lower cooling unit)	NTHR56 NTHR57 NTHR66	1 1 1	0.3 (0.65) 0.3 (0.66) 0.2 (0.4)
cooling unit (upper)	NTHR52AA or NTHR52AB	1	8.63 (19.0)
cable management brackets, metal	P0879577	2	0.91 (2.0)

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Weights of Multiservice Switch 20000 parts that are installed in a 23-inch EIA rack (continued)

Name of the hardware part	PEC or part number	Quantity	Weight kg (lbs)
cable management brackets, moulded plastic	P0937935	28	0.98 (2.16)
TOTAL WEIGHT	n/a	n/a	**80.22 (176.59)**
(2 of 2)			

Optional and to-be-determined weights for a Multiservice Switch 15000 or Multiservice Switch 20000 in a 23-inch EIA rack

Name of the hardware part	PEC or part number	Quantity	Weight kg (lbs)
23-inch wide EIA rack or equivalent	see manufacturer's	1	x.x (y.y)
polyvalent power-and-ground assembly kit	A0834143	1	2.1 (4.65)
temperature sensor bracket assembly for an NTHR52AA	NTHR68AA	1	0.459 (1.01)
temperature sensor bracket assembly for an NTHR52AB	NTHR68AB	1	0.459 (1.01)
see the weights of your selection of CP and FP cards in the table Weights of optional or additional Multiservice Switch 15000 or Multiservice Switch 20000 equipment (page 49) for card-specific weights	various	1 to 14	x.x (y.y)
Cables			
power input cable (1/0 AWG) mini-coax FP cable (upper shelf) fiber optic FP cable FP control port cable (upper shelf) FP control port cable (lower shelf) CP Ethernet cable assembly kit E1 balanced to unbalanced BITS conversion kit for an NTPN13	customer-supplied NT0479 NTPN81	0.3 m (1 ft) 0.3 m (1 ft) 0.3 m (1 ft) 1 1 1 1	0.15 (0.32)* 0.09 (0.19)* 0.025 (0.06)* 0.1 (0.2) 0.16 (0.35 0.43 (0.95) 0.3 (0.66)
Attention: * multiply this weight with the number of meters (feet) of cable that fall within the perimeter of the switch, are supported by the NEBS 2000 frame, and the quantity of cables.			
ETSI power-and-ground assembly kit	A0834149	1	3.1 (6.85)
Anchor kit for rack	see manufacturer's	2 or 4	x.x (y.y)

Front and rear access to switch hardware

It is important to be able to have comfortable access to the switch hardware to perform maintenance. The sizes of the plug-in cards and modules require minimum distances for you to be able to safely remove and insert them for a maintenance or an upgrade task. Both front access and rear access must be planned using these guidelines:

- the maintenance aisle, in front of the mounting apparatus, requires a clearance of 76.2 cm (30 in.)
- the wiring aisle, at the rear of the mounting apparatus, requires a clearance of 61 cm (24 in.)
- when adding a door to the front or rear of a NEBS 2000 frame, you need clearance to swing the door open as shown in the figure Clearance to swing a door open on a NEBS 2000 frame (page 57)

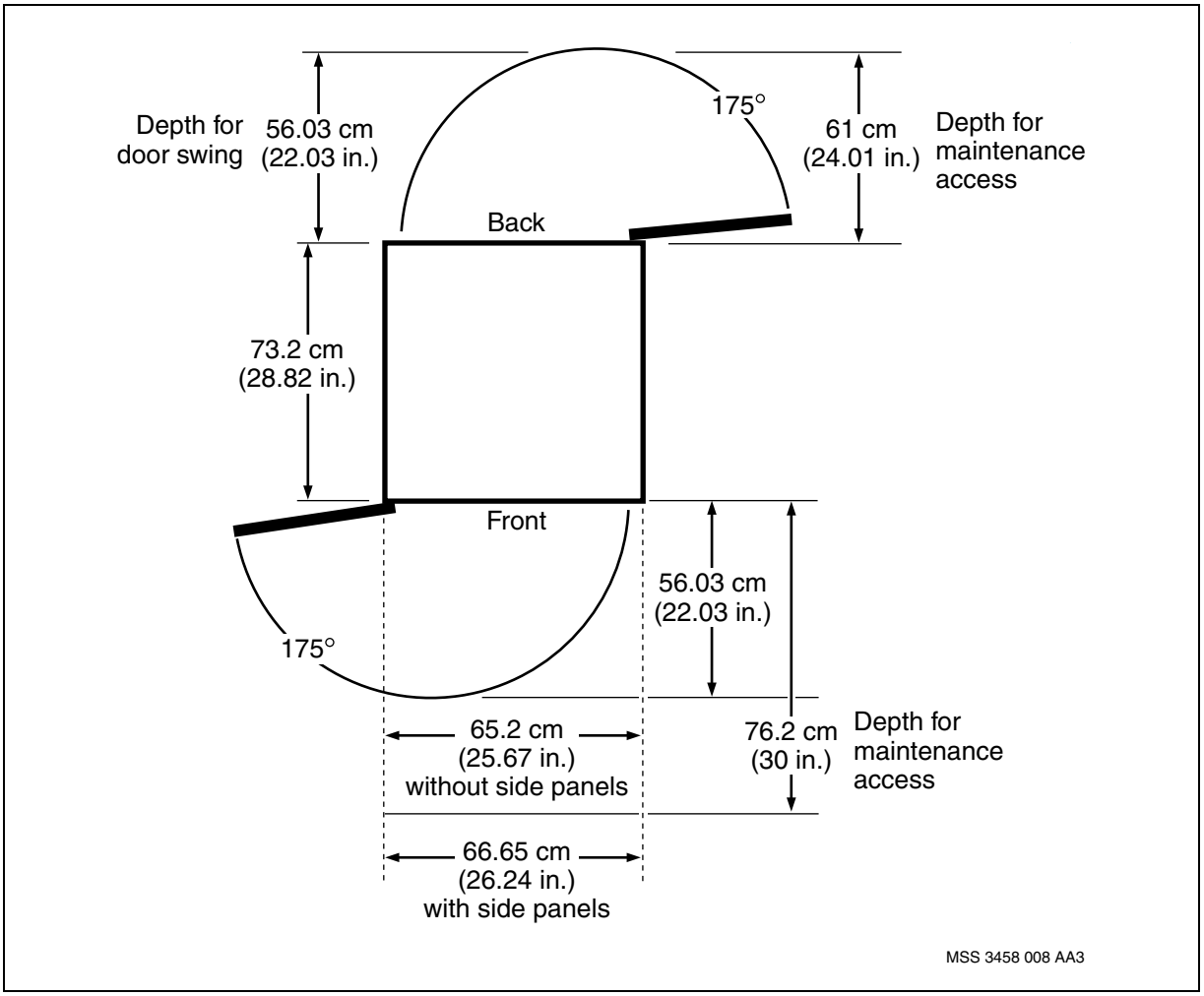
Attention: If clearance is not available, for example, the frame is already installed, an unlocked door can easily be removed to enable access to the equipment housed in the frame.

For more information about general equipment requirements, see the Telcordia NEBS, General Equipment Requirements, GR-63-CORE.

See the following documents for related information:

- UM6C28C (167-9021-102) *MFA150 Modular Front Access Power System -- NT6C28C User Manual* from Astec Advanced Power Systems
- UM6C28D (167-9021-107) *Modular Front Access Power System MFA150 NT6C28D User Manual* from Astec Advanced Power Systems
- 167-9021-133 *Advanced Power Systems MFA150 Modular Front Access Power System Detailed Installation Guidelines and Procedures Manual*

Clearance to swing a door open on a NEBS 2000 frame



Assess the location of a system of ac rectifiers

a Nortel Multiservice Switch 15000 or Multiservice Switch 20000 node can be powered from a system of ac rectifiers, such as an Astec MFA150 power system. Because the ac rectifiers supply dc power directly to the breaker interface panel (BIP) of the switch, consider the following:

- where the rectifiers tap into the ac power input source of the site
- if the MFA150 framework is to be installed in the same room with the switch

Attention: A Multiservice Switch 15000 or Multiservice Switch 20000 is mounted in a NEBS 2000 frame, and an MFA150 power system is mounted in a framework. The frame and framework are structurally different but provide the same functionality.

- how far the dc power output cables must be run from the rectifiers to the switch so that 40 to 100 A redundant service can be supplied
- if the power input cables to the BIP are to run from an overhead trough, through conduit imbedded in a solid floor, or under a raised floor (described in Assess power cable location (page 37))
- if cables for external alarms are to run to the BIP so that a rectifier failure or tripped breaker can be indicated at the BIP
- if the distance between the BIP and its MFA150 system of rectifiers is less than 10 m (32.8 ft) to accommodate the path of the external alarm cable assembly P0940531; this external alarm cable enables a rectifier failure or tripped breaker to be indicated at the BIP and reported to Nortel Multiservice Data Manager software
- If you are anchoring the framework beside a NEBS 2000 frame, consider the following:
  - if there is enough room for both footprints; a framework is 64.5 cm (25.4 in.) wide by 50.8 cm (20-in.) deep, but the dimensions are subject to change without notice
  - if the NEBS 2000 frame might receive the optional cable extension brackets or side panels after initial installation
  - if the power input and output cables on the sides of the MFA150 framework would interfere with signals passing through coax cables on the side of the NEBS 2000 frame (for example, DS3 or E3 mini-coax cables routed along the right side or standard coax connecting a fanout or sparing panel)
- if the floor can support the installed weight of the framework setup, especially when involving a raised floor

- if there is any other site-specific consideration for installing an MFA150 framework setup that could also affect the installation of the switch

An MFA150 system can be anchored beside a Multiservice Switch 15000 or Multiservice Switch 20000 without interfering with its telecommunications performance.

CAUTION
Risk of service interruption
An MFA150 power system of ac rectifiers is rated as class A equipment, therefore it requires an appropriately controlled environment for your site setup.

For powering one Multiservice Switch, the Astec identifier AP5C900FF has two 60-A mid-trip circuit breakers and three Helios rectifiers 25/48 with power factor correction (PFC). For powering two switches, the Astec identifier AP5C900FG has four 60-A mid-trip circuit breakers and five Helios rectifiers 25/48 with power factor correction (PFC). Both kits exclude the recommended No. 6 AWG (13.3mm^2) 2-wire armored cable for ac power (R0061445). These hardware configurations are subject to change, therefore consult with your sales representatives of Nortel Networks and Astec to determine the most appropriate setup for your switch and installation site.

For the details of these considerations and the installation of an MFA150, see the Astec document 167-9021-133 *Advanced Power Systems MFA150 Modular Front Access Power System Detailed Installation Guidelines and Procedures Manual*.

Throughout the Nortel Multiservice Switch documentation suite, MFA150 information has been integrated where necessary. The intent is to coordinate the overall installation of an MFA150 framework with Multiservice Switch equipment that is installed in a NEBS 2000 frame.

CAUTION
Risk of service interruption or delay
An MFA150 power system of ac rectifiers is manufactured by a third party, which means hardware specifications can change without notice. Nortel Networks attempts to integrate the changes that impact the rectifiers, but is not responsible when changes are communicated after this document is published.

Assess the locations of peripheral equipment

Peripheral equipment for a Nortel Multiservice Switch 15000 or Multiservice Switch 20000 node includes anything that connects to it but is not integrally part of the switch hardware. Since peripheral equipment is optional, assessing each location depends on which of the following you intend to deploy:

- Choosing the user interface equipment (page 60)
- Choosing the network management computer for a Multiservice Switch (page 61)
- Deciding where to place local user interface equipment (page 61)
- Deciding where to place a sparing or a fanout panel (page 62)
- Deciding where to place interworking equipment (page 63)
- Deciding which external BIP alarms to connect (page 65)
- Using a connection to a gigabit Ethernet port on NTHW84 (page 65)
- Placing a fiber management unit for cable slack (page 28)

Choosing the user interface equipment

The user interface equipment is typically a terminal (computer with a monitor) that is connected to a Multiservice Switch. The user interface equipment enables a software operator to:

- start initial software loading
- configure the software setup of the switch
- monitor the status and performance operation of the switch
- change the status of software components and hardware parts to prepare the system for maintenance or upgrades

Only one user interface terminal connects to a switch. The connection is by an RS232 cable with a V.24 DCE connector on the faceplate of the control processor (CP) in the switch and a 9-pin D-sub connector at the VT100 terminal. This connection is typically not left in place after the hardware and software installations are complete. Details of installing and connecting an operator terminal are described in NN10600-130 *Nortel Multiservice Switch 15000/20000 Hardware Installation, Maintenance, and Upgrade*.

Attention: The user interface terminal is not the equipment used for Multiservice Data Manager which communicates with the switch as a node in the network. For information about Multiservice Data Manager connectivity, see Choosing the network management computer for a Multiservice Switch (page 61).

Choose the user interface equipment before deciding where it is to be placed. The type of user interface equipment that will operate with the switch is a VT100 terminal or device that emulates a VT100 terminal. The specifications of the terminal are the standard VT100 specifications.

Once the VT100 has been chosen, do Deciding where to place local user interface equipment (page 61).

Choosing the network management computer for a Multiservice Switch

The network management equipment is typically a terminal (computer with a monitor) that is connected to the Multiservice Switch. The network management equipment runs Nortel Multiservice Data Manager software, or equivalent software. The Multiservice Data Manager host enables a software network operator to monitor and control a switch as a node in a network of nodes. Choose network management equipment that is provisioned with a hard disk that is sufficiently sized to accommodate software loads, accounting records, and other mass storage requirements used by the processor. The sizes of each node software load or Multiservice Data Manager load are different. The installation of a Multiservice Data Manager terminal is described in 241-6001-100 *Nortel Multiservice Data Manager Software Installation and Initial Configuration*.

Attention: The Multiservice Data Manager terminal is not the equipment used for the local user interface, which is necessary to initially start up and configure a Multiservice Switch 15000 or Multiservice Switch 20000. For information about the user interface, see Choosing the user interface equipment (page 60).

Deciding where to place local user interface equipment

Before deciding where to place local user interface equipment, ensure the type of terminal is chosen so that size, weight, and other limitations can be considered. See Choosing the user interface equipment (page 60). Decide where to place the terminal relative to the where the Multiservice Switch is to be positioned. The terminal must be co-located at the same site with the switch. Include the following criteria:

- a terminal (computer and monitor) and whatever requirements the manufacturer specifies (for example, a 15 A 3-prong ac outlet for the power cords of the computer and the monitor)
- a shelf, rack, or desk large enough and strong enough to house the terminal
- an area for the shelf, rack, or desk to reside, while maintaining at a distance of several meters away from the equipment

The installation of the operator terminal is in described in NN10600-130 *Nortel Multiservice Switch 15000/20000 Hardware Installation, Maintenance, and Upgrade*, the chapter on connecting an operator terminal.

Deciding where to place a sparing or a fanout panel

A sparing panel or a fanout panel should be mounted as close to the Multiservice Switch as possible to minimize the length of cable connecting them together. One NTQS31 sparing panel can be mounted in a NEBS 2000 frame with one switch, or up to 4 panels in a NEBS 2000 frame with no switch. With other types of sparing panels, for example, the 4-port DS3 NTHR79 or the 2-port DS3 NTFP99, one to three panels can also occupy a frame that has a switch in it. Each NTHR79 or NTFP99 panel is 2Us high.

The fanout or sparing panels can also be installed in a mounting apparatus other than the NEBS 2000 frame (NTRU04). Since most of the sparing panels that are used with a Multiservice Switch are 19 inches wide, they can be mounted on a 19-inch wide apparatus, or on the 21-inch wide NTRU04 using the EIA-to-NEBS adapter brackets in the kit NTHW21. Panel dimensions are identified in NN10600-120 *Nortel Multiservice Switch 15000/20000 Hardware Description*, the chapter on termination panels.

The sparing or fanout panels connecting to a Multiservice Switch 15000 VSS must be located in a different mounting apparatus. There is no room in the frame to accommodate the sparing or fanout panels.

The sparing or fanout panel connecting to a Multiservice Switch 15000 that is interworking with a SER 5500 shelf mounted the same frame, must be located in different mounting apparatus. There is no room in the frame to accommodate the sparing or fanout panels.

Cabling considerations for a termination panel

Nortel Networks makes prefabricated cable assemblies of various lengths available for the DS3 function processor (FP) cards. Typical cable lengths are 2.5 m (8 ft), 5 m (16 ft), or 15 m (49 ft). An FP an with 8W8 connector on the faceplate requires a proprietary cable assembly that cannot be custom made. The prefabricated cable assemblies that are offered for each FP and the specifications to custom make your own lengths are described in NN10600-120 *Nortel Multiservice Switch 15000/20000 Hardware Description*, the chapter on processor cards.

A frame with two fully provisioned shelves can have up to 700 mini-coax cables or 284 fiber optical cables, or a combination of both connected to the front of the shelf. Since cable slack for all coax signaling cables cannot occur at the shelf, the location of the electrical function processor (FP) cards relative to the location of the sparing or fanout termination panel directly affects how long each cable will be.

Consider where the sparing or fanout panel will be located relative to:

- how many and how far the cables must be routed from the FP in a slot to the termination panel
- how many and how far the cables must be routed from the far-end of the FP connection to the termination panel
- where and how the cable slack is to be managed along the connection path
- if the density of cables will obstruct any of the airflows that keep the entire system operating at an optimum temperature

Ensure that you address all of the cable planning criteria in Assess cable management (page 21).

Deciding where to place interworking equipment

When a Multiservice Switch will be interworking with equipment, such as an EdgeLink 100, determine from the manufacturer of the equipment

- what the dimensions and weight are
- what the maximum length that the interface cables can be
- what the power requirements are
- which external alarms on the equipment, if any, or on the switch can be connected; for the switch, see Deciding which external BIP alarms to connect (page 65)

Decide where to put the interworking equipment. It must be within reach of the switch and within reach of the power source. Decide the same criteria when the interworking equipment must also connect to a Multiservice Data Manager workstation, and not the switch.

When the interworking equipment is an EdgeLink, refer to the installation considerations in Interworking with an EdgeLink 100 (page 63).

When the interworking equipment is a SER 5500 shelf, refer to the installation considerations in Interworking with a SER 5500 (page 64).

Interworking with an EdgeLink 100

An EdgeLink 100 is an electrical multiplexer (mux) for DS1 and DS3 (T1 and T3) interfaces. It multiplexes DS1 channels into a single DS3 B3ZS data channel, and de-multiplexes the DS3 B3ZS signal into its DS1 parts. It can transmit and receive DS1 signals over an electrical DS3 interface. It also has an Ethernet port, which could be used to link to a Multiservice Data Manager workstation.

Since the hardware of an EdgeLink is manufactured by Telco Systems, it is subject to change without notice. Confirm the installation criteria in Telco Systems documentation, starting with *EdgeLink 100 Digital Multiplexer General Description,* section 825-102-001.

An EdgeLink 100 is powered by -48 V dc, but it does not need to share the same power-and-ground sources as a Nortel Multiservice Switch.

The mounting of an EdgeLink 100 in a NEBS 2000 frame, grounding it, and connecting power to it, is described in NN10600-130 *Nortel Multiservice Switch 15000/20000 Hardware Installation, Maintenance, and Upgrade*, the chapter on installing interface equipment.

External alarm connections between the EdgeLink and a Multiservice Switch 15000 is not supported.

The line impedance of the interface cables is 75 ohms unbalanced for DS3 and 100 ohms nominal balanced for DS1.

The lengths of the prefabricated interface cables are in the table Cable lengths between an EdgeLink 100 and a Multiservice Switch (page 64). For other lengths, contact your local Nortel Networks sales representative.

Cable lengths between an EdgeLink 100 and a Multiservice Switch

Type	Part numbers	Maximum length
DS1	Telco Systems' AWX436G or AWX438G	131 m (432 ft) up to an FP
DS3	custom-made coax cable	137 m (450 ft) up to an FP
Ethernet	Telco Systems' AWX454G10	3 m (10 ft) up to an Ethernet hub linked to Multiservice Data Manager

The installation of the EdgeLink 100 interface cables is described in NN10600-130 *Nortel Multiservice Switch 15000/20000 Hardware Installation, Maintenance, and Upgrade*, the chapter on installing system cables.

Interworking with a SER 5500

A SER 5500 is an enterprise switch that can be mounted in a NEBS 2000 frame with a Nortel Multiservice Switch 15000 to enable interworking, for example, with IP over VPN. The installation requires the hardware provided in kit NTHW85.

Since the hardware of a SER 5500 is subject to change without notice, confirm the installation criteria in its documentation.

A SER 5500 is powered by -48 V dc, but it does not need to share the same power source with the switch. The grounding to the site ground window is shared through the NEBS 2000 frame.

Shared external alarm connections between the SER 5500 and the switch are not supported.

The interface cable between the SER 5500 and the switch is a multi-mode fiber optic cable with flat SC connectors.

The installation of the ground cable and the interface cable are described in NN10600-130 *Nortel Multiservice Switch 15000/20000 Hardware Installation, Maintenance, and Upgrade*.

Deciding which external BIP alarms to connect

The breaker interface panel (BIP) can be connected to external alarms such as an end-of-aisle lamp, a LED, or an audible alarm. Since the alarm terminals are customer premises equipment (CPE), you must decide which alarms are to be connected to the switch. For the complete list of available BIP external alarm connections and the types of alarms they provide, refer to NN10600-120 *Nortel Multiservice Switch 15000/20000 Hardware Description*.

The choices of alarms from an Astec MFA150 power system of ac rectifiers that can be connected to the switch are described in the Astec document 167-9021-133 *Advanced Power Systems MFA150 Modular Front Access Power System Detailed Installation Guidelines and Procedures Manual*.

The recommended pin-to-pin connections of each alarm cable between the MFA150 and the BIP are described in NN10600-120 *Nortel Multiservice Switch 15000/20000 Hardware Description*.

Using a connection to a gigabit Ethernet port on NTHW84

When using the voice services processor 3 (VSP3) card with PEC NTHW84, you can either use the virtual ports of the card or use the two gigabit Ethernet ports on its faceplate. There is no cable connection to enable using the virtual ports. Using the gigabit ports requires two cable connections from an Ethernet source with 1000Base-SX transmission capability. A 1000Base-SX has a short transmission wavelength of 770860 nm.

The Ethernet source must be an Internet Protocol (IP) local area network (LAN), preferably through a router that is capable of bridging and has VRRP (or an equivalent protocol).

The maximum distance between the router (or equivalent Ethernet source) and the VSP3 faceplate depends on the diameter of the multimode fiber cable core that you will use. With 50-micron cores, the maximum distance is 550 m (1,804.55 ft.). With 62.5-micron cores, the distance is 275 m (902.28 ft.).

Card functionality and fiber cable specifications are identified in the cable assembly section of the card description in NN10600-120 *Nortel Multiservice Switch 15000/20000 Hardware Description*.

Assess timing requirements

Timing and synchronization are necessary to ensure that any network element that derives timing from the switch ports is part of the synchronization hierarchy. This is especially important for any circuit emulation applications and SONET-based networks that derive their timing information from a high quality network clock.

A switch can receive a clock signal from:

- a non-traffic carrying link to the building (BITS)
- a traffic-carrying signal originating from another node that supports line timing
- the free-running internal oscillator (stratum 3) of a CP card

Attention: Use only one type of timing mode, that is, BITS or line timing, not a combination. Mixing timing modes can interfere with sustaining timing while a module that is directly associated with timing undergoes a maintenance activity.

If the timing source of your site is BITS, you must provide and install whatever timing cables are needed to connect the site source to the alarm/BITS module itself on the switch, or to a cable assembly that is connected to the alarm/BITS module.

For information on installing or replacing the timing cables, refer to NN10600-130 *Nortel Multiservice Switch 15000/20000 Hardware Installation, Maintenance, and Upgrade*.

Plan for the use of an equivalent mounting apparatus

A Nortel Multiservice Switch 15000 or Multiservice Switch 20000 node, and the NEBS 2000 frame comply to applicable sections of the Network Equipment Building System (NEBS) standard. When you install a Multiservice Switch into a mounting apparatus other than the NEBS 2000 frame, you must ensure that the apparatus has NEBS compliance. NEBS compliance of the shelf and frame combination is your responsibility. Nortel Networks may not offer the Multiservice Switch 15000 or Multiservice Switch 20000 in the frame or cabinet you have selected.

When installing a Multiservice Switch into a mounting apparatus other than the NEBS 2000 frame, the hardware is provided in a shelf kit. The shelf kit is designed to fit a Multiservice Switch 15000 or Multiservice Switch 20000 into a 23-inch wide EIA rack. The kit hardware complies with Seismic Zone 2 requirements when installed in the bottom of the rack. The preferred installation is into a rack with no doors, however, installation is possible in a cabinet with solid or perforated doors provided cooling of the shelf is not affected.

See NN10600-130 *Nortel Multiservice Switch 15000/20000 Hardware Installation, Maintenance, and Upgrade* for installation information.

In preparation for using an equivalent mounting apparatus, consider the following.

- Dimensions and weight rating for the alternate rack (page 67)
- Rack and cabinet specifications (page 68)
- Electromagnetic compatibilities for an alternative mounting apparatus (page 69)
- Cooling considerations (page 70)
- Preparing your site's source of power (page 71)
- Grounding the switch hardware (page 71)
- Assess the location for a Multiservice Switch 15000 or Multiservice Switch 20000 (page 41)

Dimensions and weight rating for the alternate rack

Ensure that:

- the width and height of a switch fits your rack.
- your rack is rated for the weight of your hardware configuration
- your floor is rated for the combined weight of the switch, the rack, and any other equipment you plan to mount on the rack

Nortel Multiservice Switch 15000 and Multiservice Switch 20000 hardware has a width of 21 inches (53.34 cm) and a mounted height of 43.63 inches (110.8 cm). Hardware package NTQS04 or NTQH04 provides adapter brackets to accommodate a 23-inch (58.4-cm) wide EIA rack.

The weight of an installed switch depends on the number and type of plug-in cards, add-on hardware, or tie-wrapped cables that are installed into the shelf or onto the rack. Excluding the rack, a fully provisioned switch weighs up to 627 lbs (285 kg) after the installation is complete. To calculate the weight of your configuration, see Equipment size and weight (page 43).

Floor strength and anchors for the frame, in a seismic application, must be in accordance with the frame manufacturer's recommendations for the seismic zone of the installation. For additional information, see Telcordia GR-63-CORE, Issue 2, April 2002, section 4.4.2 for Earthquake Environment Criteria and section 4.4.3 for Framework and Anchor Criteria.

Rack and cabinet specifications

When a Multiservice Switch 15000 or Multiservice Switch 20000 is not mounted in a NEBS 2000 frame, the hardware is packaged in a shelf-based kit NTQH04 or NTQS04. The shelf-based kit is comprised of a BIP, shelf, and upper cooling unit. The shelf must be installed above the cooling unit and below the BIP. All parts must be installed in the bottom half of the rack or cabinet. See the figure, A shelf assembly in a rack, isometric front view (page 69).

The shelf kit requires a total of 1100 mm (43 in.) of vertical space and 575 mm (23 in.) of space front-to-back in the rack.

To mount the switch into a rack without using the adapter brackets provided in the kit, the rack must meet the following criteria:

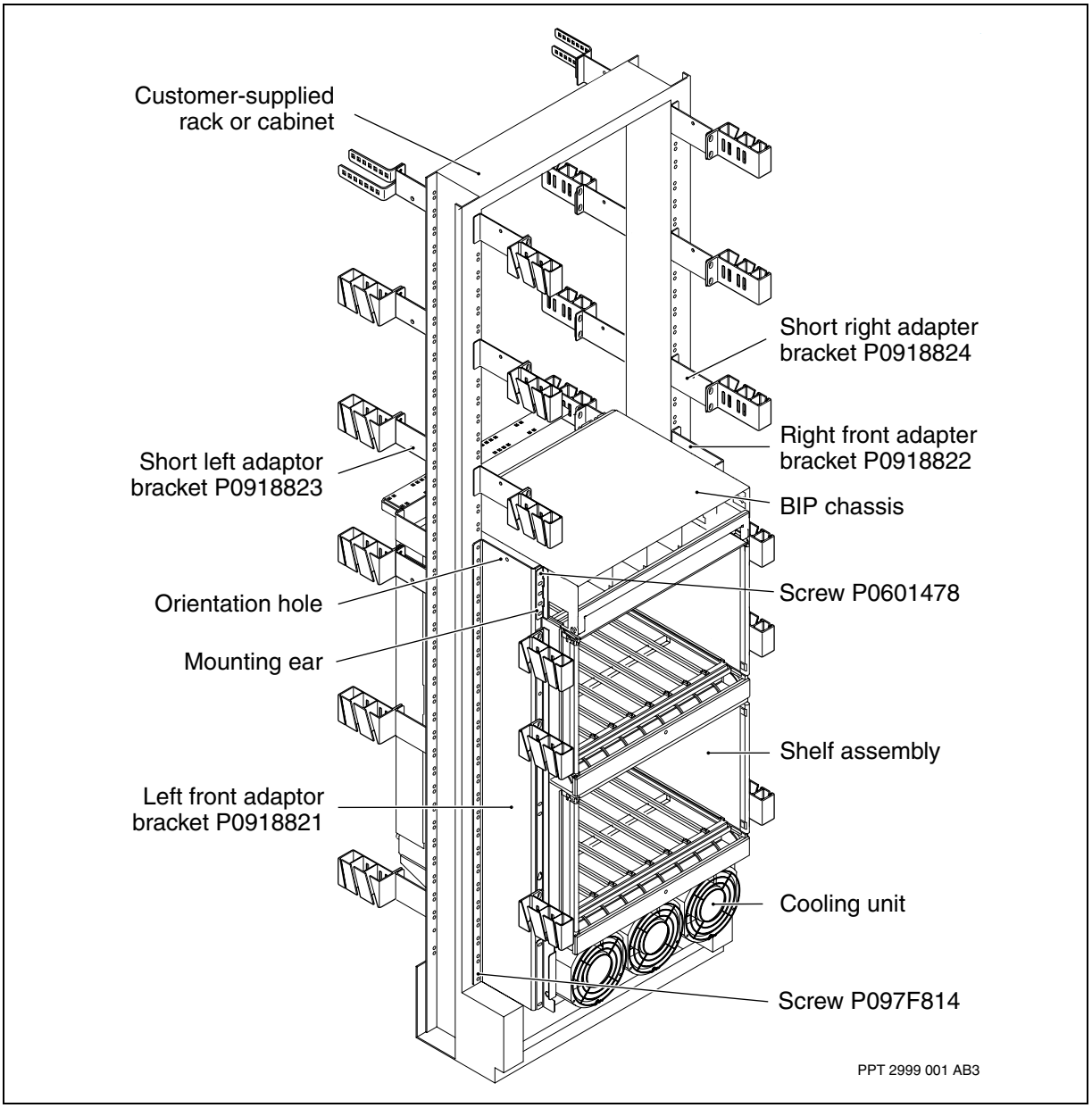
- The mounting holes must be at 25 mm (1.0 in.) vertical increments starting 12.5 mm (0.5 in.) from the bottom.
- The horizontal spacing between mounting holes must be 515 mm (20.3 in.).
- A horizontal width of 535 mm (21.0 in.)across mounting flanges.

The mounting adapter brackets have hole spacing that is compliant to the 23-inch EIA standard.

A switch installed in a cabinet with solid or perforated doors and side panels may generate acoustic noise greater than 60 dBA. For information about acoustic noise compliance see, Acoustic noise compliance (page 131).

Other criteria for choosing a rack or cabinet is identified in Plan for the use of an equivalent mounting apparatus (page 67).

A shelf assembly in a rack, isometric front view



Electromagnetic compatibilities for an alternative mounting apparatus

A Multiservice Switch 15000 or Multiservice Switch 20000 mounted in a NEBS 2000 frame meets EMC standards as described in Electromagnetic compatibilities (page 130). When a switch is placed in a customer rack or cabinet, the equipment must have the same type of EMC compliance as the switch in order to maintain Class compliance.

Regardless of the EMC compliance level of either the shelf or mounting apparatus, the EMC compliance level of the combination is equal to the lowest compliance level of the parts. For example, when using a Class A compliant Multiservice Switch 15000 and a Class B mounting apparatus, the shelf and mounting apparatus combination will have Class A compliance.

Cooling considerations

The cooling unit fans of shelf-based hardware packages NTQH04 and NTQS04 pull air from the lower front of the hardware and push it out from under the BIP to both the front and back of the rack.

A shelf kit installed in a rack, with no doors, allows for unrestricted air intake and exhaust. Consider locating your mounting apparatus where the front of the hardware will not intake exhaust air from other equipment, and where the upper rear of the hardware does not blow onto other equipment. See the table Shelf assembly air temperature rise (page 71) for additional information about temperature generated by Multiservice Switch 15000 and Multiservice Switch 20000 equipment.

A shelf kit installed in a cabinet, with solid or perforated doors, must meet the following requirements to ensure that over heating will not effect or degrade the performance the cooling unit.

- The Multiservice Switch shelf kit requires no less than 10 cm free of obstructions in front of the cooling unit inlet.
- The cabinet doors should have no less than 25 cm^2 of open area in front of the cooling unit inlet.
- The exhaust air from the shelf must be removed from the cabinet to prevent the re-circulation of hot exhaust air from returning to the cooling unit inlet. To remove the exhaust air, cabinet fans, installed at the top of the cabinet, must be able to exchange the required airflow for the switch and all other equipment in the cabinet or perforations in the rear door of the cabinet, exhaust grill, and exhaust air ducting should be used to remove the exhaust air. The exhaust air duct and grill area should be located directly behind the BIP in order to direct the exhaust air from the rear of the shelf out of the cabinet. The exhaust grill area in the cabinet door and the exhaust duct cross sectional area should be at least 25 cm^2. The exhaust air duct must be installed such that air is prevented from leaking back into the cabinet.

If you plan to install additional equipment in the rack or cabinet above the switch, do not restrict the inlet or exhaust area of the cooling unit with equipment cables. There must be sufficient air flow to ensure that the cooling unit is not taking in air heated by the additional equipment.

Shelf assembly air temperature rise

Altitude	Shelf configuration	Room temperature			Shelf air temperature rise		
		long-term (normal)	short-term (high speed)	short-term (fan fail)	long-term (normal)	short-term (high speed)	short-term (fan fail)
Sea Level	1 card cage (75 W FPs)	£48×C	>48×C	£48×C	5×C	3×C	4×C
	1 card cage (150 W FPs) or 2 card cages (75 W FPs)	£44×C	>44×C	£44×C	9×C	6×C	8×C
	2 card cages (150 W FPs)	£35×C	>35×C	£35×C	18×C	12×C	16×C
4000 m	1 card cage (75 W FPs)	£45×C	>45×C	£45×C	8×C	5×C	7×C
	1 card cage (150 W FPs) or 2 card cages (75 W FPs)	£38×C	>38×C	£38×C	15×C	10×C	14×C
	2 card cages (150 W FPs)	£24×C	>24×C	£24×C	30×C	20×C	27×C

Preparing your site's source of power

Ensure that the electricians who install the power input cabling for the switch are qualified to handle your method of power source.

switch hardware is dc-powered directly from a protected dc source (for example, by fuses or breakers) or indirectly from a system of ac rectifiers. The power demand is from 50 to 100 A for each feed. The amount of required power varies according to the number and kind of plug-in cards. To calculate your power requirements and install the appropriate power input cabling to the switch, see Power distribution and consumption (page 100).

Grounding the switch hardware

The switch and all other equipment installed in a rack must be grounded to comply with NEBS requirements. The frame must be grounded by using the silvery grounding tape, provided in the kit, mounted against clean, unpainted metal on the rack. The adapter brackets for mounting have the silvery grounding tape bonded to them at the factory.

If the rack cannot be grounded using the silvery grounding tape, the following criteria must be met:

- The BIP grounding stud connection must be utilized for bonding the BIP to the rack or cabinet.
- The switch grounding stud connection must be utilized for bonding the shelf to the rack or cabinet.
- Frame must be solidly bonded to the your site's ground

Site preparation of the floor

Prepare the site floor for the anchoring a NEBS 2000 frame (NTRU04) that houses the Nortel Multiservice Switch 15000 or Multiservice Switch 20000 hardware, other Nortel Networks switches, or interworking equipment.

Prerequisites of preparation for anchor holes in the floor

CAUTION

Risk of service prevention by small frame footprint

You must know what optional add-on hardware will be installed on your frame. The basic template footprint does not accommodate the increased size caused by adding on parts. Also, the add-on hardware is not installed on the frame at the factory, and when preparing the floor, you will not likely have done the procedures to add the hardware. Know your add-on parts and follow the task flow so that the footprint is large enough without wasting space.

- Ensure that you comply with Safety precautions (page 75).
- Ensure that you have followed all of the frame location criteria in Planning considerations (page 15).
- Preparing the floor for the anchoring holes is typically a one-time permanent task. This preparation is common to all types of anchor kits.
- You need the following tools and equipment to prepare for drilling:
  - whatever safety gear is specified by your government or union (for example, goggles, ear plugs, gloves, steel toed boots, etc.)
  - a line marker for a cement floor; consider indelible for final markings and removable for temporary markings
  - a hammer, 2-lb. ball peen
  - a punch (to dimple the floor for drilling)

— a vacuum cleaner (with induction-wound motor if you are near other electronic equipment) and narrow 4-inch nozzle to reach the bottom of an anchor hole

— a tape measure, 10-ft. (3 m) in decimal inches or cm

— a flashlight for checking holes in the floor

— a hammer drill (for example, a Hilti TE-52)

— a mason bit sized according to the instructions provided with each anchor kit

— a fridge cart, for example a Universal Mover T0155M similar the example shown in the figure Fridge cart to move a NEBS 2000 frame (page 75) -- optional unless you are using the frame itself to mark the holes

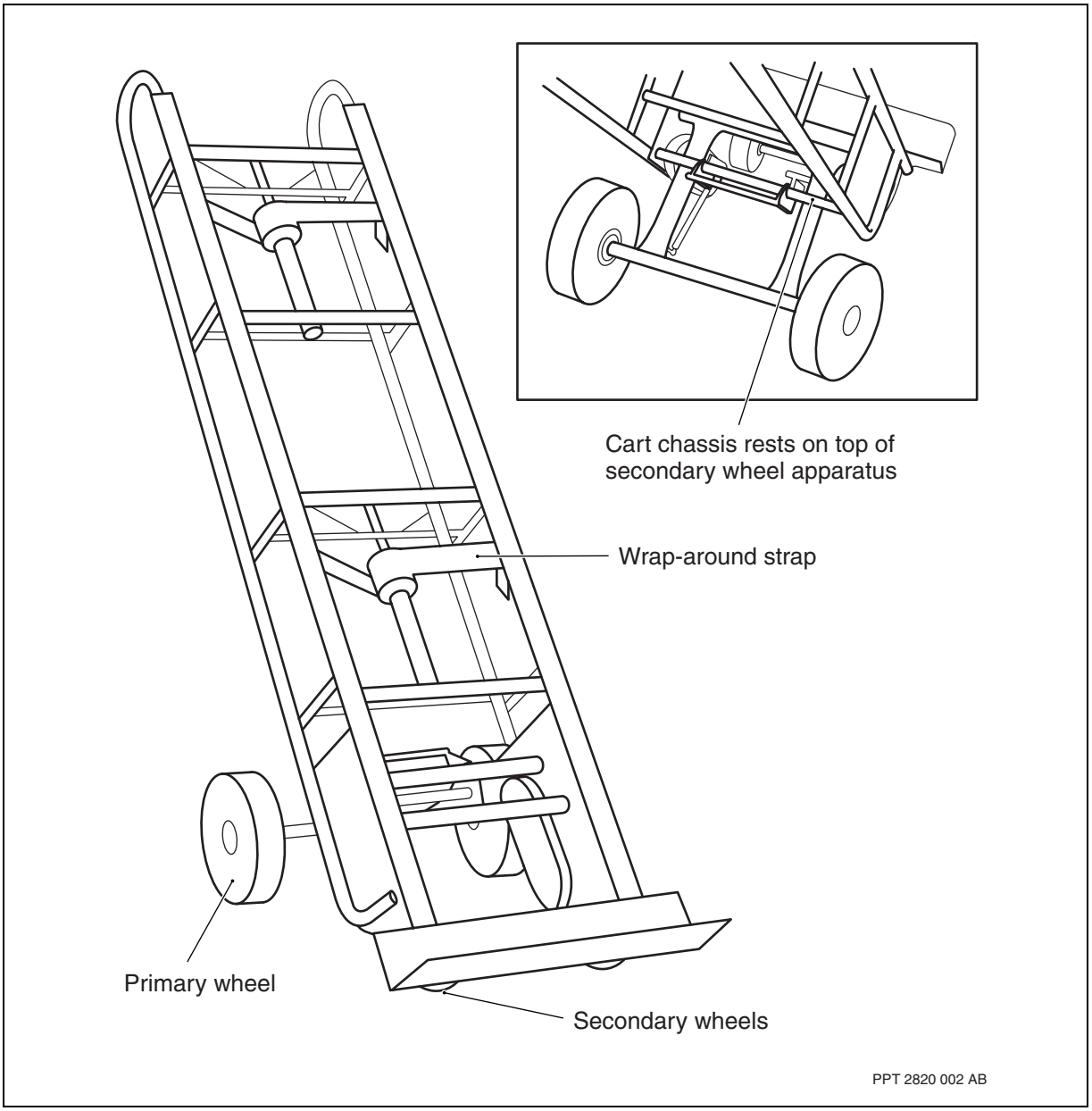
- You need the following additional tools for drilling under a raised floor:

— a raised floor marker

— a steel square, 12-in. by 24-in. minimum, plumb line, or post level

— a mason bit sized according to the height of a raised floor (optional if drilling under the raised floor instead of from above it) and according to the instructions provided with each anchor kit

Fridge cart to move a NEBS 2000 frame



Safety precautions

While you are preparing the floor, you must observe the general safety precautions against personal injury and equipment damage outlined in your local office standards. The procedures in this document contain specific caution and warning information that you must observe while doing each procedure.

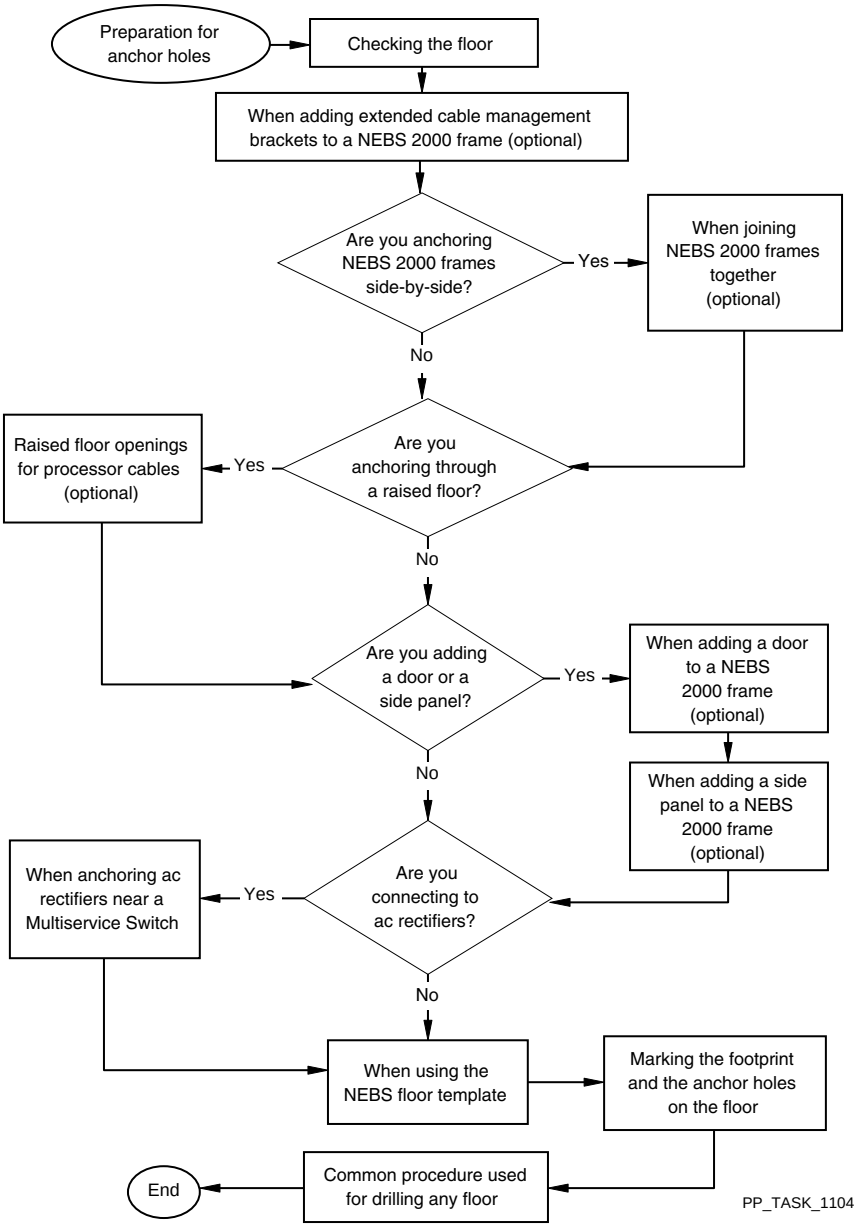
For a description of the cautions and warnings which will appear in the procedures described in this document, see Personal safety (page 9).

Before following any of the procedures in this section, you must also see Safe equipment handling (page 10) for a description of the tools and personnel required to move into position a frame housing switch hardware.

Task flow of preparation for anchor holes in the floor

This task flow shows you the sequence of procedures you do to prepare the floor for anchor holes. To link to any procedure, go to Task flow navigation (page 77).

Task flow of preparation for anchor holes in the floor



Task flow navigation

The following references are listed alphabetically:

- Checking the floor (page 77)
- Common procedure used for drilling any floor (page 88)
- Marking the footprint and the anchor holes on the floor (page 85)
- Raised floor openings for processor cables (page 79)
- When adding extended cable management brackets to a NEBS 2000 frame (page 78)
- When adding a door to a NEBS 2000 frame (page 80)
- When adding a side panel to a NEBS 2000 frame (page 82)
- When anchoring ac rectifiers near a switch (page 82)
- When joining NEBS 2000 frames together (page 78)
- When using the NEBS floor template (page 82)

Checking the floor

Before marking a floor for the position of the frame, ensure the proposed position for anchoring the frame is appropriate. In a solid floor or underneath a raised floor, verify the floor is deep enough to hold the anchor you will be using, and that each hole will be at least 80 mm (3.2 in.) from an edge of the slab or floor.

Review the building plans and site modification records to determine where anything lies imbedded in the floor and visually verify there are no obstacles within the depth at the point of anchoring. For example, know where pipes, cables, or conduit pass near the proposed anchor hole positions. For raised floors with removable tiles, verify that the underneath surface is clear of obstructions. Rebar that is imbedded in cement floors is accommodated by the multiple two-position openings for anchors in the bottom of each NEBS 2000 frame.

For any type of floor, verify that it can support a maximum weight of 726 kg (1,600 pounds) at the position of the NEBS 2000 frame. This maximum is a worst-case weight calculated by adding all of the heaviest pieces of equipment that can possibly fit within the NEBS 2000 frame footprint.

Attention: The worst-case weight is not likely to be reached by any configuration of hardware. For detailed information on calculating the actual weight of your configuration, see Equipment size and weight (page 43).

When considering the rating of your raised floor relative to the surface area to be occupied by the frame, include

38.1 + 30.48 cm = 68.58 cm (or 15 + 12 in. = 27 in.)

of aisle area in front and behind the frame. This aisle area is half the required minimum space in front of and behind a switch in a NEBS 2000 frame. With the frame and the aisle space, the total surface area of the floor would be

(38.1 + 60 + 30.48 cm) times 60 cm = 7,714.8 sq cm = 0.77148 square m
or
(15 + 21.25 + 12 in.) times 21.25 in. = 1025.3 sq in. = 7.12 square ft

When adding extended cable management brackets to a NEBS 2000 frame

The optional extended brackets enable handling high-density coax cables of one or two fully provisioned Nortel Multiservice Switch 15000s or Multiservice Switch 20000s in a frame.

Installing the NTRU0370 junction kits provides brackets and hardware to join two adjacent and equally enlarged NEBS 2000 frames. The junction kit ensures the appropriate spacing between frames with extended management brackets.

The frame spacer kits in NTRU0365 are used to enlarge the standard 600 by 600 mm footprint of a NEBS 2000 frame. They add 150 mm width to the footprint, 75 mm on each side. The increase is shown in the figure Footprint measurements for a NEBS 2000 frame with extended cable management brackets (page 84). Installing the NTRU0365 kits means that the spacer brackets from these kits must be installed on each side of the frame. Installing the spacer brackets enables adding the optional extended cable management brackets (NTRU0368 and NTRU0369).

The need for the extended cable management brackets is described in Managing very high-density coax cabling (page 27).

When joining NEBS 2000 frames together

Adjacent NEBS 2000 frames can be fastened together side-by-side with the kit numbers NTHR0370 and NTRU0365. These kits are needed when the optional extended cable management brackets NTRU0368 or NTRU0369 will be installed on the side of a frame and between the pair of frames. Using either kit:

- maximizes efficient use of floor space
- minimizes the lengths of fiber or coax cable run between a switch and its sparing panel (NTQS31) or fanout panel (NTHW52)
- maintains the minimum distance required to string FP cable clusters between cable brackets when fastening them to the extended brackets

- accommodates a 19-mm (0.75-inch) clearance for inserting cables between the arms of opposing extended cable management brackets mounted on adjacent frames
- increases the stability of the frames for safety

Anchoring a second frame beside and joining a first frame uses:

1 an identical footprint to the one shown in the figure Footprint measurements for a NEBS 2000 frame with extended cable management brackets (page 84) or at least measurements from it (for example, the footprint space between the frames is fixed, but the measurements at either end of the pair may be less if the optional extended cable management brackets will never be added)

2 the pair of frames must be adjustable to the same height together

3 the frames must be fastened together by the frame-to-frame brackets and levelled together before the pair are anchored to the floor

The floor must be pre-marked to accommodate adjacent frames to be fastened together. Refer to Marking the footprint and the anchor holes on the floor (page 85).

Raised floor openings for processor cables

When you are planning to route the signaling cables from the function processors (FPs), control processors (CPs), or both under a raised floor, then you must cut a hole either

- under the frame to align with one of the two rectangular openings in the bottom of the NEBS 2000 frame
- beside the footprint of the mounting apparatus to accommodate an opening in the raised floor tile

A floor opening should not be widened after cables are installed through it because of the risk of damaging a cable and affecting a system that is in service.

Determine the required area of the floor opening by factoring these criteria into your calculation.

- Use the table Diameters of processor card cables (page 23) to add up the diameters of the quantities of each type of processor cable that will be initially installed on the switch.
- Find the total diameter of the combined quantity for each type of processor cable for cards that will possibly be added to empty slots after the initial installation.

- Accommodate passing the largest connector through each floor opening up to the last few cables without stressing any connectors on the way through.
- Allow space for replacement cards that have more connectors.
- You will likely need more than one floor opening. Allow space for each cable bundle to be loose enough to prevent pinching or crimping any cable going through a floor opening, or exceeding the bend radius of any cable as it enters or exits the opening.

When planning to install the optional 7.5 cm (3 in.) wide extended cable management brackets, refer to the figure Footprint measurements for a NEBS 2000 frame with extended cable management brackets (page 84)). Depending on your floor tile structure and rating, you might be able to safely cut an opening up to 56 cm by 7 cm (22 in. by 2.75 in.) on either or both sides of the NEBS 2000 frame. When planning the position of an opening beside the footprint, ensure that:

- there is no support structure under the raised floor tile, or any other obstruction
- the capacity of the floor with one or two openings in it can still safely hold the weight of your frame and switches after they are fully installed
- any DS3 or E1 signalling cables do not share a parallel path with the power cables

To calculate the weight of your switch hardware, see Equipment size and weight (page 43). To calculate your diminished raised floor capacity, estimate the size of the hole and deduct its area from the area rating of the floor. Once you have calculated these values, determine whether the floor can still safely support your hardware.

If all of the criteria can be met, include floor markings beside the footprint for the processor cable openings.

When adding a door to a NEBS 2000 frame

The door hardware from kits NTQS37AA and NTQS37AB is added to the base of a NEBS 2000 frame. When adding a door and its mounting hardware to a frame, the footprint where the frame is to be anchored or has been anchored increases into the aisle on that face of the frame. The increase is shown in the figure Footprint measurements for a NEBS 2000 frame with doors or extended side panels (page 85). The larger footprint must accommodate:

- space to add the extension hardware and space to install it by hand tools

- space to fully open the door at either the front or rear of frame so that plug-in cards or modules can be safely removed and installed, as indicated in Front and rear access to switch hardware (page 56)

When adding a side panel to a NEBS 2000 frame

The hardware of a regular-sized panel (NTRU0128) or extended side panel (NTPX4050) is added to the side of a NEBS 2000 frame. When adding any side panel, that side of the frame footprint must be enlarged to accommodate the increased width. The increase is shown in the figure Footprint measurements for a NEBS 2000 frame with doors or extended side panels (page 85).

When anchoring ac rectifiers near a switch

When a switch is to be powered by a system of ac rectifiers, such as an Astec MFA150 power system, you must consider how close the rack, frame, or framework housing the rectifiers is to be anchored near the NEBS 2000 frame. The basic considerations are identified in Assess the location of a system of ac rectifiers (page 58).

For the details of preparing the floor and drilling anchor holes for an MFA150 framework, see the Astec document 167-9021-133 *Advanced Power Systems MFA150 Modular Front Access Power System Detailed Installation Guidelines and Procedures Manual*.

When using the NEBS floor template

The floor template is a paper footprint of a NEBS 2000 frame. The template (P0890503) is provided with each frame. As the footprint, it enables the exact floor marking of the position of the frame and the position of the anchor holes. Using a template maximizes efficient use of floor space.

When optional add-on frame hardware is to be installed, the template measurements must be manually enlarged to accommodate the increased footprint. When optional hardware is ordered, it is not installed at the factory. It is likely you will be drilling the anchor holes before you get to the procedures to add the hardware.

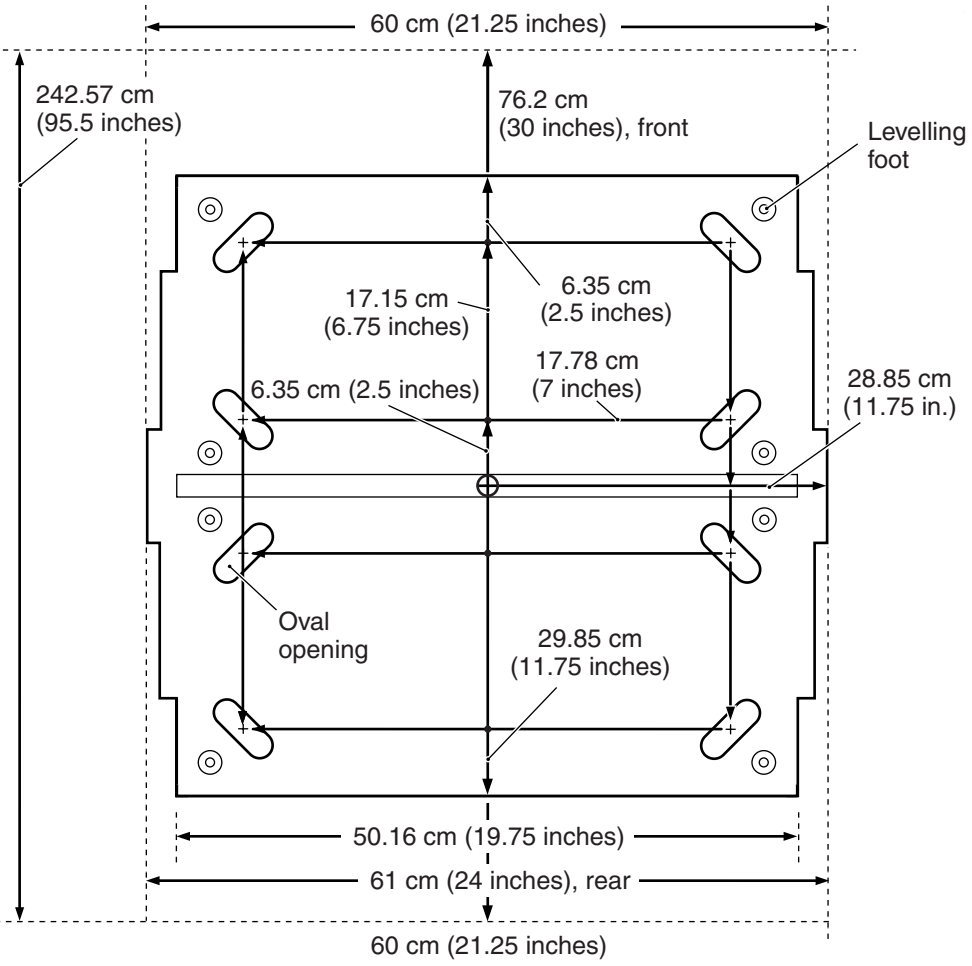
The instructions for marking the footprint in the Task flow of preparation for anchor holes in the floor (page 76) include accommodating space for:

- a basic footprint as shown in the figure Footprint measurements for a NEBS 2000 frame with no optional add-on hardware (page 83)
- safe handling of hardware, as described in Front and rear access to switch hardware (page 56)
- the optional extended cable management brackets as shown in the figure Footprint measurements for a NEBS 2000 frame with extended cable management brackets (page 84) and described in When adding extended cable management brackets to a NEBS 2000 frame (page 78)
- the optional front or rear door-mounting hardware as shown in the figure Footprint measurements for a NEBS 2000 frame with doors or extended

side panels (page 85) and described in When adding a door to a NEBS 2000 frame (page 80)

- the optional regular or extended side panels as shown in the figure Footprint measurements for a NEBS 2000 frame with doors or extended side panels (page 85) and described in When adding a side panel to a NEBS 2000 frame (page 82)
- routing signal cables through a raised floor beside a NEBS 2000 frame
- a 40-mm (1.57-in.) thick side panel on one or both sides of a frame

Footprint measurements for a NEBS 2000 frame with no optional add-on hardware



Notes

1. The minimum safety distance for front and rear is 0.9 m (3 feet).
2. Each quadrant has the same measurements, all corners are 90 degrees, each half is symmetrical, and inside measurements start from the ⊕.

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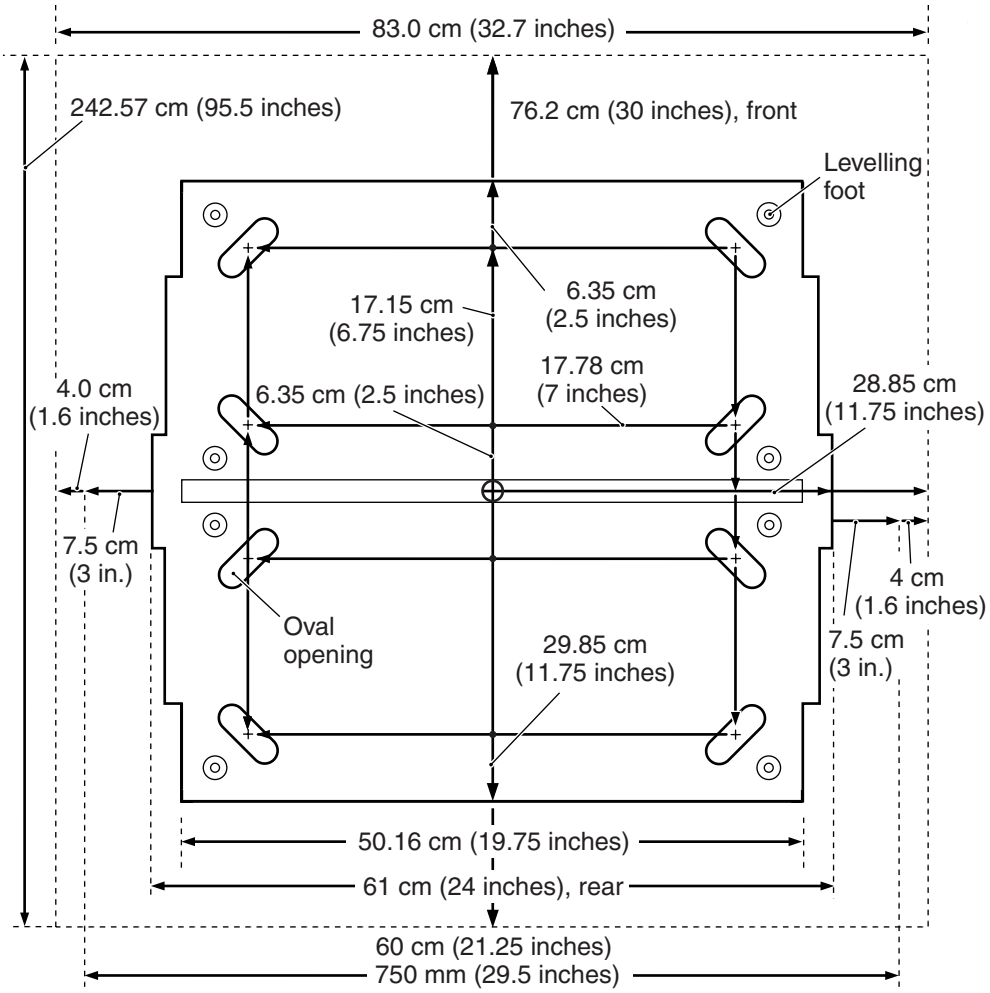
Footprint measurements for a NEBS 2000 frame with extended cable management brackets

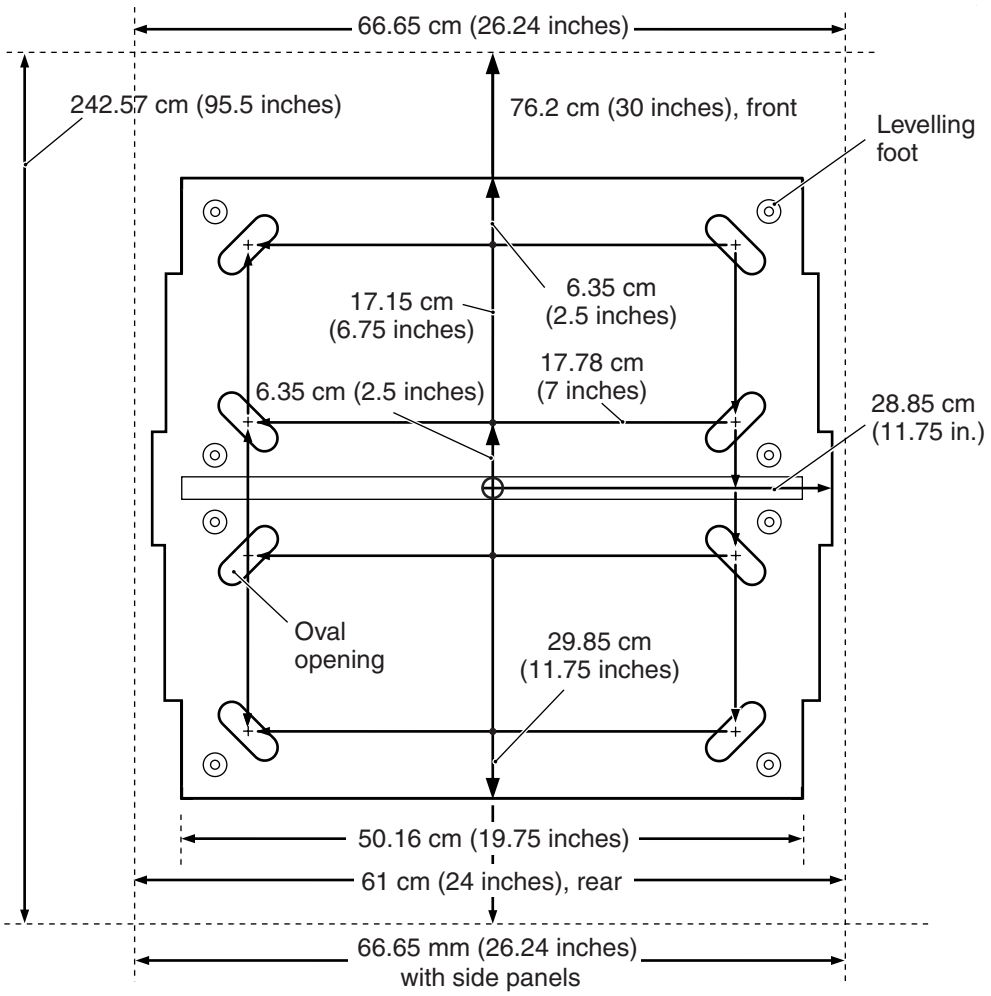


Notes

1. The minimum safety distance for front and rear maintenance activities is 0.9 m (3 feet).
2. The minimum distance for at least one optional cable management extension bracket is 7.5 cm (3 inches).
3. Each quadrant has the same measurements, all corners are 90 degrees, each half is symmetrical, and inside measurements start from the ⊕.

MSS 2819 023 AA2

Footprint measurements for a NEBS 2000 frame with doors or extended side panels



Notes

1. The minimum safety distance for front and rear maintenance activities is 0.9 m (3 feet).
2. Each quadrant has the same measurements, all corners are 90 degrees, each half is symmetrical, and inside measurements start from the ⊕.

MSS 2819 023 AC

Marking the footprint and the anchor holes on the floor

Mark the footprint of the NEBS 2000 frame (or equivalent mounting apparatus) and the anchor holes on a cement floor or cement subfloor under a raised floor in preparation for drilling.

Prerequisites

WARNING

Risk of injury when handling a frame

Never place a foot or a hand under any part of the frame while it is being tilted or moved. Always slide it with at least four people. The weight of a shipped frame with one Multiservice Switch 15000 or Multiservice Switch 20000 is approximately from 330 kg (730 lbs) to 355 kg (780 lbs); with two switches the weight is from approximately 480 kg (1052 lbs) to 490 kg (1076 lbs). For additional protection, wear safety boots with steel toes and gripping soles.

CAUTION

Verletzungsgefahr beim Gestelltransport

Stellen Sie niemals einen Fuß unter das Gestell, wenn dieses bewegt oder gekippt wird, und greifen Sie nicht unter das Gestell. Zum Bewegen des Gestells sind mindestens vier Personen erforderlich. Ein Gestell mit einem Multiservice Switch 15000 oder Multiservice Switch 20000 wiegt ca. 330 kg und mit zwei Multiservice Switch-Einheiten ca. 490 kg. Tragen Sie zu Ihrem zusätzlichen Schutz Sicherheitsschuhe mit Stahlkappen und griffigen Sohlen.

- Ensure that you have followed all of the frame location criteria in Planning considerations (page 15), especially for identifying obstructions in the floor where the frame footprint is to be located.
- Ensure that you have followed Task flow of preparation for anchor holes in the floor (page 76).
- You need to know the diameter and depth of the hole needed for an anchor. Refer to the description of anchor kits in the chapter on mounting apparatuses in NN10600-120 *Nortel Multiservice Switch 15000/20000 Hardware Description*.
- Choose your method of marking the footprint and anchor holes on the floor:
  - — the paper template (part number P0890503) as described in When using the NEBS floor template (page 82)
  - — the figures of measurements provided with this procedure
  - — through the base of the frame, which only applies when no additional hardware will be added to the front, rear, or a side of the frame; safely sliding a fully provisioned frame in and out of its intended footprint requires four helpers

- Anchoring a NEBS 2000 frame for Multiservice Switch equipment requires a minimum of six anchors. (This also meets zone 4 earthquake compliance.) The base of the frame has eight oval openings for anchors. Each oval opening accommodates one anchor. The anchor can be at either end of the oval. This provides two positions for the drill hole to miss imbedded reinforcing rods (rebar). The end of the ovals nearest the footprint perimeter is the optimum anchoring hole position, while the inner end is the secondary choice.
- Marking the footprint of a NEBS 2000 frame has no margin of error for adjusting an anchor hole after it is drilled, or moving a frame to add or replace a component.
- For information on marking the footprint of an Astec MFA150 framework (for the installation of ac rectifiers), refer to the Astec document 167-9021-133 *Advanced Power Systems MFA150 Modular Front Access Power System Detailed Installation Guidelines and Procedures Manual*.
- The footprint and various clearance spaces accommodate safe maintenance access to the frame with or without add-on frame hardware.

Procedure steps

1 At the location of the frame footprint, determine which way the front of the frame is to face. The plug-in interface processor cards are at the front of a NEBS 2000 frame. The footprint template has front and rear indicated on it.

2 Place the footprint template (P0890503) on the floor where the frame is to be anchored, position the frame itself, or mark the center of the footprint according to the point of reference shown in the figures:

Footprint measurements for a NEBS 2000 frame with no optional add-on hardware (page 83)

Footprint measurements for a NEBS 2000 frame with extended cable management brackets (page 84)

Footprint measurements for a NEBS 2000 frame with doors or extended side panels (page 85)

WARNING

Risk of injury by restricted access

Before marking the floor with the footprint of the NEBS 2000 frame, ensure that there is a minimum safety clearance of 0.9 m (3 feet) in front of or behind the frame. The minimum is required to enable personnel to safely do various installation, maintenance, or upgrade tasks on the switches housed in the frame.

WARNING
Verletzungsgefahr
Planen Sie einen Sicherheitsabstand von mindestens 0,9 m ein, wenn Sie den Umriß des Gestells auf dem Boden aufzeichnen. Dieser Abstand ist erforderlich, damit vor und hinter dem Multiservice Switch 15000 oder Multiservice Switch 20000 Installations-, Wartungs- und Aufrüstungsarbeiten gefahrlos möglich sind.

3 Measure the minimum clearances from the front, rear, and sides of the frame as indicated in one of the 3 figures.

4 Adjust the position of the footprint until all clearances are met.

For a raised floor with removable tiles, ensure the anchor hole markings are at least 5 cm (2 in.) from the edge of a tile. This avoids drilling the support of the tile that is under the floor.

5 Mark the clearances on the floor as a dashed line.

6 Indelibly mark a solid perimeter of the footprint onto the floor. The perimeter is used after the holes are drilled to accurately position the frame.

7 Mark all 8 oval anchor openings on the floor. Although the frame requires a minimum of 6 anchors regardless of earthquake zoning, additional anchors can be added. All ovals are marked in case the drilling reaches an obstruction imbedded in the floor (for example, construction rods or rebar) or reaches a part of the raised floor structure.

8

9 At each end of each oval opening, mark a center point as close to the end as the thickness of the anchor will allow.

10 Keep the footprint template with the frame because it is to be used again when the frame is anchored to the floor.

Common procedure used for drilling any floor

Use this common procedure when you need to drill holes into a cement floor or a cement subfloor under a raised floor for the anchors of any mounting apparatus.

Prerequisites

WARNING
Risk of eye or ear injury
Wear safety goggles and ear protection while drilling.

WARNING
Verletzungsgefahr
Tragen Sie beim Bohren eine Schutzbrille und einen Gehörschutz.

- Ensure that you have followed Task flow of preparation for anchor holes in the floor (page 76).
- For a NEBS 2000 frame, you need to have at least one of the following anchor kits:
  - NTRU0302
  - NTRU0325
  - NTRU0327
  - NTRU0328
- Kits NTRU0302 and NTRU0328 provide their own drilling and anchor installation instructions. Use the specifications for drill bit size and hole depth from these instructions.
- Whether using the anchor in a solid cement floor or in a cement subfloor under a raised floor, the depth criteria of the anchor hole is the same. Only the length of rods is different.
- The anchor hole diameter and depth must be precise.
- The parts of anchor kits that are mentioned in the procedure are listed in the section on anchors in NN10600-120 *Nortel Multiservice Switch 15000/20000 Hardware Description*.
- The anchor installation procedure is included with the task flow to install NEBS 2000 frame in NN10600-130 *Nortel Multiservice Switch 15000/20000 Hardware Installation, Maintenance, and Upgrade*.

Procedure steps

1 Determine the drill bit size from the kit instructions or the diameter of the shank of the isolation bushing (if present in the anchor kit). Start the hole first with a bit that is thinner than the final diameter. The hole must not be oversized or undersized, otherwise the anchor will not secure properly.

2 Where each anchor hole is to be, use a hammer to punch a dimple into the cement to prevent the drill bit from wandering.

CAUTION
Risk of service degradation or equipment damage
While drilling into the floor to create anchor holes, vacuum the dust. Use a vacuum with an induction-wound motor to prevent EMI from affecting nearby electronic circuitry. Dust can prevent the proper seating of cards or modules or prematurely increase the arrestance of the cooling air through the fan filters.

3 While drilling the floor, vacuum the drill bit debris. Use your foot, or have a helper, to hold the nozzle in position to ensure that all debris is captured.

4 Set depth stop of the drill to indicate the depth given by the kit instructions. Refer to the figures:

— Anchor A0502620 for a NEBS 2000 frame (page 93)

— Anchor A0686271 for a NEBS 2000 frame (page 94)

WARNING
Risk of equipment damage from water
Do not penetrate the concrete into the vapor barrier when drilling holes. Ground water may seep into the anchor hole.

WARNING
Geräteschäden durch Wasser
Beschädigen Sie beim Bohren nicht die Dampfsperre unter dem Estrich. Es könnte Grundwasser durch die Verankerungslöcher dringen.

5 Drill each hole in the floor. Consider drilling all 8 marked on the floor (or 16 with a raised floor), even those not intended to be used. Once a frame is fastened to the floor, the only way to drill holes later is to remove the anchors and slide the frame off the footprint. With the frame anchored and holes already drilled, additional anchors can be installed later.

For raised floor applications, drill both the upper floor and the cement subfloor. Ensure that all upper and lower holes are precisely aligned. See the figure Drilling a raised floor without removable tiles (page 92) for an example of drilling the subfloor from above the raised floor.

6 Remove the debris from the bottom of each drilled hole by taping a 10-cm (4-in.) tube to the vacuum nozzle. The tube must be narrow enough to reach the bottoms of the holes.

For a raised floor with removable panels, vacuum the debris from the upper and lower surfaces.

CAUTION
Risk of improper equipment grounding
When an anchor hole exposes conductive construction materials (for example, rebar) in a cement floor and the anchor contacts it, there is a possibility that the isolator bushing around the anchor can fail from earthquake vibrations. The contact with the rebar risks having the building ground interfere with the site ground that the frame is grounded to. Never use an anchor hole that exposes conductive material in the hole.

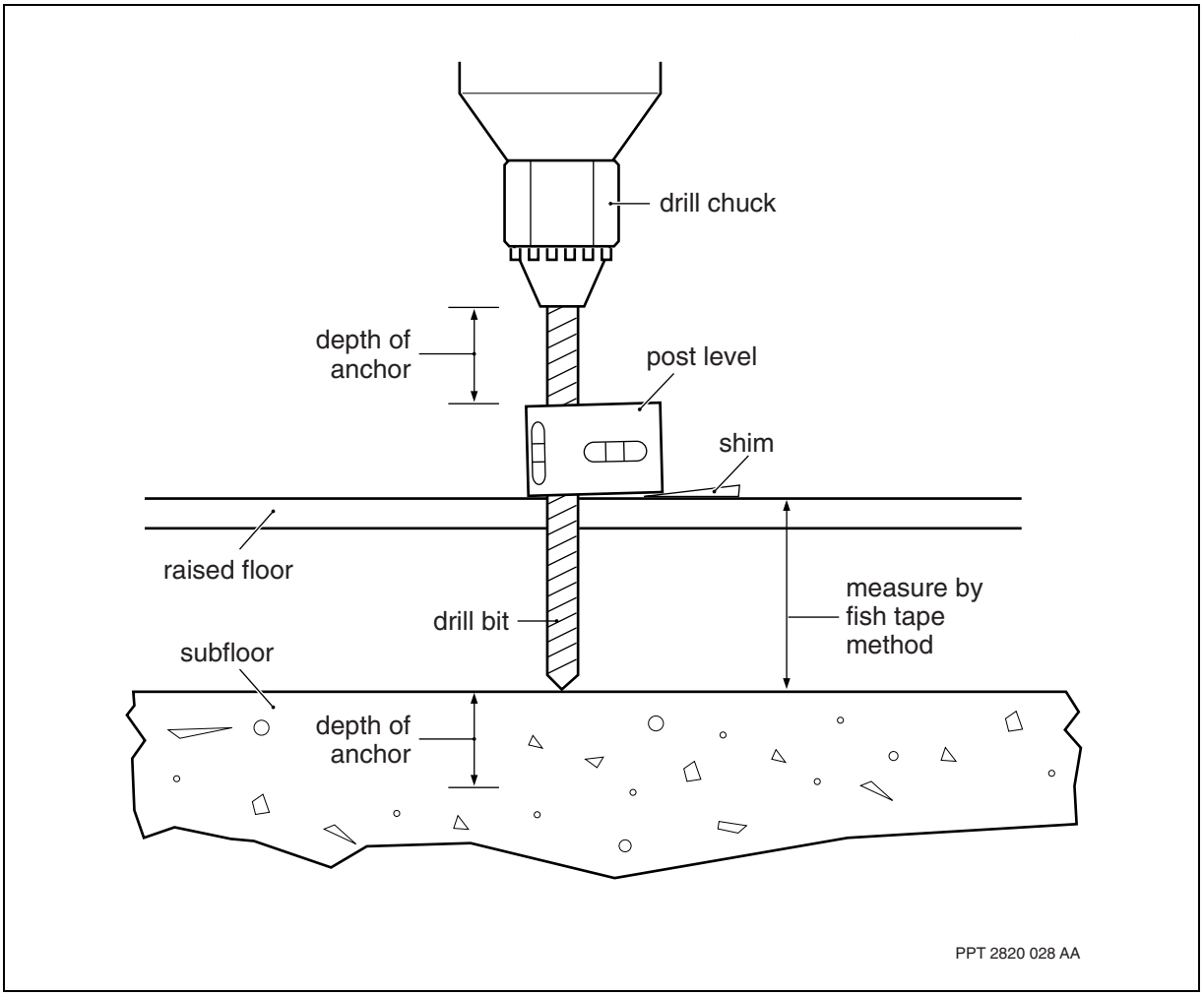
7 Shine a flashlight into each hole to verify that no conductive construction material (for example, rebar) has been exposed by the hole.

When a hole exposes such material, drill a hole at the other end of the oval opening. If the second hole hits more conductive construction material, use another oval hole.

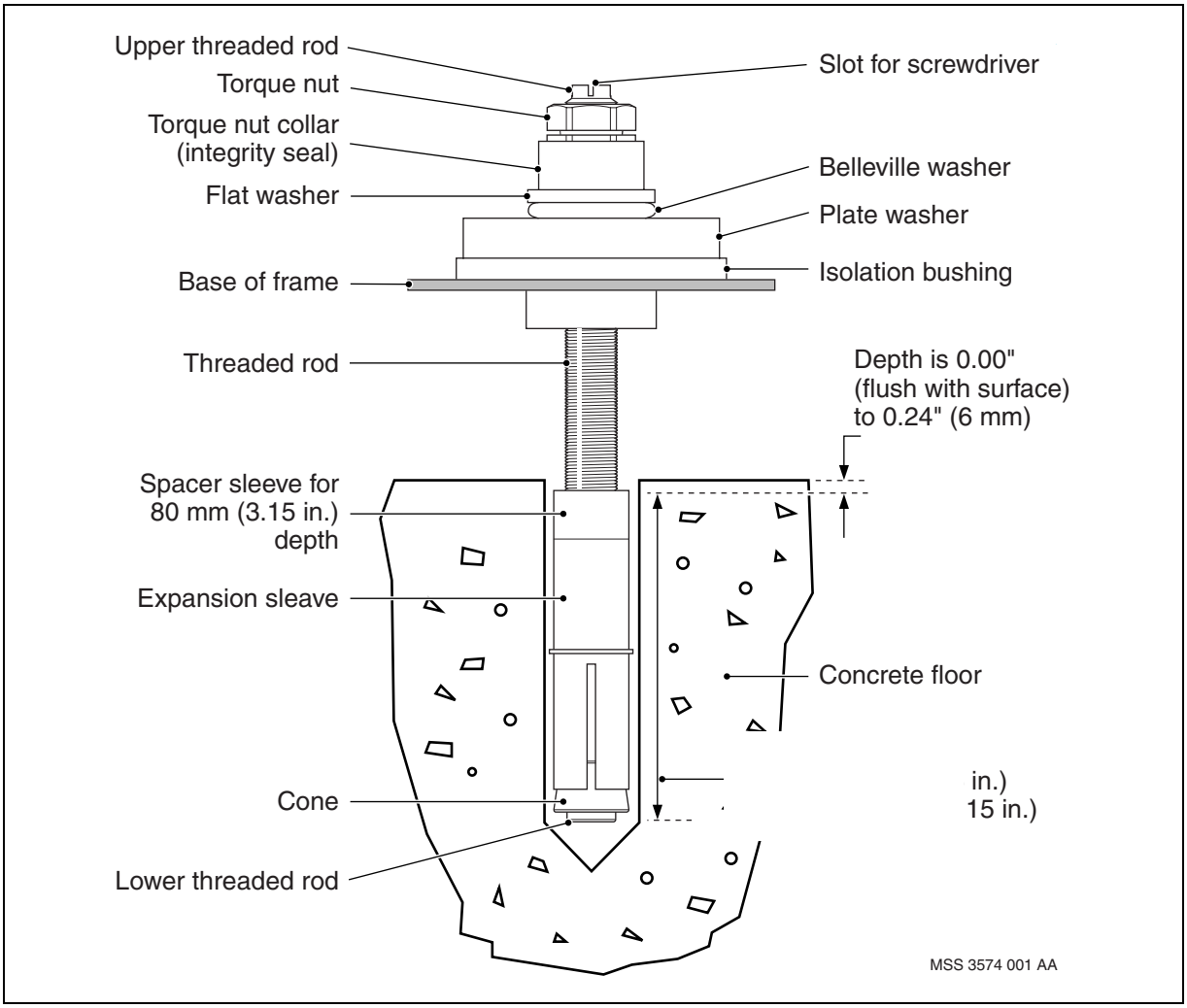
8 Cover the holes with tape to keep them clean until the anchors are actually installed. Keep the expanse of tape small so that it can be retrieved through the oval opening in the bottom of the frame.

9 Mark the part number of the anchor beside the hole on the floor. This will be used when the anchors and stack-up hardware are installed.

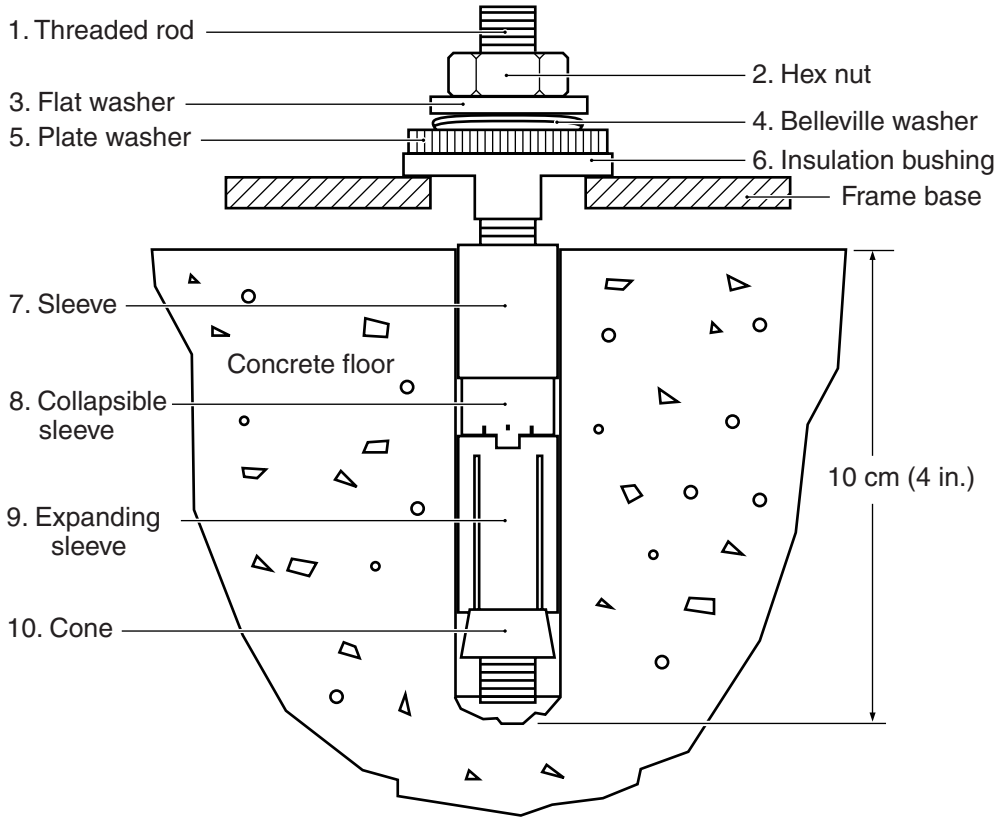
Drilling a raised floor without removable tiles



Anchor A0502620 for a NEBS 2000 frame



Anchor A0686271 for a NEBS 2000 frame



Power and grounding preparation

This section describes the aspects of power distribution and grounding that are important to consider when you plan to install one of the following Nortel Networks products:

- Multiservice Switch 15000
- Multiservice Switch 15000 VSS
- Multiservice Switch 20000

This section also includes shared power and grounding of peripheral equipment that interworks with Multiservice Switch equipment.

Navigation

Power architecture

Electrical power is supplied to a Multiservice Switch by redundant A and B feeds to the breaker interface panel (BIP). The source of power must be dc that is provided either directly from the site power plant or from a system of ac rectifiers, such as an Astec MFA150 power system.

The BIP provides the following functions.

- It is a termination point for large power distribution cables from the customer dc power source (site plant or rectifiers).
- It provides a means to power down individual incoming dc feeds to allow safe servicing at an individual shelf.

- It provides low-frequency stability filtering for each input feed. This ensures that critical damping is achieved and that step load changes will not result in oscillations on the dc power bus.
- It provides stabilized output power feed connections to the shelf assembly and cooling units. For example, when set up with the redundant A and B feeds, either feed can provide power through the BIP to the whole shelf in a load-sharing mode of operation.
- It provides internal and external alarm collection and propagation.

For each power feed to a shelf, a redundant pair of power interface modules (PIMs) further filters and interfaces the -48/-60 V dc power to the backplane. Each control processor (CP) or function processor (FP) also provides additional high frequency filtering.

In general, the power and ground cabling requirements and guidelines between a switch and an MFA150 configuration is the same as for a dc site power plant unless otherwise specified. For information about power and ground requirements between an MFA150 and a switch, see

- Power requirements (page 97)
- Preparation for installing power and ground cables (page 105)
- Power and ground cabling overview (page 122)
- Grounding the frame and communication links (page 125)

To install an MFA150 rectifier setup, see the Astec document 167-9021-133 *Advanced Power Systems MFA150 Modular Front Access Power System Detailed Installation Guidelines and Procedures Manual*.

For information about how the Astec MFA150 operates with a Multiservice Switch, see NN10600-120 *Nortel Multiservice Switch 15000/20000 Hardware Description*.

Multiservice Switch 15000 VSS power architecture

Power from the site distribution panels is supplied to a Nortel Multiservice Switch 15000 Variable Speed Switch (VSS) through two different methods:

- Power for the Nortel Multiservice Switch 15000 is supplied at the breaker interface panel as described in Power architecture (page 95).
- Power for the Multiservice Switch 7480 is supplied directly from a disconnect device to Multiservice Switch 7480 hardware, as described in NN10600-120 *Nortel Multiservice Switch 15000/20000 Hardware Description*.

Power requirements

To meet the maximum power demands on a fully provisioned switch, Nortel Networks recommends input power to be fed by up to 1/0 AWG (53.49 mm^2) cables with a guarantee of 40 or 50 up to 100 A per feed. (The 40 A is two times the largest BIP breaker for a Nortel Multiservice Switch 15000, while the 50 A is two times the largest BIP breaker for a Multiservice Switch 20000.) The cables must meet or exceed the criteria identified in Power cable specifications (page 114).

For a Multiservice Switch 15000, shelf power is supplied through four feeds at a nominal voltage of -48/-60 V dc at 20 A. Each shelf is rated at 3000 W. The maximum current rating per feed is up to 85 to 100 A, while the minimum is 40 A. When planning to use less than 100-A feeds, see Power cable specifications for a partially provisioned shelf (page 116).

For a Multiservice Switch 20000, shelf power is supplied through four feeds at a nominal voltage of -48/-60 V dc at 20 A. Each shelf is rated at 3000 W. The maximum current rating per feed is up to 85 to 100 A, while the minimum is 40 A. When planning to use less than 100-A feeds, see Power cable specifications for a partially provisioned shelf (page 116).

For information about power division and calculating power consumption, see Power distribution and consumption (page 100).

See the appropriate section for additional power requirements:

- Redundant power feeds (page 97)
- Power input through tapping a main (page 98)
- Power input from a system of ac rectifiers (page 98)

Redundant power feeds

It is desirable to power a switch from two independent sources in such a way that it eliminates a single point of failure. For example, if the A side fails, the B side continues the load to the same breaker interface module (BIM). Also, each power feed to a switch must be protected by a fuse or breaker between the battery and the BIP.

This process involves complete separation of the feeders, including the BR (battery returns) to avoid potential influence that a failing side could impose on the redundant side.

A Multiservice Switch 15000 or Multiservice Switch 20000 supports completely separate battery feeds and battery returns down to the control processors (CPs), function processors (FPs), and cooling units. Under normal

conditions, the load is shared evenly between the two feeds if they are within 0.3 V of each other. Each feed must therefore be engineered to operate a fully provisioned shelf if one feed fails.

Power input through tapping a main

When tapping the 1/0 AWG (53.49 mm^2) power cable from a larger cable to the breaker interface panel (BIP), the total consumption of power from the larger cable must always be capable of providing the power requirement at the rear of the BIP.

For information about cable sizes and ratings, see Power cable specifications (page 114).

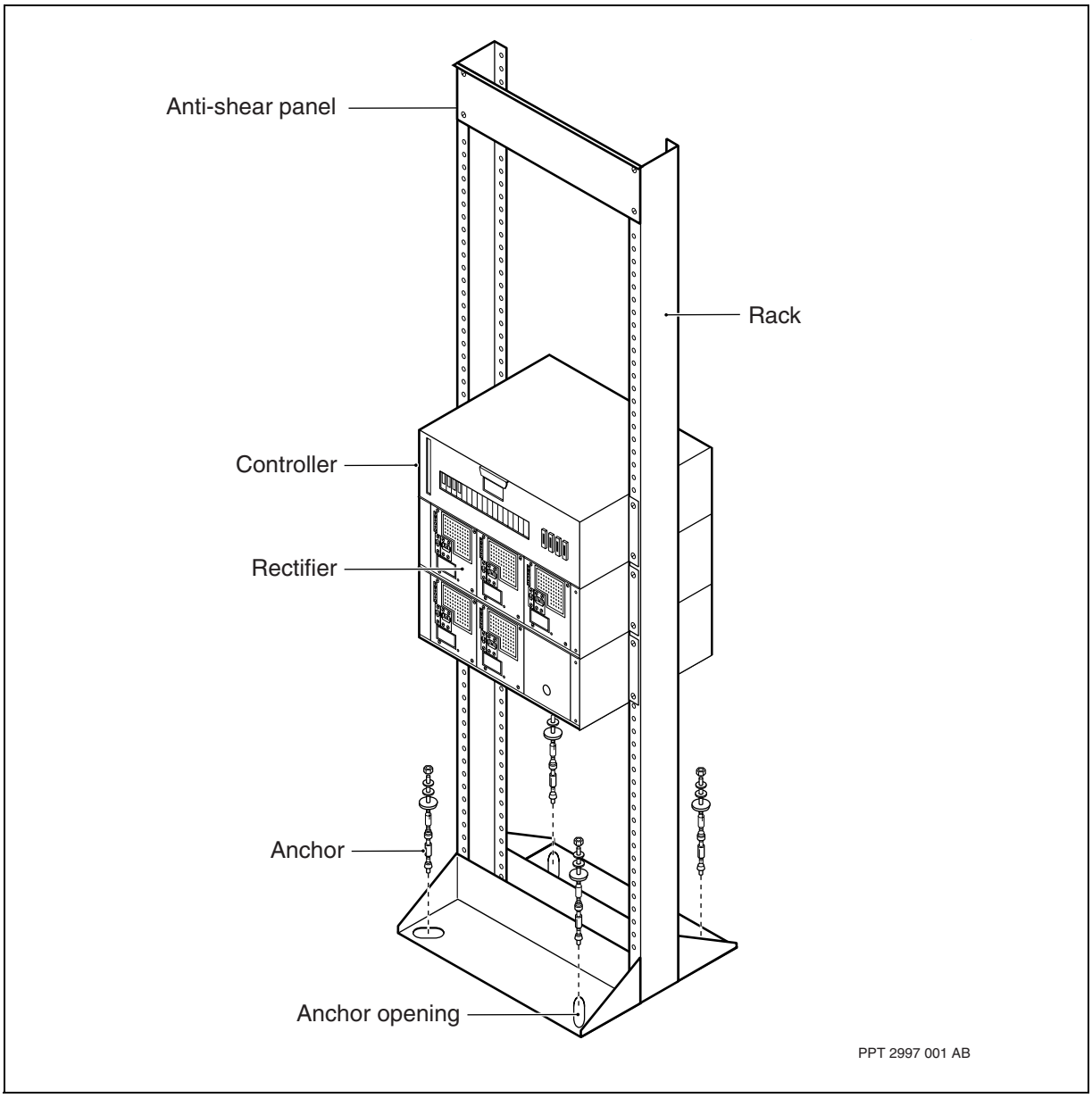
Power input from a system of ac rectifiers

When powering the BIP from a system of ac rectifiers, such as an Astec MFA150 power system without batteries, the nominal dc power output must be 50 A. To power two switches, Nortel Networks recommends using an MFA150 configuration of five 25-A rectifiers connected in parallel. To power one switch, use an MFA150 configuration of three 25-A rectifiers connected in parallel. Four or two rectifiers provide up to 50 A per shelf and one backs up any of the others for an n+1 sparing. For an example, see the figure MFA150 power system of five rectifiers for two Multiservice Switches (page 99).

After calculating the total power consumption for the switch configuration you may identify that the ac rectifier system you plan on using cannot provide enough power, or does not allow for any additional cards or modules. Calculating the power usage is described Power distribution and consumption (page 100).

For the power cables between the MFA150 rectifiers and the BIP, you must use cables with an appropriate gauge and rating for 50-A service to the BIP. See Power cable specifications when using ac rectifiers (page 121).

MFA150 power system of five rectifiers for two Multiservice Switches



Multiservice Switch 15000 VSS power requirements

The electrical power supply for a Nortel Multiservice Switch 15000 Variable Speed Switch (VSS) is dc. Since a Multiservice Switch 15000 VSS is a combination of a Multiservice Switch 15000 and a Multiservice Switch 7480, the power requirements for each is different and separate.

- For the Multiservice Switch 15000, see Power requirements (page 97).
- For the Multiservice Switch 7480, see the section on power requirements in NN10600-170 *Nortel Multiservice Switch 7400 Hardware Description*.

Power distribution and consumption

A Nortel Multiservice Switch 15000 or Multiservice Switch 20000 node is powered from four field-replaceable power interface modules (PIMs) located on the back of the shelf. Each PIM terminates two redundant power feeds from the BIP (either an A feed or B feed from a single breaker interface module). The filter consists of a passive low pass LC network that provides EMI filtering to prevent shelf generated noise from being radiated. Each filter also provides termination for the HSCX buses and clock signals.

For a Multiservice Switch 15000, the redundant power feeds are 20 A.

For a Multiservice Switch 20000, the redundant power feeds are 25 A.

Total power consumption depends on the type and quantity of modules. The total power consumption dictates the minimum gauge of power cable and the power plant that you can safely use for the switch (if you choose not to use the recommended 1/0 AWG cable).

CAUTION
Equipment damage
If you install additional power-consuming hardware parts in your configuration, you must recalculate the power consumption (and current required) and install the appropriate cabling and fuses or breakers, if necessary.

To determine the minimum gauge of cable you can use, calculate the input current that your system configuration requires by doing the following:

1 Determine the power consumption in Watts for each switch by totalling the maximum power consumption of the individual parts. Use the table Power consumption for hardware parts in a Multiservice Switch 15000 or Multiservice Switch 20000 (page 101), which is sorted by part number. The information in the table (sorted by PEC) enables you to calculate the total typical and maximum power consumption. Always use the maximum value in your calculations.

Attention: Most sparing panels show 0.0 W consumed because they get their power from at least one FP that connects to it. The power consumption values for the electrical FPs take into account how much a sparing panel will draw (about 0.8 W average except for NTQS31).

2 Divide each shelf's total maximum consumption in Watts either by the worst case voltage (36.5 V or -46.0 V with a system of ac rectifiers), or by the low drop-out voltage (for example, 43.5 V) at the BIP input if your system uses a low voltage disconnect device. (For example, this

calculation gives you the current in amps (single feed maximum) that each shelf requires. See Sample calculation of maximum input current (page 104) for an example.

3 Choose a gauge of power cable that is rated for the current in amps that each shelf requires, and rated according to the distance between the power source and the BIP to ensure the voltage drop is less than 1.75 V.

Attention: To prevent nuisance tripping of the breakers, they need to be rated at least 25 to 30% above the calculated amperage for your system, to a maximum of the 100 A breaker rating.

Power consumption for hardware parts in a Multiservice Switch 15000 or Multiservice Switch 20000

Hardware part	Typical power (W)	Maximum power (W)
NT6C61 or NT6C62 BIP (per shelf, 2 feeds, with 20 A breakers)	12.84	20.82
AP6C67AA or AP6C68AA BIP (per shelf, 2 feeds, with 25 A breakers)	12.84	20.82
NTFP99 3-port DS3 sparing panel power is supplied by the FPs	0.0	0.0
NTHR05 OC-3 multimode CQC	52.2	65.25
NTHR06 control processor (CP2E)	25.0	50.0
NTHR12, NTHR13, or NTHR14 alarm/BITS module	diode ORed across all feeds and consumes about 1.0 W.	
NTHR11 MAC address module power is supplied by the control processor (CP)	0.0	0.0
NTHR15 power interface module (PIM) power is supplied by the control processor (CP)	0.0	0.0
NTHR16EA fabric	28.0	34.0
NTHR16AA, BA, CA, or DA fabric	50.0	60.0
NTHR17 4-port OC-3 multimode	73.0	100.0
NTHR21 4-port OC-3 single-mode intermediate reach	75.0	100.0
NTHR23 12-port DS3	71.0	100.0
NTHR25 12-port E3	71.0	100.0
NTHR29 1-port OC-12 single-mode long reach	87.0	111.25
NTHR31 4-port DS3 ATM IMA	115.0	138.0
NTHR35 control processor (CP2E)	25.0	50.0

(1 of 3)

Power consumption for hardware parts in a Multiservice Switch 15000 or Multiservice Switch 20000 (continued)

Hardware part	Typical power (W)	Maximum power (W)
NTHR37 sparing panel power is supplied by the FPs **Attention:** See NTQS31 because NTHR37 is part of it.	0.0	0.0
NTHR45 CQC E3	41.76	52.2
NTHR47 CQC OC-3 single-mode	54.81	68.51
NTHR51AA or AB, or NTHR52AA or AB cooling unit	79.2	187.2
NTHR64 blank processor card (also known as a filler module) power is not used by this card	0.0	0.0
NTHR79 4-port DS3 sparing panel power is supplied by the FPs	0.0	0.0
NTHR83 1-port STM-1 channelized single-mode intermediate reach FR	84.0	105.0
NTHR86 1-port STM-1 channelized single-mode intermediate reach ATM/IMA	100.0	125.0
NTHR88 4-port DS3 channelized FR	77.2	115.0
NTHR89 4-port DS3 channelized FR	65.0	90.0
NTHR91 4-port DS3 channelized AAL1 CES	115.0	138.0
NTHW01 1-port OC-48/STM-16 single-mode intermediate reach ATM with APS	68.1	99.25
NTHW05 4-port OC-3 multimode	73.0	100.0
NTHW06 control processor (CP3)	36.7	55.0
NTHW08 control processor (CP3)	36.7	55.0
NTHW10 2-port general processor with disk	36.7	55.0
NTHW11 4-port OC-12/STM-4 single-mode intermediate reach ATM	136.0	150.0
NTHW15 4-port OC-3 single-mode intermediate reach	75.0	100.0
NTHW18 6-module packet server service processor	100.0	150.0
NTHW21 16-port OC-3/STM-1 ATM single-mode intermediate reach	130.0	150.0
NTHW30 VPN extender card	36.7	55.0
NTHW31 16-port OC-3/STM-1 single-mode intermediate reach ATM	130.0	150.0
NTHW44 16-port OC-3/STM-1 POS and ATM	140.0	150.0
NTHW46 4-port MR POS and ATM	140.0	150.0

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Power consumption for hardware parts in a Multiservice Switch 15000 or Multiservice Switch 20000 (continued)

Hardware part	Typical power (W)	Maximum power (W)
NTHW49 4-port Gigabit Ethernet	120.0	150.0
NTHW52 12-port DS3 or E3 fanout panel power is not used with this patch panel	0.0	0.0
NTHW70 4-port OC-3/STM-1Ch single-mode intermediate reach TDM/CES	120.0	150.0
NTHW77 voice services processor 3 with optical TDM interface (VSP3-o)	115.0	140.0
NTHW84 voice services processor 3 (VSP3)	90.0	130.0
NTHW86 4-port OC-12 single-mode intermediate reach ATM	120.0	150.0
NTHW87 Voice services processor 2 (VSP2)	90.0	110.0
NTHW91 2-port DS3C TDM	40.0	50.0
NTHW92 32-port E1 TDM	40.0	50.0
NTPN02 fabric	77.0	85.0
NTPN11 MAC address module power is supplied by the control processor (CP)	0.0	0.0
NTPN12 or NTPN13 alarm/BITS module	diode ORed across all feeds and consumes about 1.0 W.	
NTPN15 power interface module (PIM) power is supplied by the control processor (CP)	0.0	0.0
NTQS31 sparing panel power is supplied by the FPs **Attention:** Although the sparing panel draws its power from at least one DS3 or E3 FP, add 10 W of power consumption when using one.	10.0	10.0
NTTP0x small form pluggable (SFP) module **Attention:** Each SFP is powered from its FP, so do not add the SFP consumption to your totals.	0.7	1.0
NT0486AA multiport aggregate device (MAD) DC powered, balanced, RJ45	25.0	35.0
NT0421AA multiport aggregate device (MAD) DC powered, unbalanced, RJ45	25.0	35.0
(3 of 3)		

Sample calculation of maximum input current

This section provides a sample calculation to show you how to calculate the maximum input current (single feed max) in amps. The following example is for a very limited system configuration, with one Nortel Multiservice Switch 15000 node.

Attention: This calculation is an example only. The maximum input current for your configuration depends on the type and number of hardware parts that you install. Always use the maximum power values.

Sample calculation of maximum input current for a Multiservice Switch 15000

part	Quantity	Maximum power (W)
control processor	2	100.0
fabric card	2	120.0
BIP	1	20.82
cooling unit	1	187.2
MAC address module	1	0.0
alarm/BITS module	1	0.0
TOTAL POWER CONSUMPTION		**428.02 W**
TOTAL MAX CURRENT INPUT (at WCV) = **Attention:** 34.7 V is the worst case voltage (WCV), from 36.6 V at the BIP and an internal drop of 1.9 V. If you use a low-voltage disconnect device (LVD), see the last row of this table.		428.02 W / 34.7 V= **12.3 A** (single feed maximum)
TOTAL MAX CURRENT INPUT (at LDO voltage) = **Attention:** If you use a low-voltage disconnect device (LVD), then the WCV is the trip value of the LVD measured at the the BIP power input, that is, the low drop-out (LDO) voltage. In this example, the LDO voltage is 43.5 V.		428.02 W / 43.5 V = **9.8 A**

Multiservice Switch 15000 VSS power distribution

Power distribution for Nortel Multiservice Switch 15000 Variable Speed Switch (VSS) is different for each switch that makes up the node.

- For the Multiservice Switch 15000 component, see Power distribution and consumption (page 100).
- For the Multiservice Switch 7480 component, see the section on power in NN10600-170 *Nortel Multiservice Switch 7400 Hardware Description*

Preparation for installing power and ground cables

The Nortel Multiservice Switch is powered from a dc power source by 2 or 4 feeds to the breaker interface panel (BIP). The dc power source can be from either an all-dc power plant or a system of ac rectifiers, such as an Astec MFA150 power system. A feed is two power cables, a negative (battery) and a positive (battery return). The BIP handles the input power to the switch through the feeds A1 and B1 for the lower shelf and A2 and B2 for the upper shelf, and redundantly distributes the power to hardware parts.

The operating company must provide and install the input power cables that feed the system of ac rectifiers. If using an MFA150 power system of rectifiers, the ac power input cable to the MFA150 must be ordered separately. For the size of power input between the MFA150 and the BIP, see Power distribution and consumption (page 100) to calculate the power demand of the switch.

DANGER

Risk of injury and equipment damage by electricity

For installing input power cables, ensure the installer is a qualified electrician. Local electrical codes take precedence over Nortel Networks' recommendations unless the local code advocates a lesser grade of installation.

WARNUNG

Gefahr von Geräteschäden und Verletzungen

Lassen Sie die Stromversorgungskabel nur von einem qualifizierten Elektriker verlegen. Die an Ihrem Standort gültigen gesetzlichen Normen haben Vorrang vor den Richtlinien, die Nortel Networks aufgestellt hat, sofern diese Richtlinien nicht strenger sind als die gesetzlichen Normen.

The overall installation of power and ground cables from the power plant to the BIP includes:

- installing the A and B power feed cables from the customer premises equipment (CPE), the central office (CO), or a system of ac rectifiers to the BIP
- when using an Astec MFA150 power system of rectifiers, installing the ac power input cable
- connecting the A and B power feed cables
- grounding the switch to the CPE or the CO ground window to the NEBS 2000 frame
- if present, grounding the MFA150 power system to the same ground window used by the switch

- adding a pair of breaker interface modules (BIMs) to the BIP
- adding the power distribution cables from the BIP to a second switch and to its cooling unit (already pre-wired in NTQS10)

CAUTION

Risk of damage to equipment by reversed polarity

Use the plus (+) and minus (-) symbols on the rear of the breaker interface panel (BIP) to ensure that the polarity of each A and B battery (-48/-60 V dc) and battery return for the input power feeds is correct. When powering up the BIP, reversed polarity will damage circuits inside it.

ACHTUNG

Geräteschäden durch umgekehrte Polung

Achten Sie mithilfe der Plus- (+) und Minuszeichen (-) auf der Rückseite des BIP (Breaker Interface Panel) auf die richtige Polung der Akkus A und B (-48/-60 V dc) sowie der Batterierückleitung an den Speisestrom-zuführungen. Andernfalls werden die Schaltungen im BIP beim Einschalten beschädigt.

Before installing the power and ground cables for a switch, observe the following information:

- Allowing for voltage drop over distance (page 106)
- About restricted and non-restricted sites (page 108)
- Labeling the power feeds in CPE or a CO (page 108)
- Grounding the frame in CPE or a CO (page 110)
- Grounding when not using a NEBS 2000 frame (page 111)
- Grounding when using ac rectifiers as a power source (page 112)
- Prerequisites to installing dc power input cables (page 112)

Allowing for voltage drop over distance

As the distance from the power source to the cable connections on the BIP increases, the voltage drops on the feeds. To compensate for the loss, the gauge of wire must be increased according to the distance to the connection so that exceeding the allowable voltage drop is prevented.

In a takeover mode for power redundancy, a larger voltage drop occurs between the dc power source and the BIP. For example, when the A feed takes over the B feed, a drop larger than 1.75 V occurs and the amount of drop depends on the gauge and distance of power cable. This is normal. During the drop, switch operation and service are maintained. If during the takeover mode the battery becomes low (a double fault scenario), the system

automatically turns to protect itself. When the power source level returns to nominal, the system automatically recovers, and turns on again. For the effects of turning off the switch, refer to NN10600-550 *Nortel Multiservice Switch 7400/15000/20000 Common Configuration Procedures*.

To determine the size of power cable at CPE, a CO, or an ac rectifier to the BIP, or from a C-tap to the BIP according to the distance the cable must be run, use the table Power feed sizes (page 107) as a guide. The specifications in the table meet the following criteria:

- the distance is one way from the power source to the BIP
- a 1.75 V loop drop from the power source to the BIP for a single feed is already included in the specifications, assuming a 50% load diversity between the A and B feed pairs (that is, sharing 26.5 A each so that with one power source down, the other has 85 A)
- the insulation rating on the feeder cable is assumed to be a minimum 90-degrees Celsius and the maximum ambient room temperature is assumed to be 50 degrees Celsius (122 Fahrenheit)
- the use of No. 1/0 AWG (53.49 mm^2) to the BIP is based on 8 conductors in the cable bundle for two fully provisioned switches in one frame

Attention: When using a dc site source for power, rate the size of the over-current feed protector for dc with disconnects that are approved according to the country where the switch is installed (for example, UL, CSA, or VDE). The approved disconnect must never exceed 85 to 100 A or be lower than 40 A. (The 40 A is derived from two times the largest BIP breaker.) When using an Astec MFA150 power system of ac rectifiers to provide dc power, the over-current feed protection is provided by mid-trip breakers.

With a Multiservice Switch 20000, the breakers to the shelves on the breaker interface panel (BIP) increase from 20 A to 25 A. Apply the same criteria for voltage drop, cable size, and cable specification as a Multiservice Switch 15000 with the 20 A breakers.

Power feed sizes

Cable size	maximum distance for 1 V dc voltage drop	maximum distance for 1.75 V dc voltage drop
1 (42.41 mm^2)	48.5 ft (15.9 m)	84.8 ft (27.8 m)
1/0 (53.49 mm^2)	61.3 ft (20.1 m)	107.2 ft (35.2 m)
2/0 (67.43 mm^2) see Note	77.0 ft (25.3 m)	134.9 ft (44.2 m)

(1 of 2)

Power feed sizes (continued)

Cable size	maximum distance for 1 V dc voltage drop	maximum distance for 1.75 V dc voltage drop
4/0 (107.2 mm^2) see Note	97.3 ft (31.9 m)	170.4 ft (51.9 m)
Attention: The power cables being terminated at the BIP input studs must be up to No. 1/0 AWG. Using larger cables up to the BIP requires C-tapping by an appropriate size less than or equal to 1/0 AWG at the BIP.		
(2 of 2)		

About restricted and non-restricted sites

A switch that is installed in a non-restricted access environment (as with CPE, typically) requires the use of conduit for power cables. The conduit that is passed into the bottom of the frame must be metal, for example, electrical metallic tubing (EMT). To accommodate conduit while maintaining protection from fire, the base of the NEBS 2000 frame has two 2-inch conduit knockout disks. When using conduit for the installation, Nortel Networks recommends using 2-inch metal conduit for power cables going to the BIP. For overhead conduit, stop the installation at the conduit box above the frame. (The PEC for the conduit box is NTHR78.) According to the CE Code Handbook and the National Electric Code, 2-inch EMT conduit can house up to four No. 1/0 AWG cables. For under-floor conduit, stop the conduit at the plate in the bottom of the frame. The installations involving conduit are described in NN10600-130 *Nortel Multiservice Switch 15000/20000 Hardware Installation, Maintenance, and Upgrade*, the chapter on installing power and ground cables.

A switch that is installed in a restricted access environment (as with a central office, typically) does not require the use of conduit for power cables and must comply with the operating company's requirements. However, the fastening caution for conduit also applies to cable without conduit.

CAUTION
Risk of equipment damage by fire
In the bottom rear center of the frame, each removable plate (drip tray, part number P0870734) may have two knockout disks. Each knockout disk must remain intact and unbent unless a power conduit from a raised floor will be routed through it. Leaving an opening reduces the fire-proofing of the switch.

Labeling the power feeds in CPE or a CO

It is recommended that you identify dc input power cables with permanent labels or color codes or both according to the tables:

- Cable identification, Germany (page 109)
- Cable identification, Japan (page 110)

- Cable identification, North America (page 109)
- Cable identification, United Kingdom (page 110)

With the polyvalent power-and-ground assembly (A0834143), each terminal block for a power cable is provided with a label indicating it is a battery return or battery.

With the European Telecommunications Standards Institutes (ETSI) power-and-ground assembly (A0834149), each terminal block for a power or ground cable is provided with a label indicating it is a battery return, frame ground, or battery.

Cable identification, North America

Conductor potential	Function	Conductor label	Color code, if used
-48/-60 V	dc power	L-	blue
0 V, the grounded side of the dc power supply	dc power return battery return, BR conductor	L+	red
grounded (or bonded to ground)	framework ground, framework bonding conductor	FB	green, 50% and yellow, 50%

According to the standard IEC-950, the framework ground or the framework bonding conductors are also known as protective earth. The green and yellow ratio of color for the ground relative to a power cable is nominally 50/50 but must be no less than 30% and no more than 70% for either color.

Cable identification, Germany

Signal name	Function	Color code
-48/-60 V	dc power	black (or blue) with tape marked L-
BR	battery return	black (or red) with tape marked L+
FG	frame ground	green and yellow (or black)
LR	logical return	black
-48/-60 V	dc power	black (or blue) with tape marked L-
BR	battery return	black (or red) with tape marked L+

Cable identification, United Kingdom

Signal name	Function	Color code
-48 V	dc power	blue
BR	battery return	red (or black if referenced to 0 V)
FG	frame ground	green and yellow
LR	logical return	black

Cable identification, Japan

Signal name	Function	Color code
-48 V	dc powered	blue
BR	battery return	red
FG	frame ground	black
LR	logical return	black

Grounding the frame in CPE or a CO

With customer premises equipment (CPE) or in a central office (CO), the switch is grounded to the NEBS 2000 frame (NTRU04) and the frame is grounded to the ground window of the site.

DANGER

Risk of injury or equipment damage by electricity

The frame ground is the protective ground and must have a reliable permanent connection to earth. Do not ground a frame to another frame, especially by “jumping” a wire from frame to frame.

WARNUNG

Verletzungsgefahr

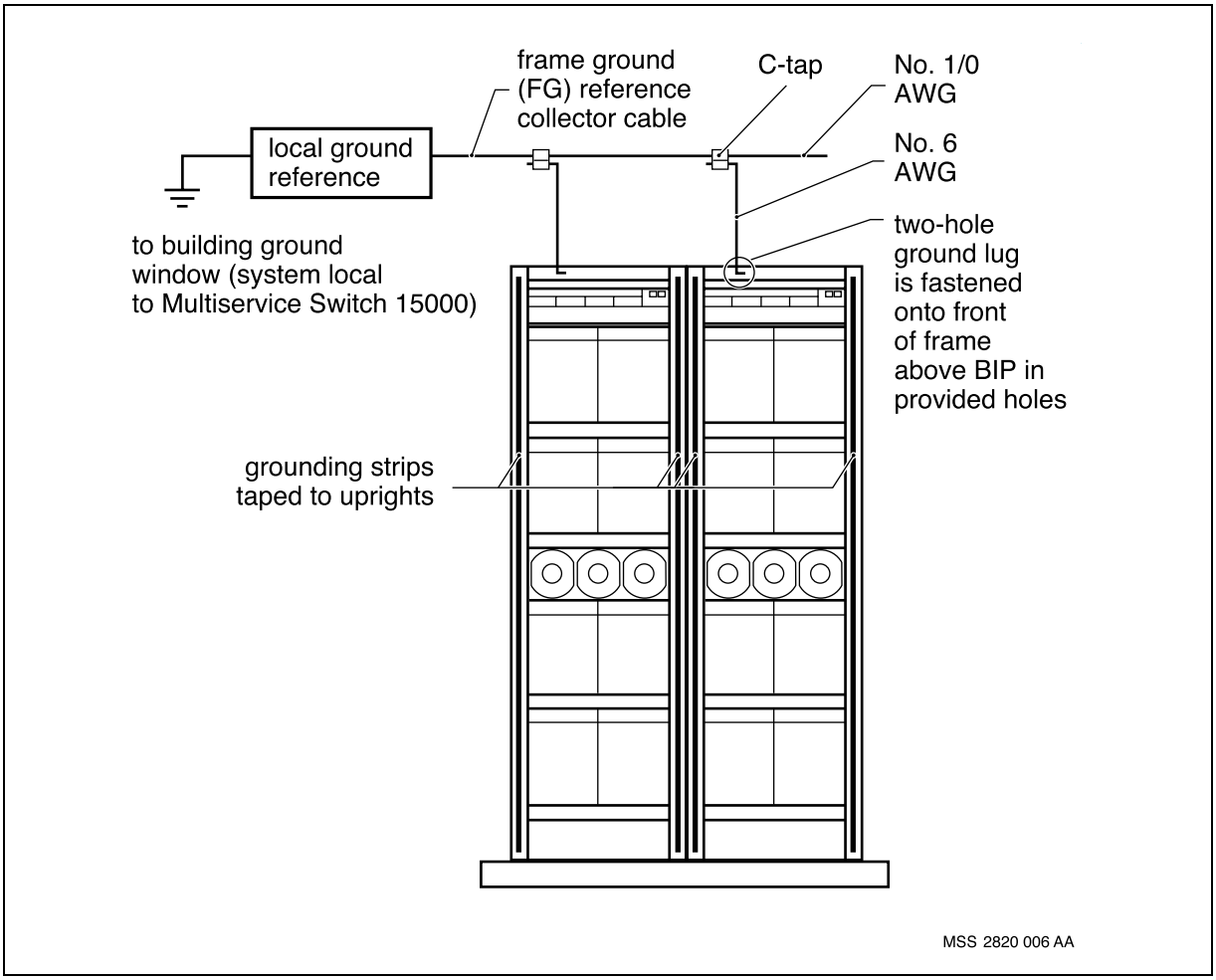
Die Erdung des Gestells ist eine Schutzerdung und muß zuverlässig und dauerhaft mit der Netzerde verbunden sein. Bilden Sie keinesfalls eine Kaskadenerdung, das heißt, erden Sie nicht ein Gestell am anderen.

The methods of grounding to the ground window vary. However, in all methods at the point where a C-tap is to ground a cable between the NTRU04 frame and the ground window cable, ensure the cable runs from the frame to the tap in the same direction as the flow of ground. That is, the end of the cable at the tap points in the direction of ground flow. The minimum cables size to ground the frame is 6 AWG (13.3 mm^2). The “S” curve of the cable at rest is not to

exceed a 90-degree bend. Ensure the cable labeling remains at both ends of the cable. See the figure Grounding an NTRU04 frame to a ground window (page 111).

With the polyvalent (A0834143) and ETSI (A0834143) power-and-ground assembly, the mounting bracket covers the normal grounding points on the rear of the NTRU04 frame. The alternative grounding point to the frame from the site ground window is at the top front of the NEBS 2000 frame on the silvery grounding strip.

Grounding an NTRU04 frame to a ground window



Grounding when not using a NEBS 2000 frame

Normally, the bonding of the metalwork of the hardware parts to the frame (with or without the conductive tape on the uprights) by the self-tapping bolts (provided), grounds the hardware to the frame. Ground your switch using this

method provided the frame is appropriately grounded to the site's ground window. The frame ground to the site's grounding window is identified by the universal ground icon across the top of the NEBS 2000 frame (NTRU04).

When installing the BIP in a frame other than an NTRU04 (that is, lacking conductive tape or is entirely painted), a secondary grounding point is provided in the BIP chassis. There are 2 studs at the rear lower right of the chassis. Ground the BIP chassis to the frame reliably by firmly attaching a ground of minimum size 6 AWG cable E/W (13.3 mm^2) between the studs and a common grounding point. Use two straight 2-hole lugs, one to the chassis and the other to the frame ground bonding point. The stud nuts on the chassis are number 10-32 unc and are included with washers on the studs. There is no metric equivalent to the stud nuts. Use star washers between the lug and the frame. Do not overtighten the nuts.

Grounding when using ac rectifiers as a power source

When installing a system of ac rectifiers such as an Astec MFA150 power system to provide dc power to the switch, ground the frame and the framework to the same ground window. Also, ground both by similar methods, for example, as described in Grounding the frame in CPE or a CO (page 110).

For more information on grounding an MFA150, see 167-9021-133 *Advanced Power Systems MFA150 Modular Front Access Power System Detailed Installation Guidelines and Procedures Manual*.

Prerequisites to installing dc power input cables

Installing dc power cables for the BIP means routing the cables from the power source to the BIP or the frame's floor footprint without connecting either end. Dressing the cables onto the NEBS 2000 frame and connecting to the BIP or power-and-ground cable assembly is handled in the appropriate sequence by an installation task flow. Because of the lead time recommended to schedule a qualified electrician, the task flows accommodate installing the cables before the hardware arrives.

Each input stud at the rear of the BIP is provided with a narrow-tongued 2-hole 90-degree offset 2/0 AWG lug (part number A0757391) underneath a clamped insulating boot. The boot prevents direct access to the power connections and potential shorting between adjacent connections. The power input cables must have been installed directly to the studs on the BIP or to a power-and-ground assembly that relays the feeds to the BIP.

CAUTION

Risk of equipment damage by reversed polarity

Use the plus (+) and minus (-) symbols on the rear of the breaker interface panel (BIP) to ensure that the polarity of each A and B battery (-48/-60 V dc) and battery return for the input power feeds is correct. When powering up the BIP, reversed polarity will damage circuits inside it.

ACHTUNG

Geräteschäden durch umgekehrte Polung

Achten Sie mithilfe der Plus- (+) und Minuszeichen (-) auf der Rückseite des BIP (Breaker Interface Panel) auf die richtige Polarität der Akkus A und B (-48/-60 V dc) sowie der Batterierückleitung an den Speisestromzuführungen. Andernfalls werden die Schaltungen im BIP beim Einschalten beschädigt.

When connecting power input cables to the rear of the BIP, you will be connecting to the breaker interface modules (BIMs) on the other side of the BIP backplane. Determine each appropriate connection from the information in the table Feed codes of the BIP BIMs, rear view (page 113).

When connecting power output cables from a system of ac rectifiers to the BIP, ensure that the dc power cable connections at the system support the redundant A and B feeds with correct polarity from the BIP. Determine the correct connection pattern and labelling for the system of ac rectifiers from the table Feed codes of the BIP BIMs, rear view (page 113).

Feed codes of the BIP BIMs, rear view

Position of BIM	At rear of BIM	Label	Output to
left BIM	right pair of studs left pair of studs	A1+ A1-	lower shelf
middle left BIM	right pair of studs left pair of studs	B1+ B1-	lower shelf
middle right BIM	right pair of studs left pair of studs	A2+ A2-	upper shelf
right BIM	right pair of studs left pair of studs	B2+ B2-	upper shelf

Power cable specifications

Power cable specifications vary according to:

- the amount of power required to safely operate a fully or partially provisioned switch
- the power cable limitations of the source of dc power from the site's batteries or from a system of ac rectifiers
- the distance between legs and endpoints of the power source
- the electrical codes of the country of installation

For a Nortel Multiservice Switch 20000, the breakers to the shelves on the breaker interface panel (BIP) increase from 20 A to 25 A. Apply the same criteria for voltage drop, cable size, and cable specification as for a Multiservice Switch 15000 with the 20 A breakers.

Refer to the cabling section that applies to your installation of power cables:

- Power cable specifications for a fully provisioned switch (page 114)
- Power cable specifications for a partially provisioned shelf (page 116)
- Power cable specifications with a polyvalent assembly (page 118)
- Power cable specifications with an ETSI assembly (page 119)
- Power cable specifications when using ac rectifiers (page 121)

Power cable specifications for a fully provisioned switch

The cable specifications for the input power cables terminating at the breaker interface panel (BIP) must be fed by 1/0 AWG (53.49 mm^2) cables for each fully provisioned switch. The operating company must provide the power cables up to the BIP. The cable size between the BIP and the power plant or the BIP and a branch cable must be very flexible 1/0 AWG cable (such as welding cable). Use cable or an equivalent with these recommended wire specifications from the National Wire and Cable Standard:

- 1/0 AWG gauge of Super Flex cable has 2646/34 strands and strand size with a conductor diameter of 0.437 inches or 96.77 mm^2
- 1/0 AWG gauge of Welding cable has 1045/30 strands and strand size with a conductor diameter of 0.431 inches or 94.17 mm^2

Use the indicated gauge and especially the flexibility of the power cables for safe, easier, and appropriate installation. Manufacturers of 1/0 AWG (53.49 mm^2) cable typically have a different number of strands in the cable, which affects how easily the cable can be bent (flexed) and whether a lug for 1/0 AWG can be easily crimped onto the end of the cable. Because the inside diameter of a 1/0 AWG lug barrel is 0.39 inches (1 cm) and for a 2/0 AWG (67.43 mm^2) lug is 0.45 inches (1.1 cm), 2/0 AWG 90-degree offset narrow-

tongued 2-hole lugs (part number A0757391) are typically included with the BIP. Also, when the insulation is stripped from the cable, the strands tend to splay slightly and the 1/0 AWG lug is awkward to fit onto the end.

At the rear of the BIP, each input power connection has two studs to ensure a safe installation of the power cables. The top stud of each pair carries the power. The bottom stud prevents rotation of the lug from the weight of the power cable. With secure fastening of a 90-degree (right-angled) 2-hole lug, arcing and rotation are prevented.

At the rear of the BIP, each A and B feed connection is identified as positive (+) for the battery return or negative (-) for the battery (-48 V/-60 V dc). Each connection is also provided with an insulating boot covering a 90-degree offset narrow-tongued 2-hole lug for the 1/0 AWG flexible cable. The provided lug is size 2/0 AWG to accommodate differences in the thickness of 1/0 AWG cable by different manufacturers.

Attention: The polyvalent or ETSI power-and-ground assembly accommodates power non-Super Flex input cables from No. 6 AWG (13.3 mm^2) up to 2 AWG (33.62 mm^2). Provided your local electrical codes accept the equipment, using the assembly to accommodate power input cabling at the BIP can be a much simpler installation method at your site. See Power cable specifications with a polyvalent assembly (page 118) or Power cable specifications with an ETSI assembly (page 119).

If, according to the National Electrical Code (NEC), 100 A protectors are being used between the site power source and the BIP, and the room's ambient temperature can reach 50 degrees Celsius (122 degrees Fahrenheit), a cluster of 8 power conductors running over 2 feet with a cable insulation rating of 90 degrees Celsius (194 degrees Fahrenheit) is required for a 97.58 A current. These specifications are met by using 1/0 AWG cable.

All power cables must meet the requirements of the country of installation. For example, use cable with a rating such as CSA or UL VW-1. For the ratings, see the table North American ratings for cable (page 115).

North American ratings for cable

Canada	US	Description
FT-4	UL 1581	general installation
FT-4	UL 1666	riser
FT-6	UL 910	plenum

Additional information about cables used in a setup with an ac rectifier is included in Power cable specifications when using ac rectifiers (page 121).

CAUTION

Risk of damage to equipment by reversed polarity

Use the plus (+) and minus (-) symbols on the rear of the breaker interface panel (BIP) to ensure that the polarity of each A and B battery (-48/-60 V dc) and battery return for the input power feeds is correct. When powering up the BIP, reversed polarity will damage circuits inside it.

ACHTUNG

Geräteschäden durch umgekehrte Polung

Achten Sie mithilfe der Plus- (+) und Minuszeichen (-) auf der Rückseite des BIP (Breaker Interface Panel) auf die richtige Polarität der Akkus A und B (-48/-60 V dc) sowie der Batterierückleitung an den Speisestromzuführungen. Andernfalls werden die Schaltungen im BIP beim Einschalten beschädigt.

Power cable specifications for a partially provisioned shelf

A partially provisioned shelf means some card or module slots are empty, that is, covered by a filler (blank). The cable specifications for the input power cables terminating at the breaker interface panel (BIP) can be less than the recommended 1/0 AWG (53.49 mm^2) cables for a partially provisioned switch.

The operating company must provide the power cables up to the BIP. The cable size between the BIP and the power plant or the BIP and a branch cable must be determined from the power consumption of your shelf. To calculate your minimum power consumption, and accommodate the addition of powered parts after the initial installation, see Power distribution and consumption (page 100).

At the rear of the BIP, each input power connection has two studs to ensure a safe installation of the power cables. The top stud of each pair carries the power. The bottom stud prevents rotation of the lug from the weight of the power cable. With secure fastening of a 90-degree (right-angled) 2-hole lug, arcing and rotation are prevented.

At the rear of the BIP, each A and B feed connection is identified as positive (+) for the battery return or negative (-) for the battery (-48 V/-60 V dc). Each connection is also provided with an insulating boot covering a 90-degree offset narrow-tongued 2-hole lug intended for the 1/0 AWG flexible cable. When using a gauge of less than 1/0 AWG cable, you must replace the

provided lugs with ones that have an appropriately sized lug barrel with the same 2-hole size and spacing on a 90-degree offset narrow-tongued lug. The original insulation boots are used for any cable size less than 1/0 AWG.

Attention: The polyvalent or ETSI power-and-ground assembly accommodates non-Super Flex power input cables from No. 6 AWG (13.3 mm^2) up to 2 AWG (33.62 mm^2). Provided your local electrical codes accept the equipment, using the assembly to accommodate power input cabling at the BIP can be a much simpler installation method at your site. See Power cable specifications with a polyvalent assembly (page 118) or Power cable specifications with an ETSI assembly (page 119).

If, according to the National Electrical Code (NEC), less than 100 A protectors are being used between the site power source and the BIP, and the room's ambient temperature can reach 50 degrees Celsius (122 degrees Fahrenheit), a cluster of 8 power conductors running over 2 feet with a cable insulation rating of 90 degrees Celsius (194 degrees Fahrenheit) is required. These specifications must be met by whatever cable you plan to install.

All power cables must meet the requirements of the country of installation. For example, use cable with a rating such as CSA or UL VW-1. For the ratings, see the table North American ratings for cable (page 115).

Additional information about cables used in a setup with an ac rectifier is included in Power cable specifications when using ac rectifiers (page 121).

CAUTION

Risk of damage to equipment by reversed polarity

Use the plus (+) and minus (-) symbols on the rear of the breaker interface panel (BIP) to ensure that the polarity of each A and B battery (-48/-60 V dc) and battery return for the input power feeds is correct. When powering up the BIP, reversed polarity will damage circuits inside it.

ACHTUNG

Geräteschäden durch umgekehrte Polung

Achten Sie mithilfe der Plus- (+) und Minuszeichen (-) auf der Rückseite des BIP (Breaker Interface Panel) auf die richtige Polarität der Akkus A und B (-48/-60 V dc) sowie der Batterierückleitung an den Speisestromzuführungen. Andernfalls werden die Schaltungen im BIP beim Einschalten beschädigt.

Power cable specifications with a polyvalent assembly

When the power-and-ground setup of a switch uses the optional polyvalent assembly, the assembly is installed between the power source cables and the breaker interface panel (BIP). See the figure Polyvalent power-and-ground assembly A0834143 (page 119).

The polyvalent hardware must be installed on the NEBS 2000 frame on site as an optional kit (part number A0834143). All of the criteria in Power architecture (page 95) still apply.

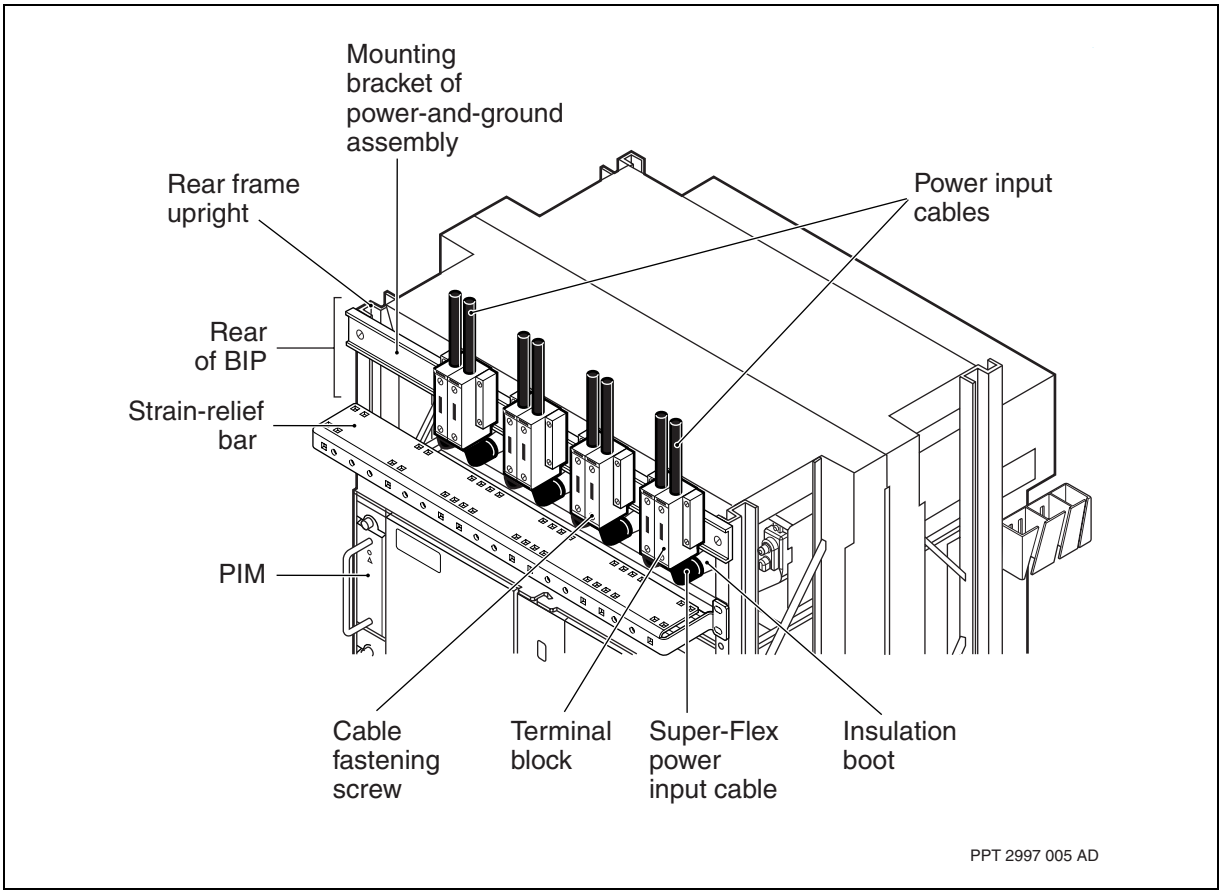
The power cables in the polyvalent hardware kit that connect the bottom of the terminal blocks to the BIP studs are provided. The difference with polyvalent power cables is that the power cable for this leg is size 2/0 AWG (67.43 mm^2) Super Flex excelene (manufactured by Essex). The cable is rated R +105C 600V and is cut to measure at 21 cm (8.3 inches). The narrow-tongued 2-hole 90-degree offset 2 AWG lugs used to fasten the power cables to the BIP are included.

When connecting the power input cables to the terminal blocks, bared cable is fastened directly to each block, therefore no special lugs are required.

Attention: The polyvalent power-and-ground assembly can accommodate power input cables from No. 6 AWG (13.3 mm^2) up to 2 AWG (33.62 mm^2), including non-Super Flex.

The NEBS 2000 frame is normally grounded to the site window through the the silvery grounding strip at the top of the frame. The polyvalent assembly bracket covers the strip. When using the polyvalent assembly, the grounding point between the frame and the site ground window must be on the silvery strip at the top front of the frame.

Polyvalent power-and-ground assembly A0834143



Power cable specifications with an ETSI assembly

When the power-and-ground setup of a switch uses the hardware that complies with the European Telecommunications Standards Institutes (ETSI), the hardware assembly is installed between the power source cables and the breaker interface panel (BIP). See the figure ETSI power-and-ground assembly A0834149 (page 120).

The ETSI hardware must be installed on the NEBS 2000 frame on site as an optional kit (part number A0834149). All of the criteria in Power architecture (page 95) still apply.

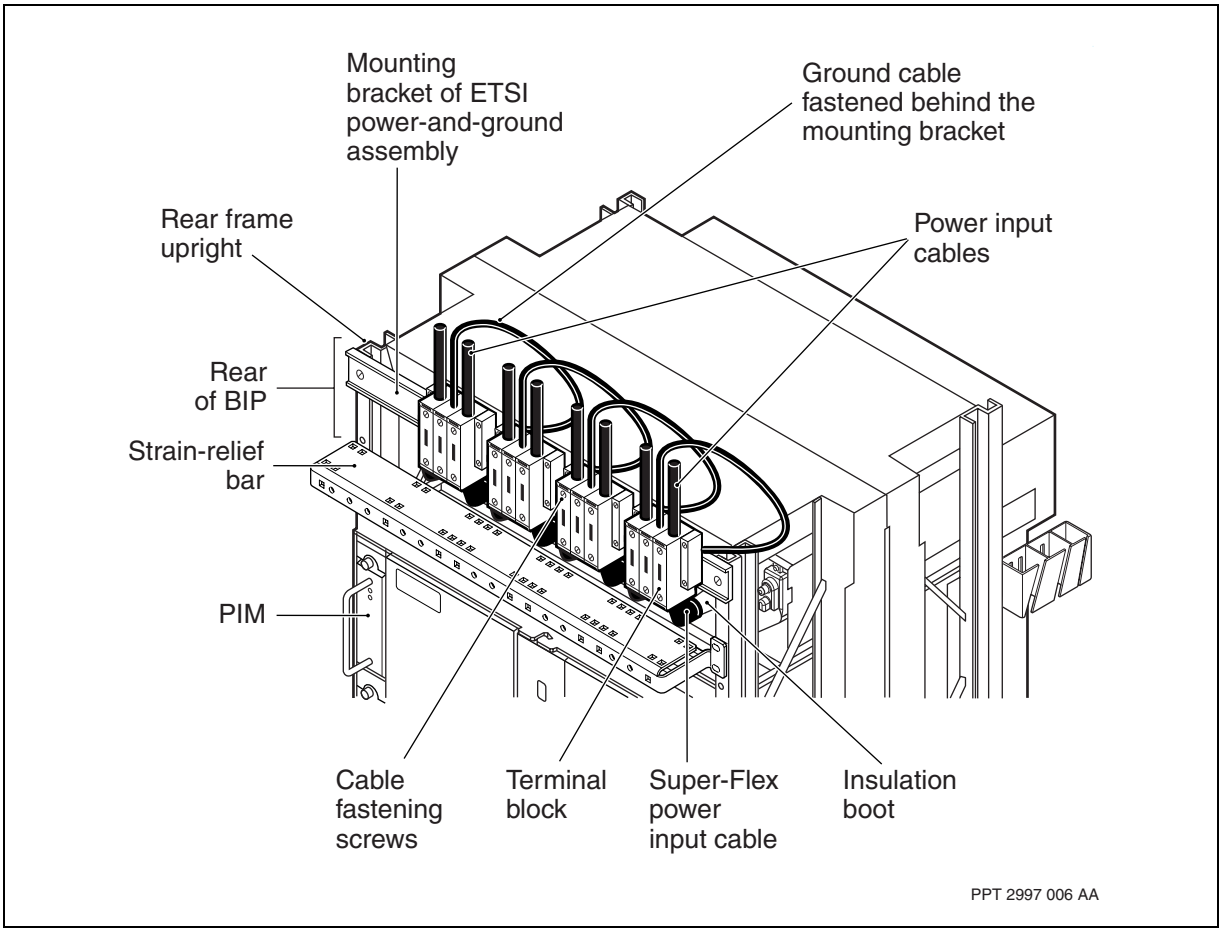
The power cables in the ETSI hardware kit that connect the bottom of the terminal blocks to the BIP studs are provided. The difference with ETSI power cables is that the power cable for this leg is size 1/0 AWG (53.49 mm^2) Super Flex excelene (manufactured by Essex). The cable is rated R +105C 600 V and is cut to measure at 21 cm (8.3 inches). The narrow-tongued 2-hole 90-degree offset 2 AWG lugs used to fasten the power cables to the BIP are included.

When connecting the power input cables to the terminal blocks, bared cable is fastened directly to each block, therefore no special lugs are required.

Before installing the ETSI power-and-ground assembly, the grounding point between the frame and the site ground window must be on the silvery strip at the top front of the frame. The ground cables in the ETSI hardware kit that connect each middle terminal block to the grounding strip across the top rear of the NEBS 2000 frame are also provided. Typically, the grounding cable is 6 AWG (13.3 mm^2) with a matched straight 2-hole lug.

Attention: The ETSI power and ground assembly can accommodate power input cables from No. 6 AWG (13.3 mm^2) up to 2 AWG (33.62 mm^2), including non-Super Flex.

ETSI power-and-ground assembly A0834149



Power cable specifications when using ac rectifiers

When the power and ground setup of a switch uses a system of ac rectifiers as a power source, such an Astec MFA150 power system, the size of the dc cables between the rectifier and the rear of the breaker interface panel (BIP) may be different from a rectifier or a dc power source. For example, the MFA150 without batteries provides up to 50 A, while a dc site plant with batteries can provide up to 100 A. Refer to Power architecture (page 95).

When the system of ac rectifiers is the MFA150, cable kit AP5C90FJ contains electrical hardware to connect the MFA150 to the BIP to power one or two switches. The kit includes:

- 100 m (328 ft) of No. 2 AWG (33.62 mm^2) cable, to be cut equally for the input cables
- for the MFA150, five 1-hole 2 AWG lugs and six 2-hole 5/8-inch lugs
- for the BIP, ten 2-hole 90-degree offset narrow-tongued lugs, which includes two spares

Although the insulation boots that cover the power input studs on the BIP are 1/0 AWG (53.49 mm^2), the connection procedure for cables to the rear studs address thinner cables passing through the boots.

When the ac rectifier setup is installed with an optional power-and-ground assembly, either the polyvalent kit (part number A0834143) or the European Telecommunications Standards Institutes (ETSI) kit (part number A0834149), the size of the dc cables between the rectifier and the terminal blocks of the power-and-ground assembly are calculated according to the distance between endpoints. The kit also provides the power input cables between the terminal blocks and the BIP. When connecting the power input cables to the terminal blocks, bared cable is fastened directly to each block. For more cable information, refer to Power cable specifications (page 114).

With a system of ac rectifiers, the guidelines for voltage drop are the same as for both the ac and dc methods of cabling except for the Note on overprotection. Refer to Allowing for voltage drop over distance (page 106).

CAUTION
Risk of service interruption
An MFA150 power system of ac rectifiers is rated as class A equipment, therefore it requires an appropriately controlled environment for your site setup.

For more information on installing power cables for the MFA150 power system, see the Astec document 167-9021-133 *Advanced Power Systems MFA150 Modular Front Access Power System Detailed Installation Guidelines and Procedures Manual*.

Power and ground cabling overview

The NEBS 2000 frame in which one or two switches are mounted has the versatility to use either top or bottom cable routing for the power feeds and the top frame ground (labeled with the standard icon). A -48/-60 V dc power source is required. It must be reliably connected to ground and must be electrically isolated from the ac source. Before you proceed, review the following information and procedures:

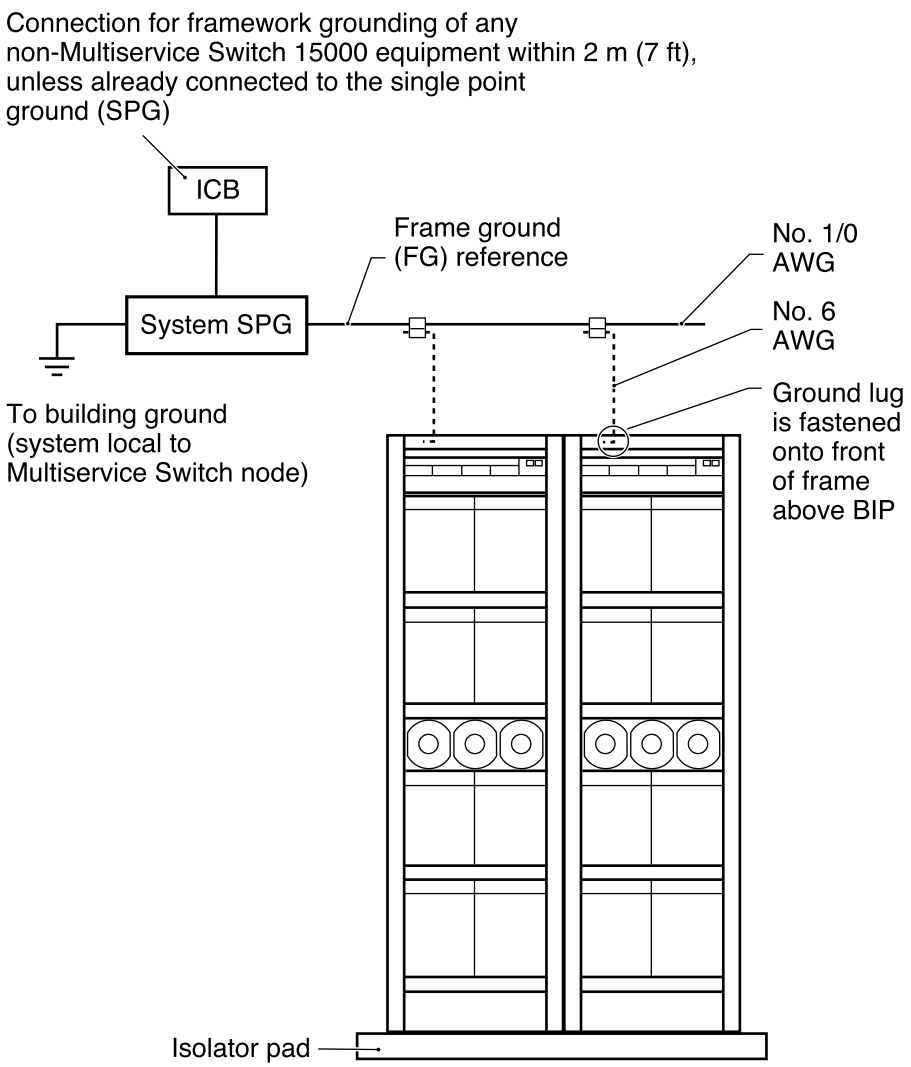
- Grounding topologies (page 122)
- General grounding rules for IBN and CBN topologies (page 124)

Grounding topologies

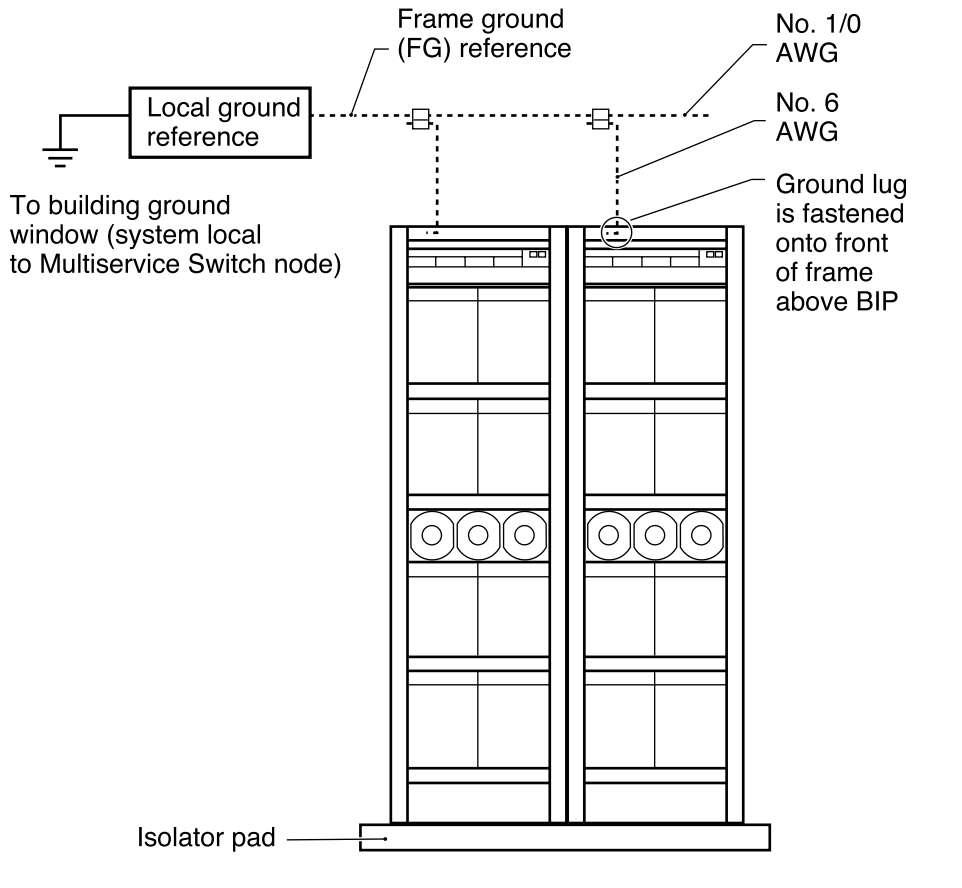
There are three grounding topologies to choose from depending on your location and requirements:

- Isolated bonding network (IBN), which is used in North America and is isolated from the floor (see the figure IBN grounding (page 123))
- Common bonding network (CBN), which is used in North America (see the figure CBN grounding (page 124)
- Mesh-BN, which is the standard for the European Telecommunications Standards Institutes (ETSI). The requirements for this grounding topology are similar to CBN, except that each battery return (BR) must be bonded to the frame ground (FG).

IBN grounding



CBN grounding



General grounding rules for IBN and CBN topologies

The recommended configuration for IBN bonding topologies is that the power feed only IBN equipment. The following rules apply:

- There must be only one single point ground (SPG) for all equipment fed from the power plant.
- All communication equipment must be within one floor of the system SPG.
- Insulate the battery return (BR) bar of the power plant from the power plant framework.
- The BR must be connected to the SPG by a battery return reference conductor.
- The framework of the power plant must be bonded to the FGB of the floor where the power plant is located.
- Grounding conductors must not carry current under normal operating conditions.

If both IBN and CBN equipment must receive power from a common power plant, then the configuration must be restricted to applications such as small CB entities co-located with the IBN equipment. In this case, the following rules apply:

- The SPG for all IBN equipment fed from the power plant must be a non-current carrying section of the insulated battery return bar of the power plant.
- All IBN equipment must be within one floor of the power plant.
- The battery return bar of the power plant must be insulated from the framework and bonded to the FGB.
- The framework of the power plant must be bonded to the FGB.

For an European Telecommunications Standards Institutes (ETSI) topology using mesh-BN, the optional hardware kit is A0834149, which can be ordered with the switch or added later. These rules apply:

- the frame ground (FG) of each cabinet is bonded to the local CBN
- the logical return (LR) is bonded to the FG at each cabinet
- the battery return (BR) is bonded to the local CBN by multiple connections, typically at each power distribution cabinet (for example, a PDC)

Grounding the frame and communication links

This section describes the grounding requirements for a NEBS 2000 frame and communication links. The topics described in the section are:

- Grounding a switch (page 125)
- Grounding the communication links (page 126)

Grounding a switch

Each frame is grounded with a minimum No. 6 AWG cable (13.3 mm^2) and a 2-hole lug. The 2-hole lug is installed in a position on the top of the frame, usually at the front where the universal grounding icon is located. The No. 6 AWG cables are C-tapped into a No. 0 AWG FG collector cable.

With the power-and-ground setup for either the polyvalent (A0834143) or the ETSI (A0843149), the frame ground cable must be fastened at the top front of the frame.

For a NEBS 2000 frame, the frame ground is bonded to the metalwork of the BIP through conductive tape on the frame's uprights and the frame mounting brackets and bolts.

Grounding the communication links

In a system with an isolated bonding network (IBN) grounding topology, care must be taken that communication cables going into and out of the system do not violate the topology. To prevent this, the links must be isolated.

There are two main concerns associated with signal links between IBN systems and other equipment:

- operational concerns, when signals are referenced to different ground potentials (possible signal errors or damages to circuity, or both)
- safety concerns, when metallic connection allows contact between different ground potentials (possible hazard)

Potential differences can occur when signals and shields, or both, are connected to different ground references. This requires specific installation measures to offset any possible hazards or violation. There are three main types of communication cables used in the Nortel Multiservice Switch system: fiber optic cables, shielded twisted-pair, and coaxial cables.

Standards and compliance considerations

Each Nortel Multiservice Switch complies with North American and international regulatory safety requirements for the handling and the installation of equipment. The prerequisite standard is ITU-T K.27 (Bonding Configurations and Earthing Inside a Telecommunication Building).

Attention: Some warnings and cautions in the Multiservice Switch documentation suite appear in German. This complies with requirements for VDE (Verband Deutscher Elektrotechniker).

The standards and compliances that apply to each type of FP are included with the description of each FP type in NN10600-551 *Nortel Multiservice Switch 7400/15000/20000 FP Configuration Reference*.

Navigation

Product safety or regulatory requirements

Each Nortel Multiservice Switch meets the following safety or regulatory requirements:

- Telcordia GR-1089-CORE (Issue 3, October 2002), GR-63-CORE (Issue 2, April 2002)
- FDA 21 CFR Parts 1000 and 1040 for laser products
- IEC 825
- Nortel Networks corporate safety standards 9001

In North America, UL and CSA specifications apply to an input of -48 V dc, wherein the battery return (BR) and the logical return (LR) are properly grounded. The frame ground (FG) and LR are grounded at the shelf and at the ground window.

The BR and the FG/LR are tied together at the ground window.

A Multiservice Switch was tested to, or verified by, CSA for North America (Canada and USA) to CSA C22.2 no. 950/UL 1950, 1995.

A Multiservice Switch was tested to, or verified, using CB reports for international markets according to:

- EN 60950
- IEC 60950 (formerly IEC 950) 1991, 2nd ed., A1:1992, A2:1993, A3:1995, and A4:1997
- CENELEC European Norm EN60950 1992 2nd ed., A1:1993, A2:1993, A3:1995, and A4:1997
- CENELEC EN60825
- AS/NZS 3260

A Multiservice Switch was tested to, or verified by, VDE to:

- EN 60950
- VDE 0805

Grounding standards

WARNING
Risk of equipment damage by improper grounding
All metallic telecom equipment interfaces must be connected only to intra-building or non-exposed wiring or cabling.

WARNING
Risk of radio interference
Multiservice Switch 15000 is a class A product. In a domestic environment this product may cause radio interference, in which case the user may be required to take adequate measures.

WARNING
Risk of radio interference
Multiservice Switch 15000, Multiservice Switch 15000 VSS, and Multiservice Switch 20000 are class A and class B compliant for radio interference.

The references for grounding standards are:

- CSA 22.4 (Canadian Electrical Code)
- ETSI EE-2002 (Earthing and Bonding of Telecommunication equipment in Telecommunication Centers)
- ETSI PRETS 300 253 (Earthing and Bonding of Telecommunication equipment in Telecommunication Centers)
- GR 1089 CORE for grounding and bonding, Issue 3, October 2002
- NFPA70 (US National Electrical Code)
- REA Telecom Engineering and Construction Manual, section 810
- TPH 2253, Telecom Australia (High Ohmic Power and Earthing Guidelines)
- TP01115(U), (Telecom Australia)
- TR-NWT-000295, Telcordia Technical reference, isolated Ground planes: Definition and Application to Telephone Central Offices, July 1992

Powering standards

The references for powering standards are:

- ANSI T1.315-1994, (North American Telcos), Voltage Levels for DC Powered Equipment Used in the Telecommunications Environment, May 1994
- BTR2511, issue 3, British Telecom Requirements for Telecommunication Power Requirements
- DS8171, Issue 2, 60 Hz and -48 V dc Power for DC Powered Telecommunication Equipment, Bell Canada
- ETS 300 132, Draft, Power Supply Interface at the input to Telecommunications Equipment (ETSI)
- FTZ 19, Issue 1, German Telecom Power Requirements (Deutches Bundesposte Telekom, Germany)
- TELEBRAS 240-500-700, General Specifications for DC Powered Telecommunication Equipment, Brazil
- TP00344B, Spec 1550, Issue 1, Telecom Australia / Power Interface Standards

Electromagnetic compatibilities

The references for electromagnetic compatibilities are as follows.

Electrical fast transient

EN 300-386-2

Electrostatic discharge (ESD)

GR-1089-CORE, Issue 3, October 2002
EN 300-386-2

Electromagnetic emissions

FCC Part 15B class A
EN 55022 (CISPR 22 class B)
ETSI 300-386-2
GR-1089-CORE, Issue 3, October 2002
IECS 003

CAUTION
Risk of radio interference
A Multiservice Switch 15000 is a class A product. In a domestic environment this product may cause radio interference, in which case the user may be required to take adequate measures.

Electromagnetic immunity (EMI)

EN 55022
EN 300-386-2
GR-1089-CORE, Issue 3, October 2002

Acoustic noise compliance

A Multiservice Switch meets OSHA 1910.9.

Interconnect compliance

A Multiservice Switch meets:

- these ITU standards for interconnect compliance
  G.707
  G.825
  G.957
- CTR 24 for the E3 metallic interfaces
- ACA TS026, as required
- BAKOM 786 prTA, as required

Quality compliance

A Multiservice Switch meets Nortel corporate quality standards.

Material and manufacturing

A Multiservice Switch meets the material and manufacturing standards of GR-00078.

Other standards

Much of a Multiservice Switch is manufactured with plated metals to ensure no rusting or degradation of ground contact. All non-plated metallic surfaces are painted.

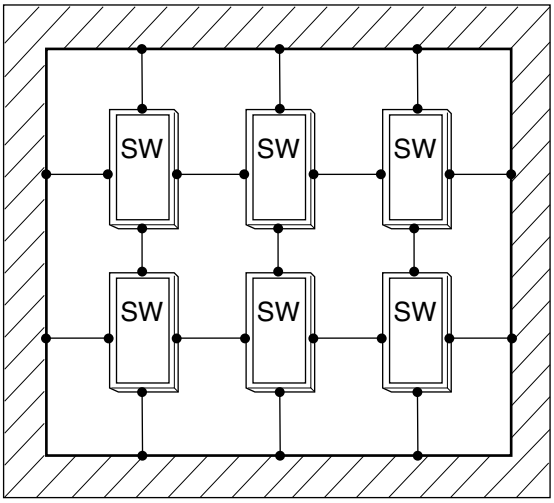
Astec MFA150 standards and compliances

When using an MFA150 power system of rectifiers to provide dc power for a Multiservice Switch, refer to the standards and compliances listed in Astec's document UM6C28C (167-9021-102) *MFA150 Modular Front Access Power System -- NT6C28C User Manual*.

Grounding topologies

Grounding topologies for telecommunications equipment are usually one of three types of bonding networks (BN): mesh, mesh-isolated, and star-IBN isolated. The different types of grounding networks from the International Telecommunications Union standard ITU TS K.27 are shown by the figures Mesh-BN bonding network (page 132), Mesh-IBN isolated bonding network (page 133), and Star-IBN isolated bonding network (page 134).

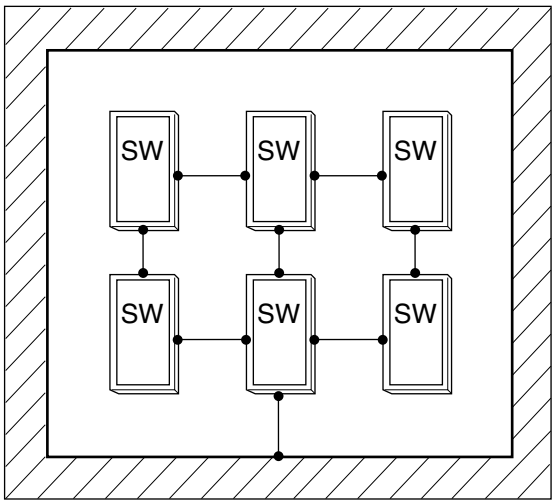
Mesh-BN bonding network



A bonding network in which all associated switch (SW) frames, racks, and cabinets, and usually, the dc power return conductor, are bonded together as well as at multiple points to the common bonding network (CBN). Consequently, the Mesh-BN augments the CBN.

PPT 2819 055 AA

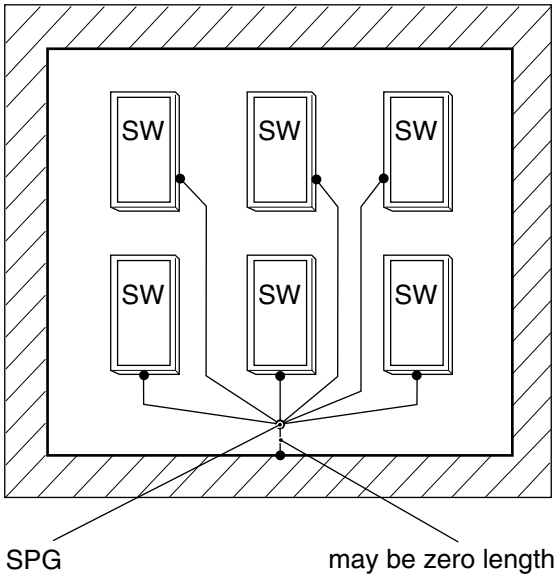
Mesh-IBN isolated bonding network



A type of IBN in which the components of the IBN (for example, equipment frames) are interconnected to form a mesh-like structure. This may, for example, be achieved by multiple interconnections between cabinet rows, or by connecting all equipment frames to a metallic grid (a bonding mat) extending beneath the equipment. The bonding mat is, of course, insulated from the adjacent CBN. If necessary the bonding could include vertical extensions, resulting in an approximation to a Faraday cage. The spacing of the grid is chosen according to the frequency range of the electromagnetic environment.

PPT 2819 056 AA

Star-IBN isolated bonding network



A type of IBN consisting of clustered or nested IBNs sharing a single point ground (SPG) connection.

PPT 2819 054 AA

Nortel Multiservice Switch 15000/20000

Planning Site Requirements

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