SL-1

Automatic Call Distribution

Feature engineering

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About this document

The Automatic Call Distribution (ACD) feature is used to allow several MSL-1 sets (called Agent Positions) to share a large volume of calls made to one or more ACD Directory Numbers (ACD-DNs). Incoming ACD calls are placed in an ACD-DN queue and presented to Agent Positions on a first-in, first-out basis. Similarly, Agent Positions are placed in queues so that the Agent who has been idle the longest is the first presented with a call. More complete information on ACD can be found in the publications listed above.

The SL-1 can be configured to support customers with only the ACD feature, or configured to support both ACD and Private Branch Exchange (PBX) features. When the SL-1 is to serve both ACD and PBX features, the ACD requirements should be calculated first. Any remaining system capacity is then used to serve the PBX customers. Use this Publication to determine how ACD features are added to an existing MSL-1, or to configure an initial MSL-1 dedicated to an ACD application. This publication gives information on how to calculate and assign the following requireemtns for ACD:

—Agent Positions

—Supervisor Positions

—ACD trunk traffic

—Recorded Announcement (RAN) trunks

—Music (MUS) trunks

—Call Registers

Because the information given here applies only to the ACD feature, you should also consult *Engineering and Assignment of Equipment* (553-2001-151 or 553-2201-151) with this publication for overall SL-1 requirements.

Related documents

Automatic Call Distribution (ACD) is a special feature of the Meridian SL-1 which allows a large number of incoming calls to the same directory number (ACD-DN) to be answered at agent positions that share the influx of calls equally. For a complete description of the ACD system, refer to the documents listed below:

553-2671-100 ACD Basic Features Description

553-2671-101 ACD Advanced Features Description

553-2671-102 ACD Management Reports

553-2671-103 ACD Load Management

Some ACD systems utilize an Auxiliary Data System (ADS) which requires additional hardware. Customers with ACD Package D software for Auxiliary Data Systems (ACD-D), should also refer to the Package D documents listed here:

553-2671-103 A1	ACD-D Load management description
553-2671-104	ACD-D Description
553-2671-105	ACD-D Management reports and displays
553-2671-151 A1	ACD-D Engineering, Ordering, and Configuration Information
553-2671-200	ACD-D Interface and software installation
553-2671-310	ACD-D Administration
553-2671-500	ACD-D Maintenance guidelines

The administration of ACD-MAX systems may also require the following publications. Consult with your Northern Telecom representative.

553-2671-120 ACD-MAX Description

553-2671-220 ACD-MAX Installation procedures

553-2671-320 ACD-MAX Reference information

Contents

Traffic engineering

Traffic estimates required

Initial engineering of the ACD feature requires the following information, either from an estimate provided by the customer, or estimated based on a comparison of historical records of other systems equipped with the ACD feature and serving similar applications. If estimates are not available, use the suggested values shown.

The average number of ACD Calls Offered (ACO) at Average Busy Season Busy Hour (ABSBH).

The average agent Direct Call-Processing (DCP) time

—Recommend
Reservations, about 180 s per ACD call
Directory assistence, about 30 s per ACD call

The average agent Post Call-Processing (PCP) time

—Recommend
Reservations, 0 s
Assistence, 30 s per ACD call).

The agent Total DN (TDN) time
total time spent by all agents assigned to an ACD-DN on calls other than ACD calls per hour active

—Recommend 360 s

The High-Day Busy-Hour (HDBH) to ABSBH ratio

—Recommend 1.3

The agent occupancy

—Recommend 92 %
if the traffic load requires 92 agents, 100 should be assumed (allows for pauses, rest periods, etc.).

The Average Speed of Answer (ASA) objective

—Recommend 10 s

The waiting time befor First RAN

—Recommend 20 s

The percentage of connections to Second RAN as a function of First RAN connections

—Recommend 30 %

The basis for provisioning supervisor positions

—Recommend 1 Supervisor for each 35 Agents The system maximum is 40 Agents per Supervisor.

The proportion of ACD calls coming from trunks instead of internal calls

—Recommend 100 %

SL-1 type

On initial configuration of an MSL-1, if the total number of ACD calls offered is known, then the necessary configuration is found by comparing the estimated total number of calls offered with the maximum allowed per machine type. Refer to the appropriate appendix to *Engineering and Assignment of Equipment* (553-2001-151 or 553-2201-151) to find the most current maximum values.

For instance, the followinf machine types have these listed values for calculating traffic capacities:

—an LE can process 6000/3000 ACD calls per hour at 0.35/0.7 s per call, or terminate up to 360,000 call-seconds per hour.

—a VLE can process 16000/6400 ACD calls per hour at 0.13/0.33 s per call, or terminate up to 1,800,000 call-seconds per hour.

—an XN or XT can process 12000/21000 ACD calls per hour at 0.18/0.10 s per call.

For complete details on all machine types, refer to the appropriate appendix to *Engineering and Assignment of Equipment* (553-2001-151 or 553-2201-151).

Values shown depend on queuing, Recorded Announcement (RAN), and Answered/Abandoned Calls. Specific limits may apply to the Auxiliary Data Link (ADL) or Auxiliary Processor (AUX) configuration. Please refer to the *ACD/ADS General Description* (553-2671-104).

Calculating Agent requirements

Use the following formula to determine the Agent Traffic (AT) for each ACD-DN:

AT = (PCO/100) x (DCP + PCP) x F

where:

AT	= agent traffic in CCS
PCO	= peak calls offered; i.e., ACO x HDBH to ABSBH ratio
DCP	= direct call-processing time per call
PCP	= post call-processing time per call
F	= the agent DN time factor; i.e., 3600 divided by (3600 minus the total agent DN (TDN) time per hour).

Example:

AT1 = ([2000 x 1.3]/100) x (120 + 30) x (3600/[3600-360])
= 4290 CCS

AT2 = ([1500 x 1.3]/100) x (200 + 0) x (3600/[3600-1000])
= 5382 CCS

Therefore, the total agent traffic is 4290 + 5382 = 9672 CCS.

Once the Agent Traffic has been calculated, refer to Table 1 for the number of ACD Agents required. If the Agent Traffic is not an exact multiple of 600 CCS (660 CCS for N or XN machines), then use the following formula to determine how many agents are needed:

NA = AT = B/A

where:

NA	= the number of ACD agents required
AT	= the agent traffic
A	= value of agent CCS from Table 2-A which is closest to AT
B	= the number of agents required for the value A in the table.

Example:

NA1 = 4290 x (127/4200) = 130

NA2 = 5382 x (164/5400) = 163

Then, the total number of agents required is 130 + 163 = 293, and the average traffic per agent is 9672/293 = 33 CCS

> ***Note:*** If Automatic Overflow is used between the two queues, then the total Agent Traffic can be used to determine the combined number of Agents required:

NA (with overflow) = (AT1 + AT2) x (B/A)
= 9672 x (290/9600) = 292

Customers can enloy a significant savings in total Agents by making available a larger (combined) number of answering Agents for the combined traffic in certain applications.

Calculating requirements

This part outlines the procedures required to calculate the type of Meridian SL-1 required for the ACD feature. In example, a hypothetical ACD system with the following requirements is shown below. Note that calculations are rounded up to the next higher whole number value.

Two ACD-DN are required, with ACD-DN1 handling 2000 calls per hour, and ACD-DN2 handling 1500 calls per hour.

— For ACD-DN1:
average agent DCP time = 120 s
average agent PCP time = 30 s
agent Total DN time = 360 s per hour
ratio of runk calls = 100 percent.

— For ACD-DN2:
average agent DCP time= 200 s
average agent PCP time = 0 s
agent Total DN time = 1000 s per hour
ratio of runk calls = 50 %

Agent occupancy ≤ 92 % at ABSBH

The ASA objective ≤ 10 s
This is a 4 s average wait in queue plus 6 s to ring the Agent set and answer the call
—Call Forcing reduces it to 1s

Ratio of HDBH to ABSBH traffic is 1.3.

ACD calls delayed 20 s or more receive a 12 s RAN.

Thirty percent of callers who receive First RAN, also receive Second RAN.

Each ACD Supervisor monitors 35 agents and both call queues. Each agent is associated with only one supervisor. Supervisor positions generate an estimated 10 CCS per position.

A Meridian Sl-1 type VLE is required.

Assume an average of 0.22 s per ACD call.
Actual real time per ACD call is dependent on Meridian SL-1 machine type.

Table 1
Number of ACD Agents required

Agent traffic in CCS	Busy time per call in seconds							
	20	**40**	**80**	**120**	**150**	**200**	**300**	**500**
600	20	21	22	22	23	23	24	25
1200	37	38	39	40	41	41	42	43
1800	55	55	57	58	58	59	60	62
2400	73	73	74	75	76	77	78	79
3000	91	91	91	92	93	94	95	97
3600	109	109	109	109	110	111	113	115
4200	127	127	127	127	127	128	130	132
4800	145	145	145	145	145	145	147	149
5400	164	164	164	164	164	164	164	167
6000	182	182	182	182	182	182	182	184
6600	200	200	200	200	200	200	200	201
7200	218	218	218	218	218	218	218	218
7800	236	236	236	236	236	236	236	236
8400	254	254	254	254	254	254	254	254
9000	272	272	272	272	272	272	272	272
9600	290	290	290	290	290	290	290	290
10200	308	308	308	308	308	308	308	308
10800	327	327	327	327	327	327	327	327

Calculating ACD trunk traffic

Use the following formula to determine Trunk Traffic:

TT = THT x (B/A) x (TF/100)

where:

TT	= trunk traffic in CCS
THT	= trunk holding traffic (PCO x [DCP + ASA])/100
PCO	= peak calls offered (ACO x HDBH to ABSBH ratio)
DCP	= direct call-processing time per call
ASA	= average speed of answer
ACO	= average calls offered
A	= agent CCS from Table 2-B closest to THT
B	= trunk traffic for value A from Table 2-B
TF	= percentage of ACD calls from trunks

Example:

TT1 = ([2000 x 1.3 x (120+10)]/100) x(3240/3000) x (100/100)
= 3650 CCS

TT2 = ([1500 x 1.3 x (200+10)]/100) x(3773/3600) x (50 x 100)
= 2150 CCS

Then the total Trunk Traffic (TT) is 3650 + 2150 = 5800 CCS.

Table 2
ACD total Trunk Traffic (TT) in CCS

Agent traffic in CCS	Trunk holding time per call in seconds							
	20	**40**	**80**	**120**	**150**	**200**	**300**	**500**
600	841	722	662	647	633	627	617	610
1200	1702	1466	1344	1294	1276	1258	1238	1224
1800	2579	2209	1998	1934	1916	1884	1857	1832
2400	3251	2890	2673	2587	2544	2507	2474	2447
3000	4022	3571	3346	3240	3187	3140	3098	3057
3600	4792	4252	3982	3892	3892	3773	3711	3666
4200	5564	4933	4618	4513	4471	4406	4333	4281
4800	6336	5615	5255	5135	5087	5039	4956	4896
5400	7091	6281	5876	5741	5687	5633	5579	5502
6000	7866	6966	6516	6366	6306	6246	6186	6116
6600	8641	7651	7156	6991	6925	6859	6793	6736
7200	9417	8337	7797	7617	7545	7473	7401	7344
7800	10193	9023	8438	8234	8165	8087	8009	7947
8400	10970	9710	9080	8870	8786	8702	8618	8551
9000	11746	10396	9721	9496	9406	9316	9226	9154
9600	12523	11083	10363	10123	10027	9931	9835	9758
10200	13300	11770	11005	10750	10648	10546	10444	10363
10800	14072	12452	11642	11372	11264	11156	11048	10962

Calculating RAN requirements

The Recorded Announcement (RAN) feature does not make use of conference cards. Each RAN trunk is connected to only one ACD call at a time, but only for the duration of the RAN message. The RAN machine is assigned to one or more RAN trunks grouped by software into trunk routes.

A continuous RAN source can serve more than one trunk route and more than one trunk in a route. However, different RAN sources require different RAN trunk routes. Stop/start RAN machines can only be assigned to one customer and one RAN trunk route. For example, if the First RAN is different from the Second RAN, they need different RAN trunk routes. If a RAN is used for Night Treatment, it may require its own RAN trunk route. If, on the other hand, it is decided to use the same RAN trunk message for Second RAN as for First RAN and Night Treatment, then the same RAN trunk route can be used.

Use Table 3 and the Trunk Holding Traffic (THT) CCS from Table 2 to find the number of First RAN trunks required. If the Trunk Holding Traffic (THT) is not an exact multiple of 600 CCS (or 660 CCS for N and XN machines), then use this formula to find the number of First RAN trunks required:

NRT = THT x (B/A)

where:

NRT = number of First RAN trunks required
THT = Trunk Holding Traffic CCS, in the ACD Trunk Traffic calculations
A = Agent CCS from value closest to THT
B = number of First RAN trunks required for the value of A

Example:

NRT1 = 3380 x (12/3000) = 14 First RAN trunks required

NRT2 = 4095 x (10/3600) = 12 First RAN trunks required

The number of trunks for the Second RAN is found by multiplying the number of First RAN trunks by the specified (or assumed) factor. This

serves as a value to start with, and may have to be modified as a result of ACD Management Reports data when available.

Example:

NRT1 requires 14 x 0.3 = 4 Second RAN trunks

NRT2 requires 12 x 0.3 = 3 Second RAN trunks

Therefore, the total number of RAN trunks required is 14 + 4 + 12 + 3 = 33.

Assume that the traffic on each RAN trunk is the same as the individual Agent (33 CCS). Then, the total RAN trunk Traffic (RT) is 33 x 33 CCS = 1089 CCS.

Table 3
Number of First RAN Trunks required

Trunk traffic in CCS	Trunk holding time per call in seconds							
	20	**40**	**80**	**120**	**150**	**200**	**300**	**500**
600	15	11	6	5	5	4	3	2
1200	27	16	10	8	7	6	5	3
1800	39	22	14	10	9	7	6	4
2400	—	28	17	12	11	9	6	5
3000	—	—	19	14	12	10	7	6
3600	—	—	22	15	13	11	8	7
4200	—	—	24	15	13	11	9	7
4800	—	—	28	18	16	13	9	8
5400	—	—	31	21	18	15	11	8
6000	—	—	—	23	20	17	12	9
6600	—	—	—	26	19	18	13	10
7200	—	—	—	28	24	19	14	10
7800	—	—	—	30	25	19	15	10
8400	—	—	—	32	26	20	15	11
9000	—	—	—	33	27	21	16	12
9600	—	—	—	34	28	22	17	13
10200	—	—	—	35	29	23	18	13
10800	—	—	—	36	30	24	18	14

Calculating network loops

Each network loop can handle up to 600 CCS (660 CCS for N or XN machines) of ACD trunk traffic. Use the following formula to find the number of network loops required:

L = TT/600 or TT/660

where:

L = the number of network loops required
TT = the total ACD trunk traffic.

Example:

L = 5800/600 = 10 network loops.

Supervisor Positions required

In theory, one ACD Supervisor can monitor up to 40 ACD Agents. However, if the Supervisor is required to handle some ACD calls or perform normal administrative functions, then assigning that Supervisor to 40 Agents is not practical.

For our hypothetical ACD system, we have arbitrarily assigned 35 Agents to each Supervisor. Our calculations show that ACD-DN1 requires 130 agents and ACD-DN2 requires 163 agents. Based on 35 Agents per Supervisor, ACD-DN1 needs four Supervisors and ACD-DN2 would need five Supervisors assigned.

Note: Agent-to-supervisor assignments need not be related to Agent-to-ACD-DN assignments. The customer can choose any combination or configuration to meet operational needs.

Calculating network loops and RAN trunks

Use the following formula to determine the number of network loops required to serve the agents and RAN trunks:

L = (AT + RT)/750

where:

L = the number of network loops required
AT = the total agent traffic in CCS
RT = the total RAN trunk traffic in CCS (including second RAN).

Note: If (AT + RT) is less than 2000, divide by 600 (or 660 for N or XN machines) rather than 750.

Example:

L = (9672 + 1089)/750 = 15 network loops.

Note: If Agent Positions require multiple appearance DN keys, the "same loop" restriction must be observed (see Assignment Guidelines). This can increase the total number of Agent loops required.

In the most cases, one network loop is more than enough to handle all traffic generated by Supervisor positions. Agents, ACD trunks, and RAN trunks should not be assigned to a loop which has Supervisor positions assigned to it. Other PBX traffic can use any remaining capacity on a loop which has Supervisors assigned to it. In our example, a total of 16 network loops are required to serve the Agents, RAN trunks, and Supervisors.

Assignment guidelines

Once the number of Agents, RAN trunks, etc., have been determined, they can be assigned to the required network loops. Use the following guidelines for an equal distribution of traffic:

— Assign the ACD requirements first, in a system sharing ACD with PBX features. The remaining capacity is then assigned to serve PBX lines and trunks.

— Agents and RAN trunks should be assigned together on loops separate from all other traffic. Distribute the Agents and RAN trunks as evenly as possible over all such loops. Assign Supervisor positions to a loops which are not associated with ACD Agent traffic.

— Assign ACD trunks to dedicated loops, 600 CCS per loop maximum, or 660 for N or XN machine types.

— Intermix Agent Positions for the various ACD-DN on each loop, if applicable.

— For multiple network group configurations, assign the ACD Agent and trunk loops over as *few* network groups as possible to minimize junctor blocking.

— Music and RAN trunks must not be assigned to the same trunk circuit pack.

— When assigning Music trunks, remember that these trunks cannot be accessed between network groups. A Music trunk must be provided for each network group with Music On Hold or Music On Delay assigned. These trunks can be assigned to the same Music route and/or Music source if desired.

Table 4
Example: Assigning RAN Trunks for Agents & Supervisors

Loop	NA 1	NA 2	NR T1	NR T2	SU PV1	SU PV2
1	9	10	3			
2	9	10	2	1		
3	9	10	1	1		
4	9	11	1	1		
5	9	11	1	1		
6	9	11	1	1		
7	9	11	1	1		
8	9	11	1	1		
9	9	11	1	1		
10	9	11	1	1		
11	8	11	1	1		
12	8	11	1	1		
13	8	11	1	2		
14	8	11	1	2		
15	8	11	1	4		
16					4	5
Totals	**130**	**163**	**18**	**19**	**4**	**5**

Note: Loops 1-7 would be in one network group, while loops 8-15 would be in a multiple network group configuration. The loop for Supervisors, ACD trunks, Music, and Conference would also be split between the two network groups.

Calculating call register requirements

Use the following formula to find the number of call registers required to serve the ACD feature:

NCR = ([TT x R] + Y)/Z

where:

NCR = the number of call registers
TT = the total ACD trunk CCS
R = the ratio of HDBH traffic to ABSBH traffic (1.3)
Y = 128 when ACD trunk CCS is 1400 or less
= 815 when ACD trunk CCS is more than 1400
Z = 25.5 when ACD trunk CCS is 1400 or less
= 33.8 when ACD trunk CCS is more than 1400

Example: NCR = ([5418 x 1.3] + 815)/33.8 = 233 call registers

Note: Each call register occupies space in the unprotected data store portion of the Meridian SL-1 memory. Refer to *Engineering and Assignment of Equipment* (553-2001-151 or 553-2201-151) and the appropriate appendix to determine how much unprotected memory is required to serve the call registers.

Conference packs for Music On Delay

Music can be provided to calls waiting in an queue after First and Second RAN. The music comes from a Music source via a RAN trunk dedicated to Music, and is connected to the delayed calls via a conference circuit pack in a broadcast mode. The Music trunk constitutes one of the conference parties, and the remaining parties are calls eligible to receive Music On Delay.

The total conference traffic for the Meridian SL-1 depends on these factors:

- number, size, and holding time of multi-party conferences
- temporary use of the Conference feature by other features (for example, Call Transfer).

Because these factors can vary greatly, the total conference traffic is hard to calculate exactly. In general, one conference loop is provided for each half-network group to handle maximum conference loads and to provide enhanced reliability. See *Engineering and Assignment of Equipment* (553-2001-151 or 553-2201-151).

For ACD, the total expected Music traffic depends on the following factors:

- The number of calls/hour arriving at the ACD, and the percentage of these calls receiving First RAN.
- The average waiting time for each ACD call connected to Music, minus an allowance for repeat connections to Second RAN.

Unexpected increases in ACD traffic or answering delay, can increase the percentage of calls connected to RAN. This in turn can cause a sharp increase in the number of calls being conferenced into Music On Delay. For this reason, the Music feature is designed on a "worst-case" basis. One additional conference loop (per network group) assigned to Music On Delay is generally sufficient even for a large ACD system. This conference loop requires one music trunk. Since the Music conference operates in a broadcast mode only, up to 29 calls can be conferenced with music simultaneously. Refer to *Features and Services Description* (553-2311-105), for a complete description of the Music feature and enhancements.

N ***o*** ***t*** ***e*** ***:*** This loop can still be used for non-music conferences, if ports are available at any time. Music cannot be accessed across network groups.

Each network group equipped for music should be provided with at least *two* conference cards. Each network group with trunks or stations able to receive Music must have a music conference loop with a music trunk assigned to it. The music trunks can share the same music source and be

members of the same trunk route. Music trunks cannot be shared between customers or network groups. Each music source requires a separate trunk route. All RAN trunks on a RAN circuit card must terminate on the same RAN machine or music source; music trunks cannot be on the same card as RAN trunks.

The conference loop for Music On Delay should be selected from the lower network loops of a network group. This is because the MSL-1 begins searching for regular conference ports with the higher-numbered conference cards, and will minimize conflicts with the music conference.

Output buffer and memory requirements

Refer to *Engineering and Assignment of Equipment* (553-2001-151 or 553-2201-151) and the appropriate appendix to determine the impact of the ACD feature on Meridian SL-1 output buffers and memory.

List of terms

This section lists, by alpha-numeric order, the acronyms, abbreviations, and initializations used in this document.

ABSBH

Average Busy Season Busy Hour

ACD

Automatic Call Distribution system

ACD-DN

ACD-Directory Number

ACO

ACD Calls Offered

ADL

Auxiliary Data Link

ADS

Auxiliary Data System

ASA

Average Speed of Answer

AT

Agent Traffic

AUX

Auxiliary Processor

CCS
Centi Call Seconds ("hundreds" of call seconds)

DCP
Direct Call Processing

DTOT
Daily Totals report command

FORC
Call Forcing feature

FRRT
First RAN Route assignment

FRTT
First RAN Route Timer

HDBH
High Day Busy Hour

LAGP
List Agent Priorities command

MSB
Make Set Busy capability

MURT
Music trunk Route

MUS
Music On Hold feature

NCR
Night Call Register requirement

NITE
Nite Forwarding number assignment

NRRT
Night RAN Route Assignment

PCO
Peak Calls Offered

PCP
Post Call Processing

POS-ID
ACD Agent Position Identifier.

RAN
Recorded Announcement feature

RGA
Ring Again feature

RT
total RAN trunk Traffic

SPCP
Separate Post-Call Processing option

TDN
Total Directory Number

THT
Trunk Holding Traffic

TOF
Time Overflow feature

TOFT
Time Overflow Timer

TSF
Telephone Service Factor

TSFT
Telephone Service Factor Timer

TT
Trunk Traffic

TTY

Teletypewriter

VDT

Video Display Terminal

SL-1

Automatic Call Distribution

Feature engineering

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