Radio Access System Overview

RU10 Release

Nokia Siemens Networks Academy

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Document change history

Date	Version	Name	Change comment
14.04.2009	1.0	Suriansyah	Draft – Updated to RU10

Content

- RAN Architecture and Interfaces
- RAN Functionalities
- NSN RAN Roadmaps
- NSN RAN Solution
- RAN Operation and Management

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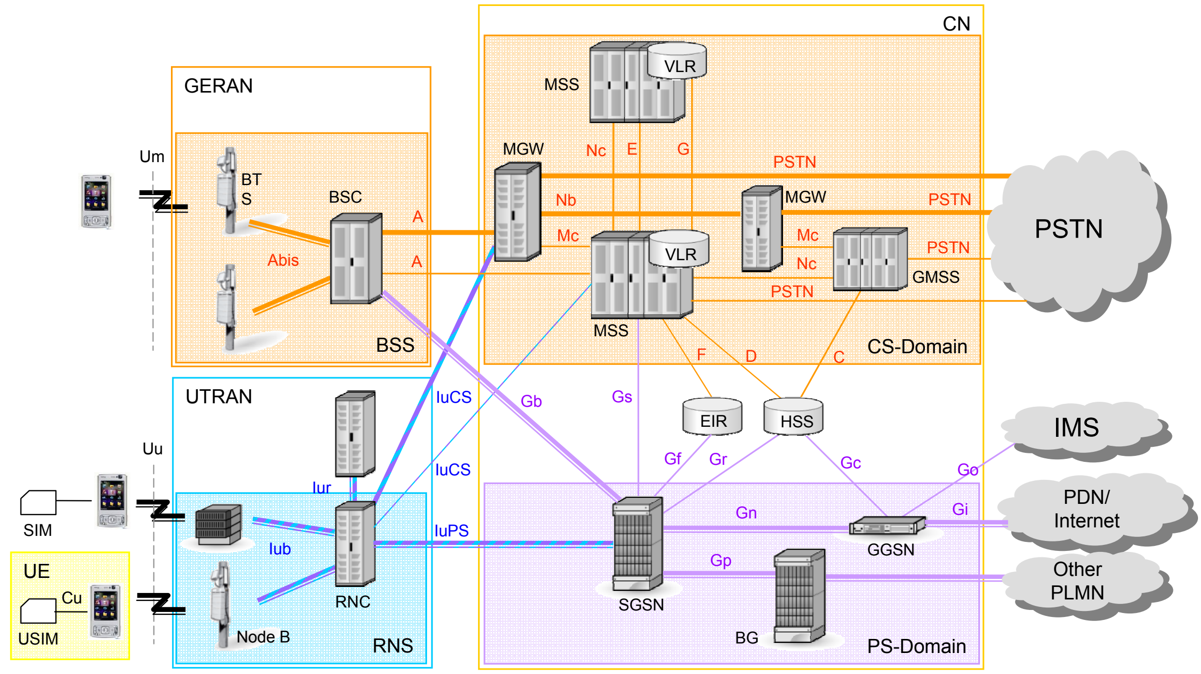
UMTS Generic Architecture



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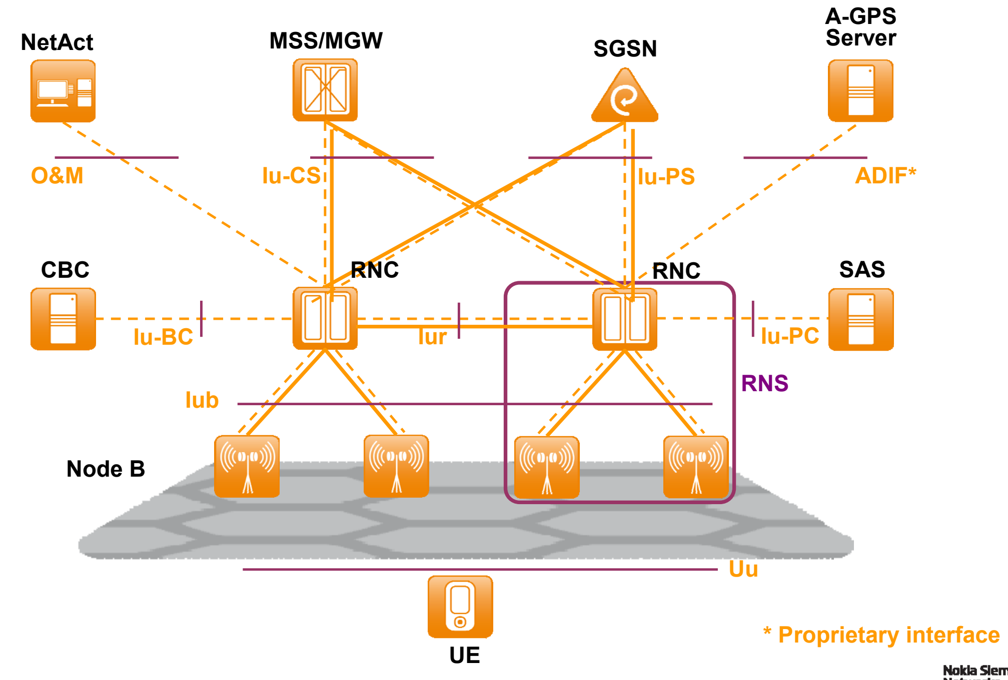
The general idea in UMTS is to harmonise the CN with GSM/GPRS as much as possible. This can be done since there is no major difference in how subscribers or charging are handled in both systems. Therefore, CN is constituted of a Circuit Switched (CS) domain and a Packet Switched (PS) domain which have the same main elements as is GSM/GPRS beside the CN common elements.

The biggest change is in the UMTS Radio Access Network that introduces several new functions and a totally new air interface. The Radio Access Network is controlled by a Radio Network Controller (RNC), unlike the Base Station Controller (BSC) in a GSM network. In the 3GPP specification, the WCDMA BTS is referred to as Node B.

RAN Architecture and Interfaces



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WCDMA Radio Access Network (WCDMA RAN)

WCDMA RAN consists of one or more Radio Network Subsystem (RNS) where each RNS is constructed by a Radio Network Controller (RNC) and its controlled Node Bs. The main function of WCDMA RAN is handling all radio-related functionalities and managing radio resources in a 3G network. In addition, WCDMA RAN also handles telecommunication management for Circuit-switched and Packet-Switched traffic in a 3G network.

The standardised interface between RNCs is called Iur, and interface RNC – Node Bs is called Iub.

Core Network

Core Network (CN) is responsible for routing calls, data connections or other defined services to external network as well as handling user mobility.

RAN interface toward Switching Core Network (SCN) is called Iu-CS, and it is implemented by connecting RNC to MSC Server (MSS) for control plane and to Multimedia Gateway (MGW) for user plane.

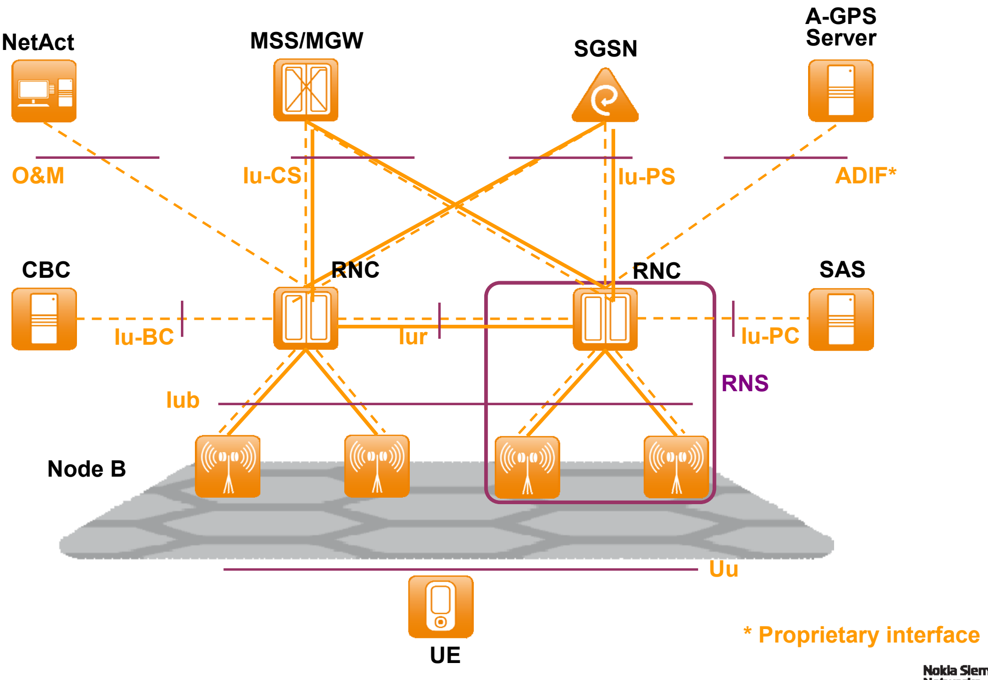
RAN interface toward Packet Core Network (PCN) is called Iu-PS, and it is implemented by connecting RNC to Serving GPRS Support Node (SGSN).

RAN interface toward Cell Broadcast Center (CBC), for Cell Broadcast Service (CBS), is called Iu-BC.

RAN interface toward Positioning Center (PC), for Location Service (LCS), is called Iu-PC. It is implemented by connecting RNC to Standalone SMLC (SAS).

NSN also provides alternative solution for LCS, which is implemented by connecting RNC directly to A-GPS server. For this solution, the position calculation is done by RNC. The proprietary interface toward A-GPS server is called A-GPS Data Interface (ADIF)

RAN Architecture and Interfaces



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Operation Support System

Operations Support System (OSS) is common for both 2G and 3G networks. The same management system is used for managing both the network and the services provided. In the NSN 3G solution, NetAct Framework is used for this task. The O&M interface toward OSS, called Network Interface for 3rd Generation Network (NWI3), is a CORBA based interface.

RAN Functionalities

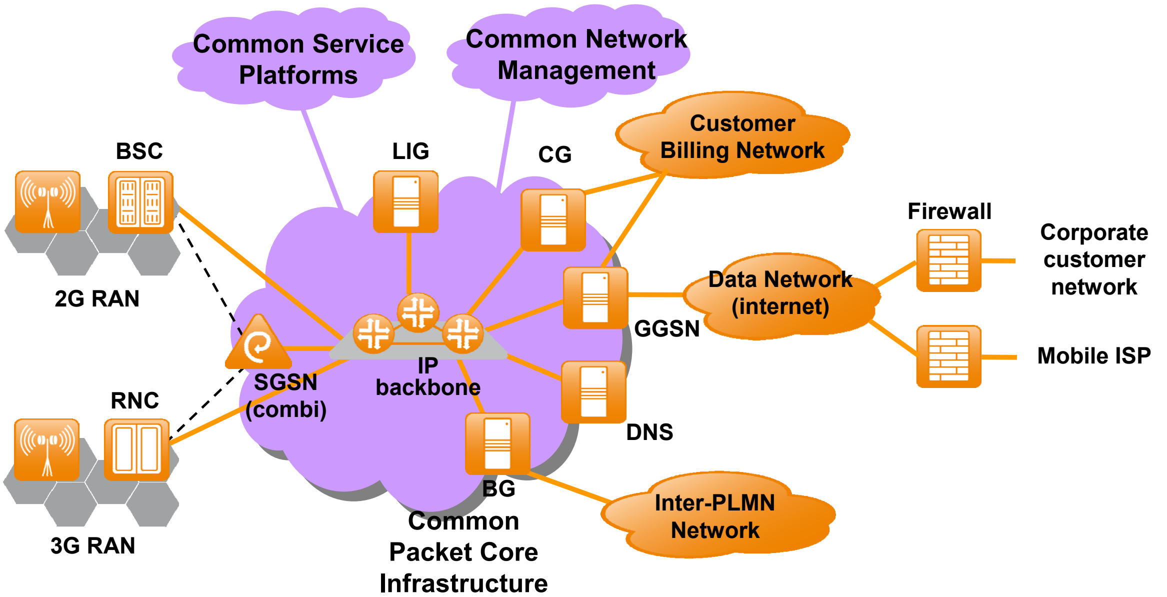
3GPP TS 25.401

- Transfer user data
- Functions related to overall system access control
- Radio channel ciphering and deciphering
- Functions related to mobility
- Functions related to radio resource management and control
- Synchronisation
- Functions related to broadcast/multicast services
- Tracing
- Volume reporting
- RAN information Management
- Functions related to MBMS

The following are RAN functionalities defined in 3GPP specification number TS 25.401. RAN may have more functions in newer release.

1. Transfer user data. This function provides user data transfer capability across the UTRAN between the Iu and Uu reference points.
2. Functions related to overall system access control (e.g. admission control, congestion control, system information broadcasting, etc.)
3. Radio channel ciphering and deciphering. This function is a pure computation function whereby the radio transmitted data can be protected against a non-authorised third-party.
4. Functions related to mobility (e.g. handover, SRNC relocation, positioning, NAS node selection function, shared network access control, etc.)
5. Functions related to radio resource management and control
6. Synchronisation
7. Functions related to broadcast/multicast services
8. Tracing. This function allows tracing of various events related to the UE and its activities.
9. Volume reporting. This function is used to report the volume of unacknowledged data to the CN for accounting purpose.
10. RAN information Management. This function is a generic mechanism that allows the request and transfer of information between two RAN nodes.
11. Functions related to MBMS

Rel.7 Packet Switched Network



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Radio Access Network access the PS Core network through SGSN. With the introduction of Combi SGSN, both 2G and 3G RAN are connected to the same network element in the PS Core Network. The implementation of Iu-PS over IP in RU10 allows the RNC to be directly connected to IP backbone.

Functionalities Split Between Network Elements

Functionality	SGSN	RNC	BSC
Authentication	X		
Interaction with HLR, MSC/VLR	X		
Charging and Statistics	X		
Interface toward OSS	X	X	X
GTP Tunnelling	X	X	
Radio Protocol to IP conversion	X*	X	
Ciphering	X*	X	
Compression	X*	X	
Mobility Management	X	X**	
High Capacity Routing	X	X	
IP Telephony	X	X	
Real-time Multimedia	X	X	

* in case of 2G RAN
** URA concept

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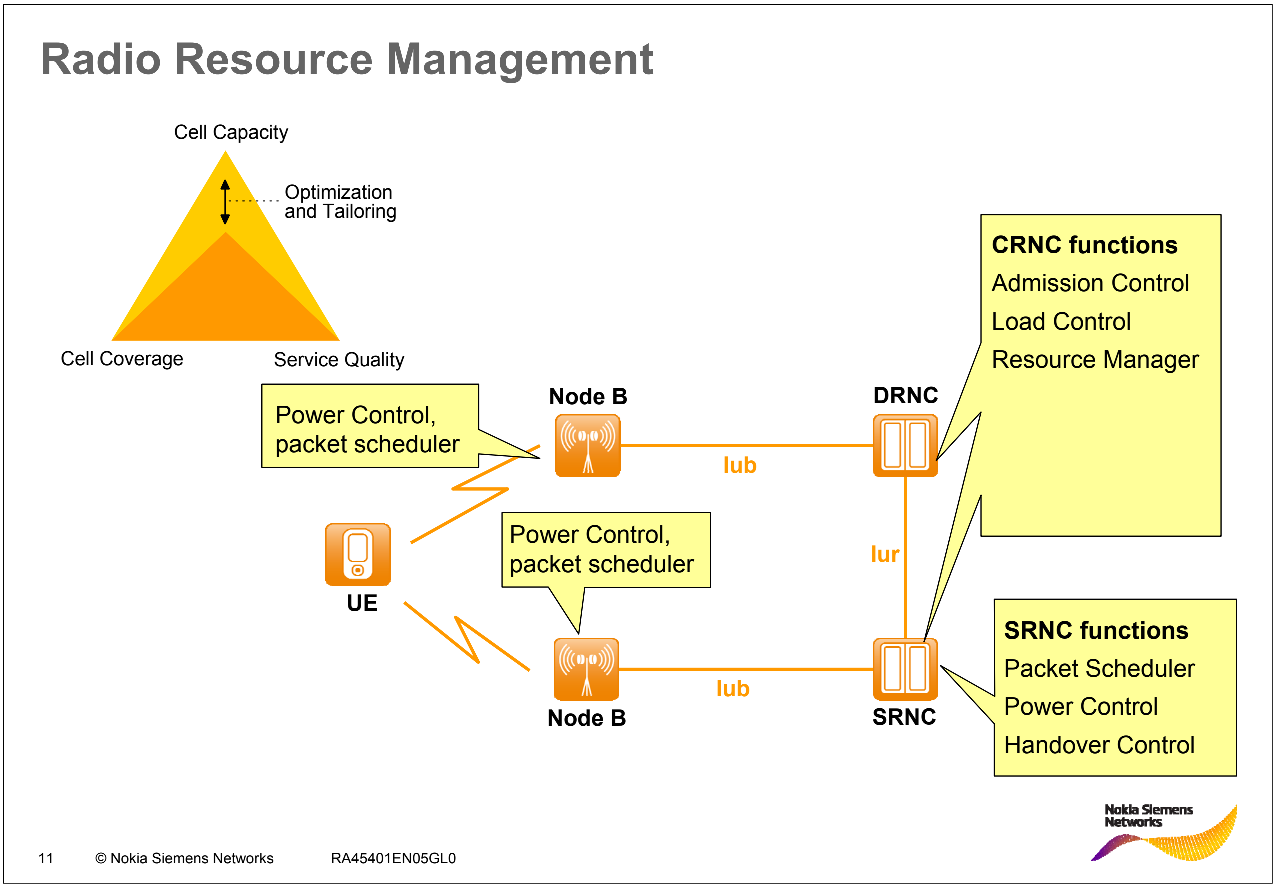
Some functionalities in handling packet data traffic are shifted from SGSN to RNC, e.g. Radio Protocol to IP conversion, Ciphering and Compression. Another packet data handling function, i.e. GTP tunnelling is implemented between RNC – SGSN, besides SGSN – GGSN.

The ciphering is done in RLC layer of radio interface protocol, while IP packet compression is handled by PDCP layer. The RAN also has mobility concept which is implemented by UTRAN Registration Area (URA) to support packet data operation.

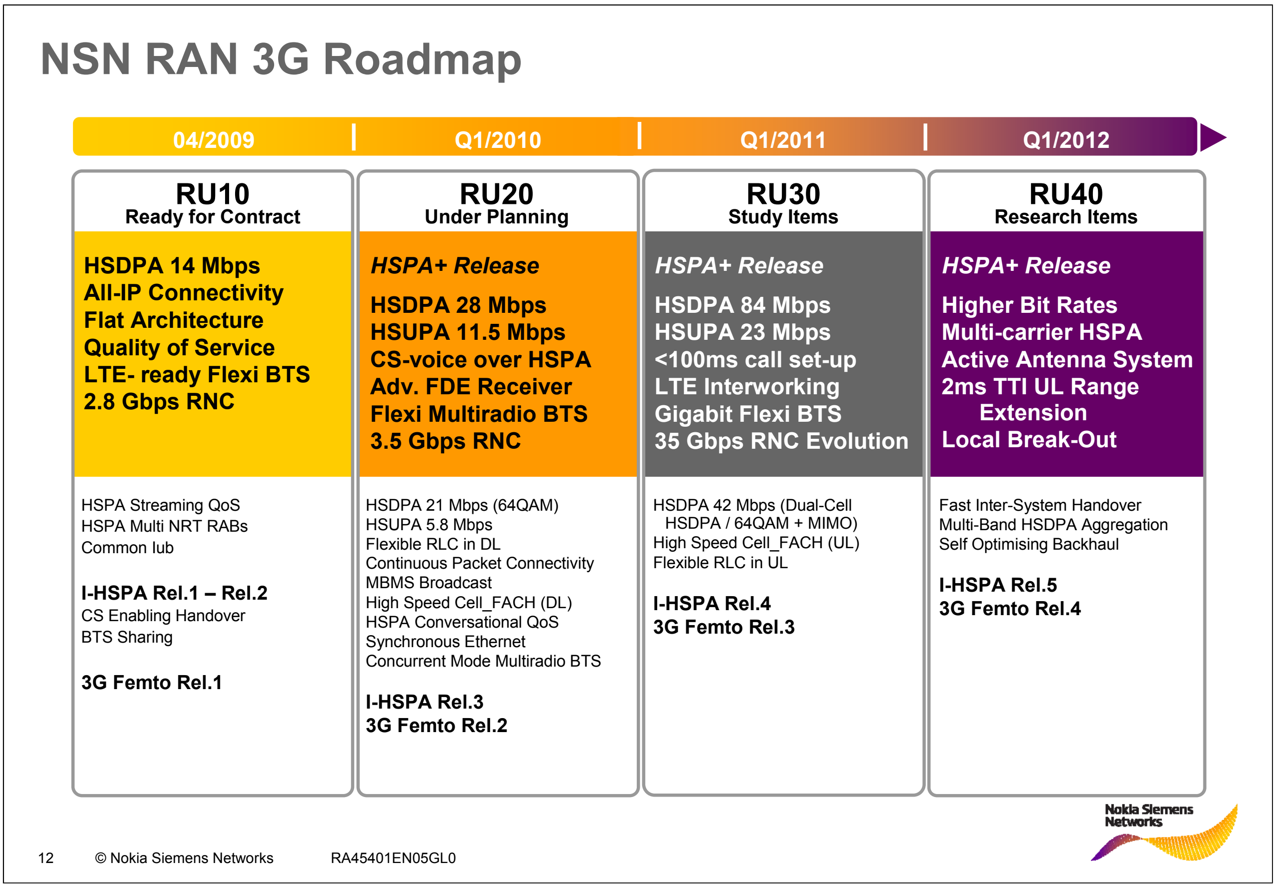


The goal of Radio Resource Management (RRM) is to ensure that the radio network capacity is used as efficiently as possible, i.e. radio access network offers high capacity, maintains the planned coverage area and the required quality of service. In WCDMA, the radio resources are defined in terms of transmission power, received wideband power, logical codes, BTS HW, Iub/Iur transport, and RNC HW.

To achieve the goal, RRM algorithms are implemented on the RAN Network Elements. They are:

- Cell-based algorithms, i.e. Admission Control (AC), Packet Scheduler (PS), Load Control (LC) and Resource Manager (RM).
- Connection-based algorithms, i.e. Power Control (PC) and Handover Control (HC)

In case of HSPA connection, the packet scheduler is shifted to Node B



The key drivers of NSN WCDMA/HSPA evolution are:

- Best user experience with the leading HSPA capability and evolution e.g. 40% lower latency, real service differentiation (QoS) and extended terminal battery use time
- Lowest Total Cost of Ownership (TCO). Typically 20-30% less sites and less site cost with Flexi BTS. Flexi BTS SW upgradeable radio, baseband, and transport reduces site visits 50-90%. Most cost efficient RNC and unique Flat Architecture option with I-HSPA data network. Leading WCDMA 900MHz refarming solution with unique 4.2MHz carrier bandwidth and with faster and more accurate planning with NetAct Optimizer.
- Greenest 3G network with lowest power consumption and typically 70% lower CO2 emissions
- Shortest time to revenue with Flexi BTS true SW upgradeability.

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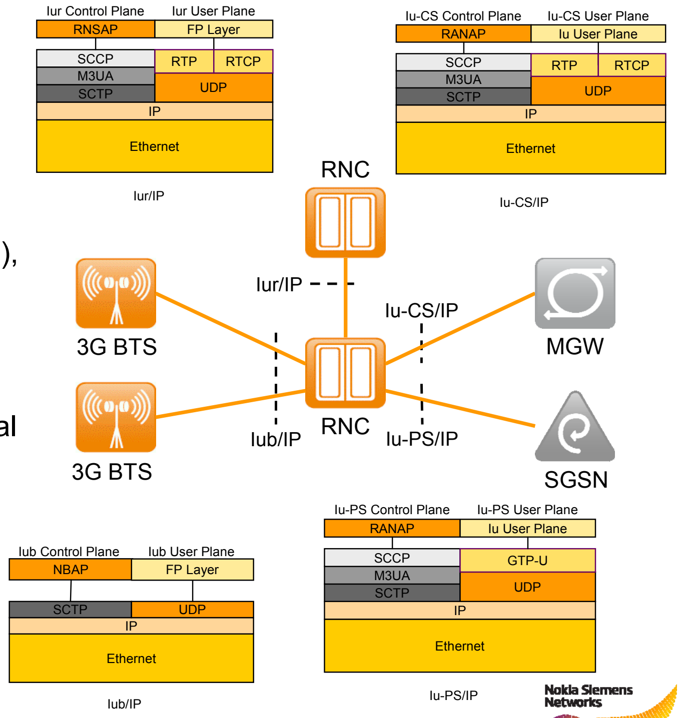
All-IP Connectivity Solution in RU10

- Provides 3GPP compliant IPv4 transport option for all RNC interfaces
- Allows to use IP and/or Ethernet connectivity from RNC towards to
  - core networks (Iu-CS and Iu-PCS),
  - other RNCs (Iur) and
  - base stations (Iub)
- New features available are:
  - Gigabit Ethernet Interfaces (optical and electrical)
  - IP based Iu-PS, IP based Iu-CS
  - IP based Iur
  - IP based Iub



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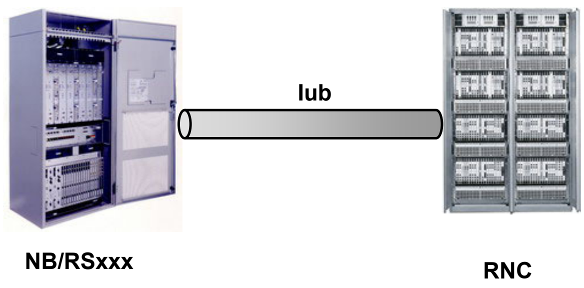
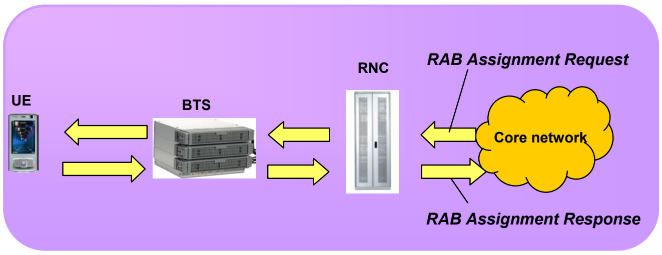
C-Iub: S-NB Operability in N-RNC

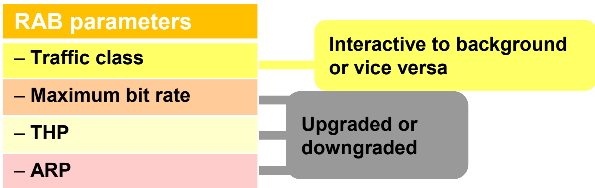
- This feature defines the basic O&M functions in the common NBAP interface
  - BTS initialization
  - BTS logical resource management
  - BTS and RNC recovery



PS RAB Reconfiguration



- PS RAB parameters can be reconfigured.
- It allows the deployment of single APN and UEs.
- The usage of network resources is optimized when the QoS parameters in the network are aligned with the QoS requirements of the service.



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SGSN or UE can request the RAB reconfiguration procedure if there is a need to modify the characteristics of a RAB service. To the RAN the reconfiguration is triggered by the CN with a RAB Setup message requesting reconfiguration of the existing RAB.

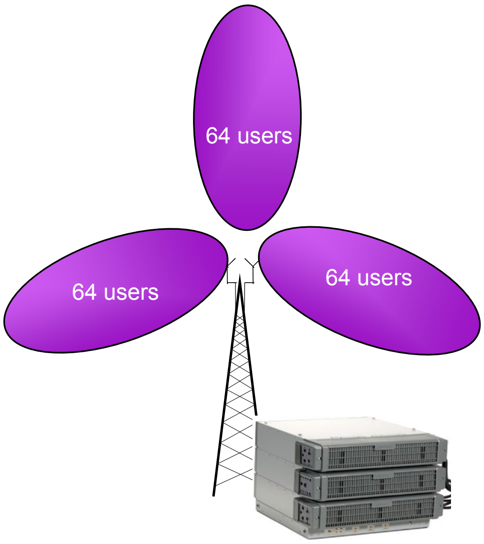
The following RAB parameters can be changed for the interactive and background traffic class RABs:

- Traffic class interactive <-> background
- Maximum bit rate (UL/DL)
- Change of Traffic Handling Priority (THP) of an interactive RAB
- Change of Allocation and Retention Priority (ARP)

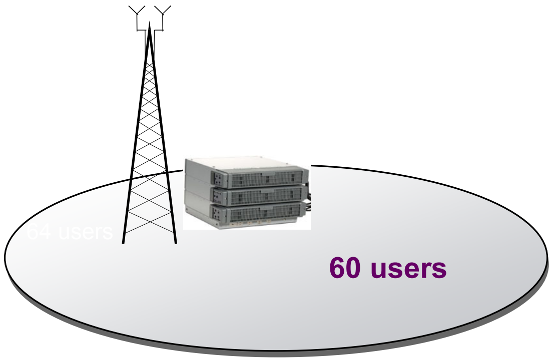
RNC reconfigures the RNC and BTS with the new RAB/SPI parameters after receiving the RAB reconfiguration request from CN.

HSPA Solution

HSDPA 64 users / cell

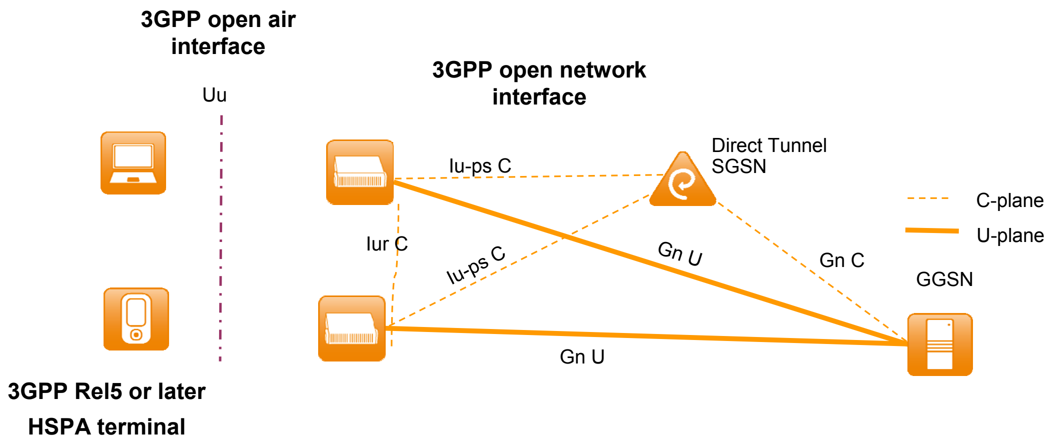


HSUPA 60 users / bts



I-HSPA Architecture and Interface

- I-HSPA is a simplified flat architecture network
- Standard 3GPP packet core
- RNC HSPA functionality integrated to Node B
- Standard 3GPP HSPA terminal



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I-HSPA is part of 3GPP R7 HSPA Evolution Work Item. It specifies

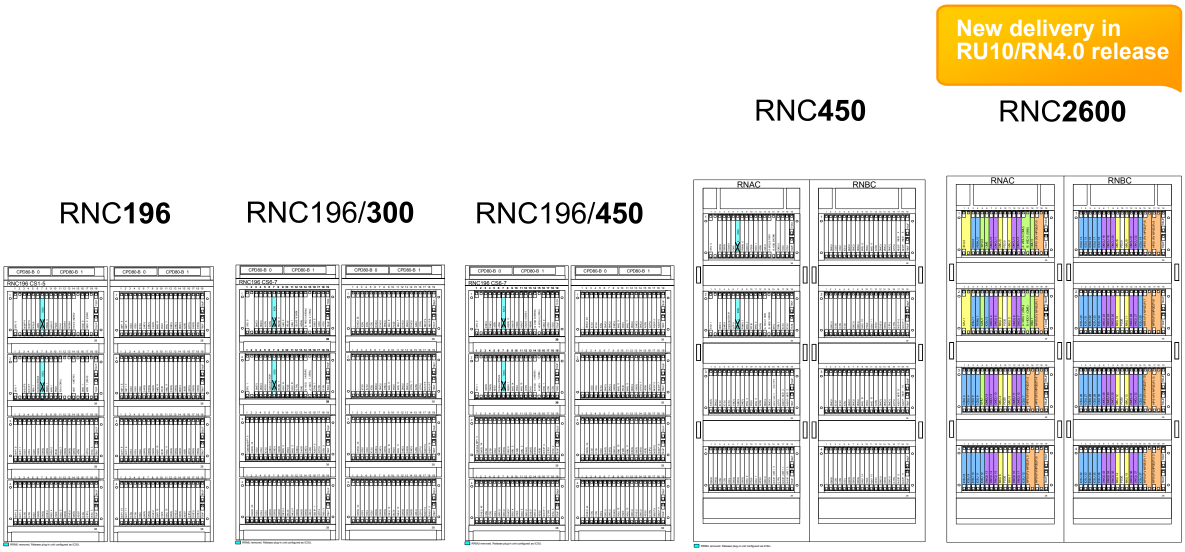
- Flat PaCo: **Direct Tunnel** defined in SA WG2, for **removing SGSN from the U-plane**
- Flat RAN: HSPA Evolution TR25.999 defines **BTS collapsed RNC**
- RNC ID extension from 4096 to a higher value to allow large I-HSPA network

NSN Radio Access Solution

NSN provides Radio Access solution:

- Radio Network Controller (RNC)
- Base Station
- Transmission and Transport Solution
- RAN Operation and Management

NSN Radio Network Controller



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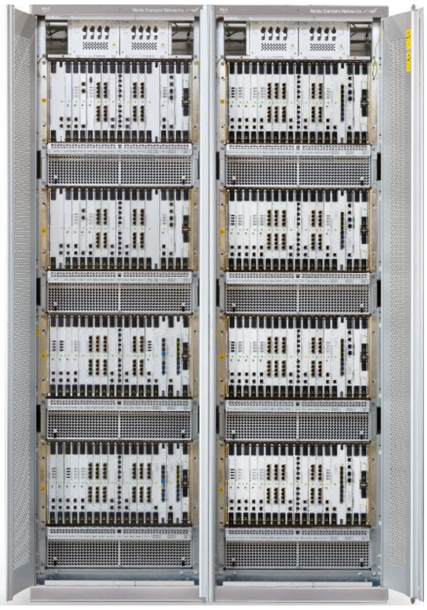
Basic new delivery configuration steps in RN4.0 are:

- RNC2600/900, configuration for capacity step 1
- RNC2600/1450 ,configuration for capacity step 2
- RNC2600/2000, configuration for capacity step 3

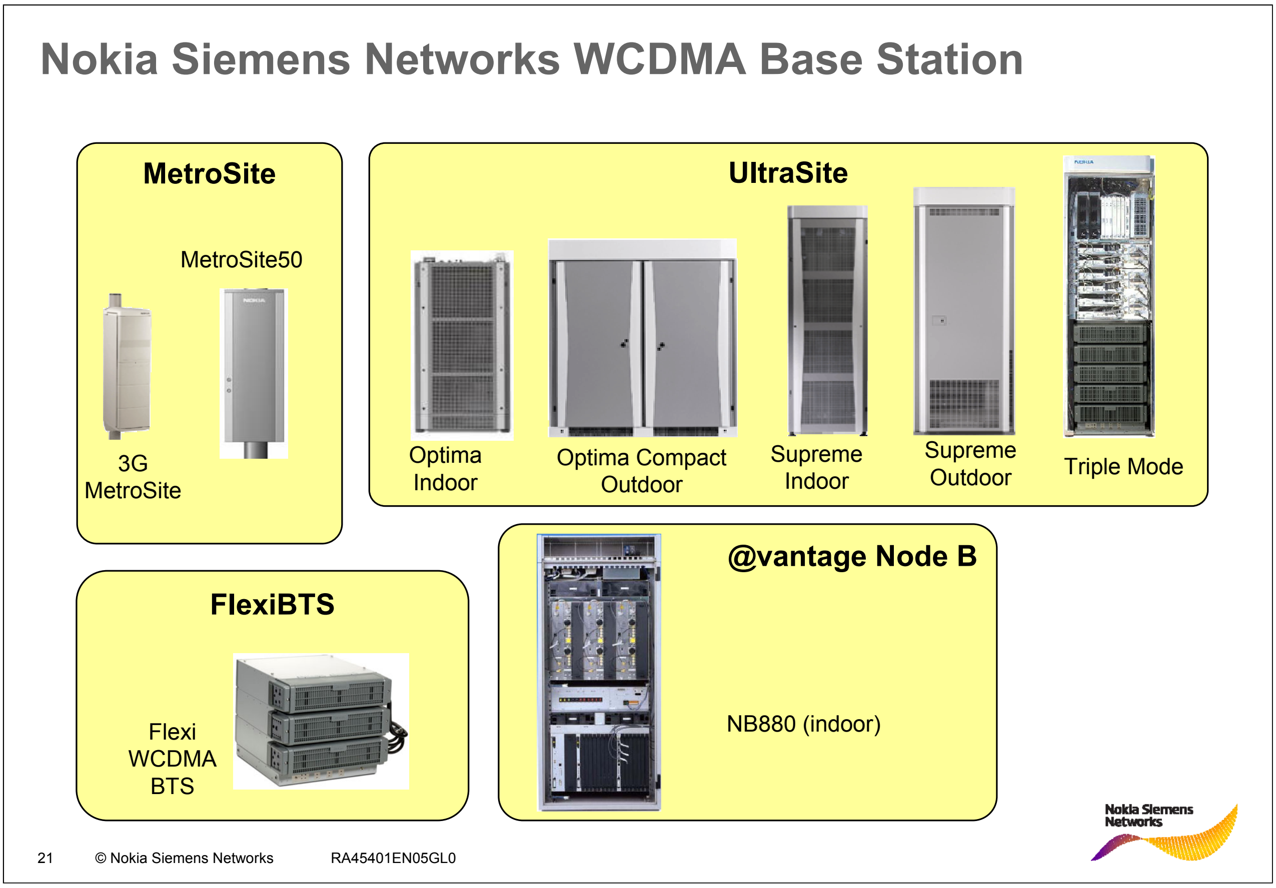
Feature upgrade configuration steps in RN4.0 are:

- RNC196/196 configuration for RNC196 capacity step 1-5
- RNC196/300 configuration for RNC196 capacity step 6
- RNC196/450 configuration for RNC196 capacity step 7
- RNC450/150 configuration for RNC450 capacity step 1
- RNC450/300 configuration for RNC450 capacity step 2
- RNC450/450 configuration for RNC450 capacity step 3

RNC2600



- With full configuration:
  - Total Iub throughput 2839 (DL+UL)
  - 2800 carriers or Node Bs connectivity
  - 20000 Erl Iu capacity
- Full load sharing, regardless cabinet or subrack
- Scalability through hardware configuration and capacity licensing
- Upgrade path is available for RNC450
- Upgradeable to support RU20


Nokia Siemens Networks WCDMA Base Station
MetroSite
MetroSite50
3G MetroSite
UltraSite
Optima Indoor
Optima Compact Outdoor
Supreme Indoor
Supreme Outdoor
Triple Mode
@vantage Node B
NB880 (indoor)
FlexiBTS
Flexi WCDMA BTS
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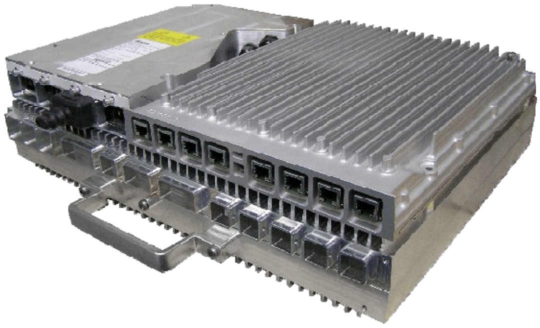
Flexi WCDMA BTS Rel.2 HW

- Flexi BTS multimode system module is also prepared for LTE evolution with a SW upgrade.
- High capacity system module
  - FSMC with 180 CEs
  - FSMD with 396 CEs
- Can be used as capacity extension for Rel.1 HW (FSMB)



- Transmission sub module FTIB to support All-IP transport and Timing over Packet (TOPA)
- FRGF, triple RF Modules, support configuration:
  - 2+2+2@30W or 20W
  - 1+1+1@40W or 60W.

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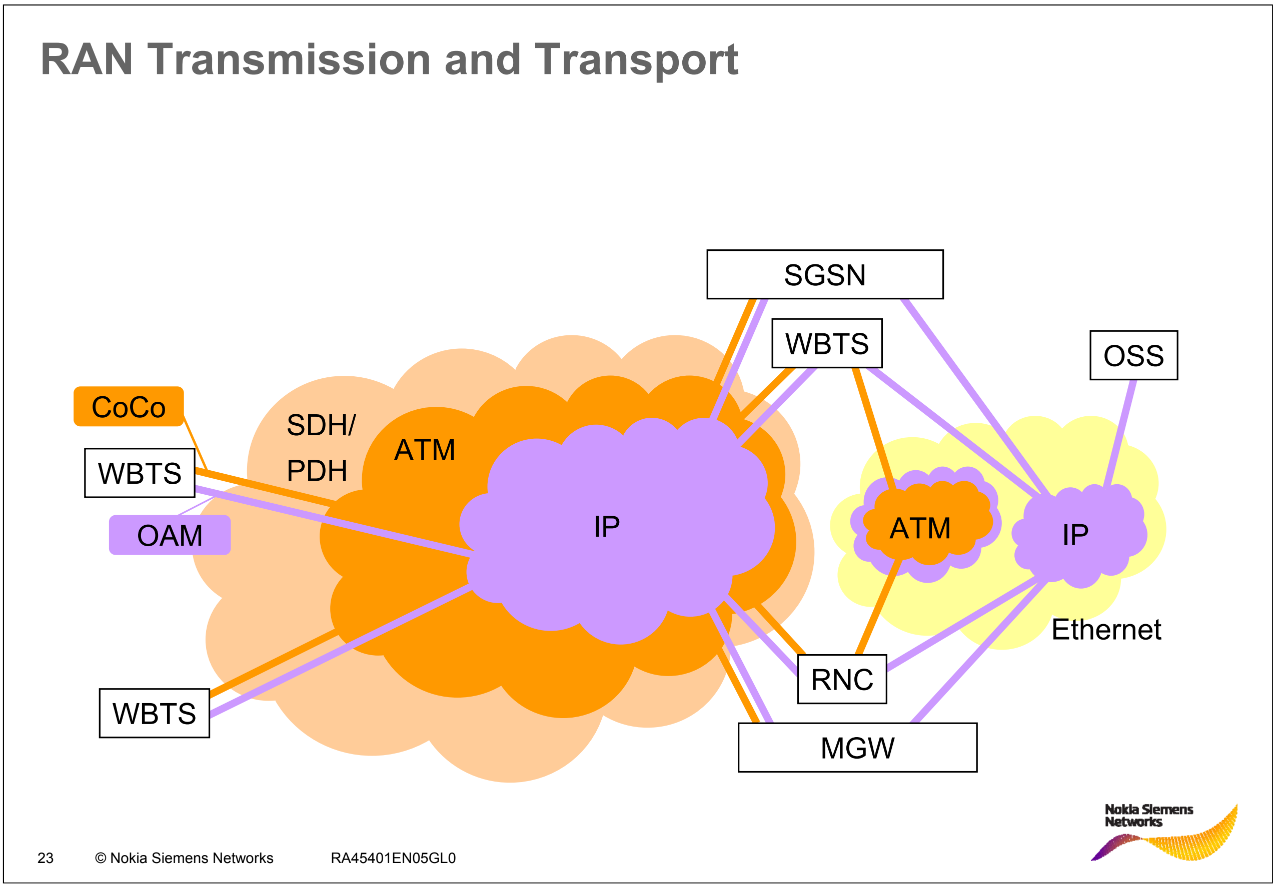
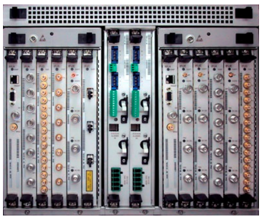


RAN supports different transport solution, i.e. ATM and IP. Both types are possible to be used independently for signalling or user plane, even used toward the same network element in RAN (called hybrid transport)

Transmission and Transport Solution

- Standalone AXC (S-AXC) is ATM transmission node.
- One subrack (on the figure) supports 2 x 1.2 Gbps of switching capacity.
- Various interface unit are available



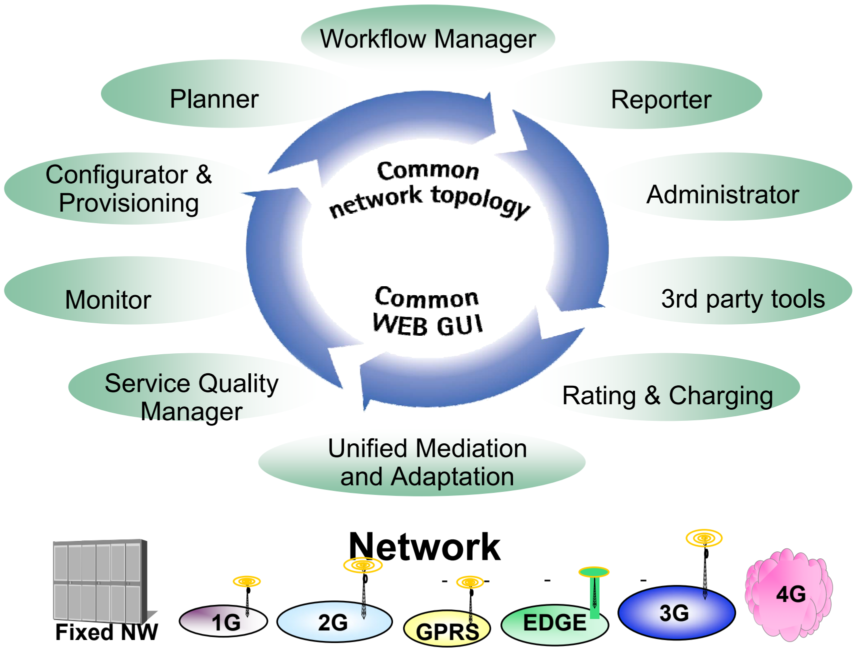
Standalone AXC

PowerHopper

FlexiHopper

- Short to long hop length
- Various frequency band: 6, 7, 8, 13, 15, 18, 23, 26, 28, 32, 38 and 58 GHz
- PDH radio
- SDH radio (PowerHopper)
- Various indoor unit type: FIU19, IFUE or FXC-RRI
- Flexbus interface

NetAct® Framework



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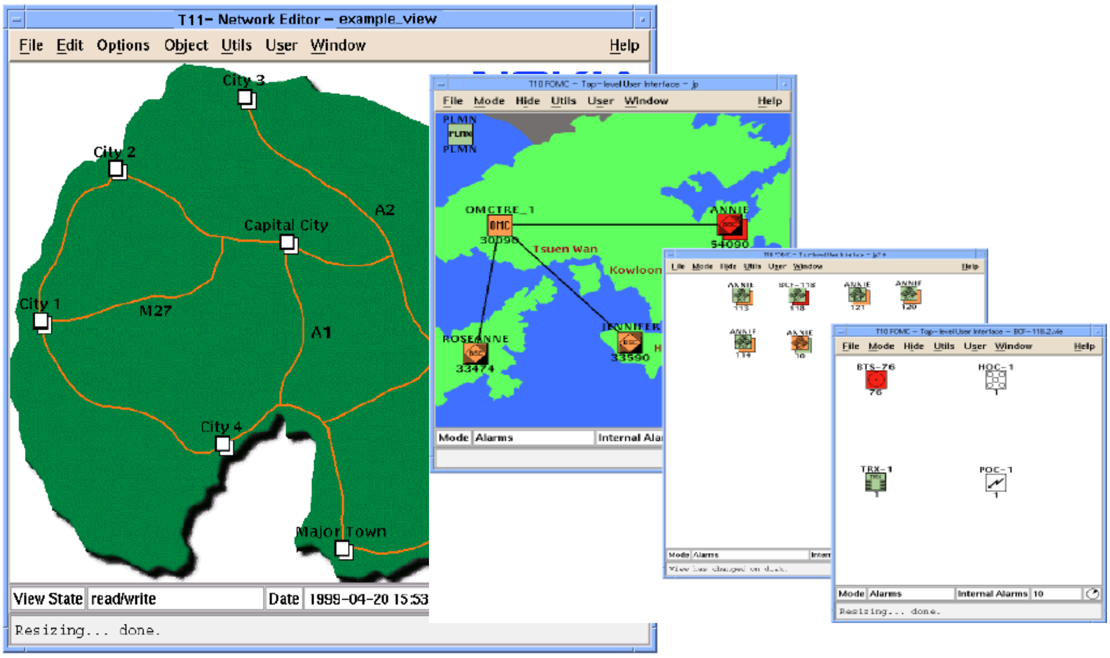
The new NSN OSS product architecture provides a lot of benefits to the service provider. The separation of the element management from network and service management allows for fast adaptation to new network technologies and new releases of network elements. This kind of architecture is capable of supporting any combination of network technologies. The main principle is that current and new systems and applications can co-exits smoothly in the same network.

Highlights of the NetAct Framework:

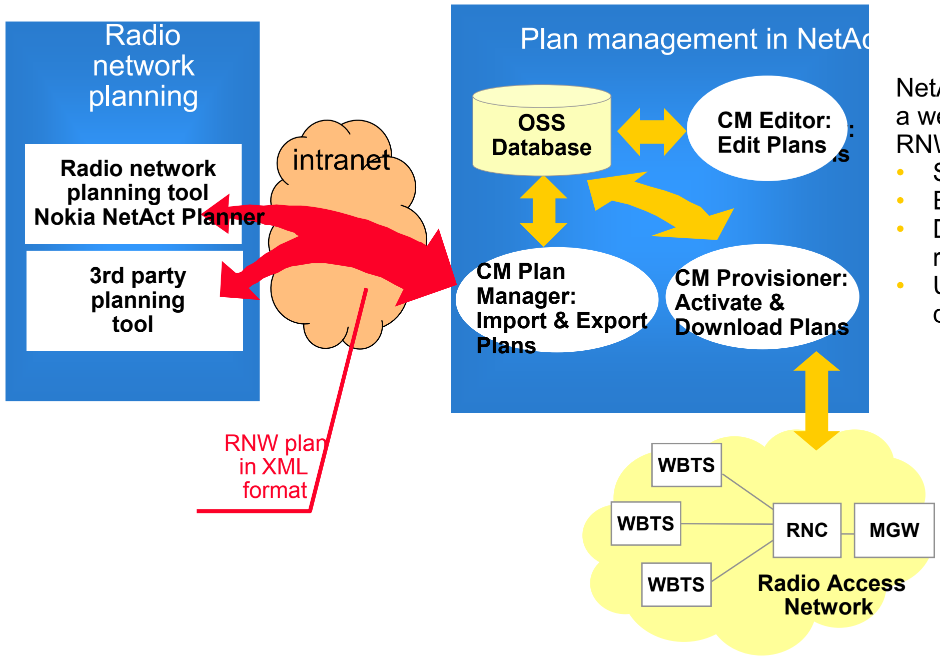
1. 3rd party tools: Building blocks allow the use of 3rd party products as an integrated part of OSS.
2. Common Network Topology: Access to OSS data is available through open interfaces. This enables the integration to other OSS/IT systems.
3. The use of a CORBA (Common Object Request Broker Architecture) based message bus allows peer-to-peer communication within the OSS.
4. Common WEB-GUI (Graphical User Interface):
   - user access via Web interface
   - application location transparent to the users
   - all user interface applications work on network level
5. Management applications are developed separately as system components which are based on operator processes.

Top Level User Interface



- Presents a graphical, hierarchical view of the network or part of the network
- General alarm situation of managed objects can be viewed.
- Uses pop-up menus for a variety of applications
- Activates also other Nokia NetAct applications.
- The users can easily create and tailor the view hierarchy as well as the contents of the views.

RAN Configuration Management



NetAct provides a web site for RNW plans:

- Storage
- Edit
- Download, activate and rollback
- Upload actual configuration

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The NetAct solution supports the capability to plan the RAN with NetAct Planner or a 3rd party planning tool. The plan is transferred to NetAct electronically and the planned parameters, settings and software are downloaded to the actual network equipment. Storing the plan for later use is also possible.

The main advantages of the NSN tools for RAN network development are:

- Faster planning and implementation of network coverage provides for an early launch of service.
- Less manual work and site visits are required to put parameters into network elements. This results in fewer errors and an improved effectiveness.
- Optimised infrastructure investments and improved network quality can be achieved by analysing the network behaviour, performance and usage.