Automated Base Station Configuration

(Automatic Establishment of IP Connectivity for 3G Base Station Commissioning and Recovery)

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Outline

- UMTS architecture
- RAN topology
- Problem: Time consuming and expensive Base Station (BS) commissioning
- Solution: Automated BS configuration
- Automated BS configuration process
- Proof-of-Concept
- Conclusion

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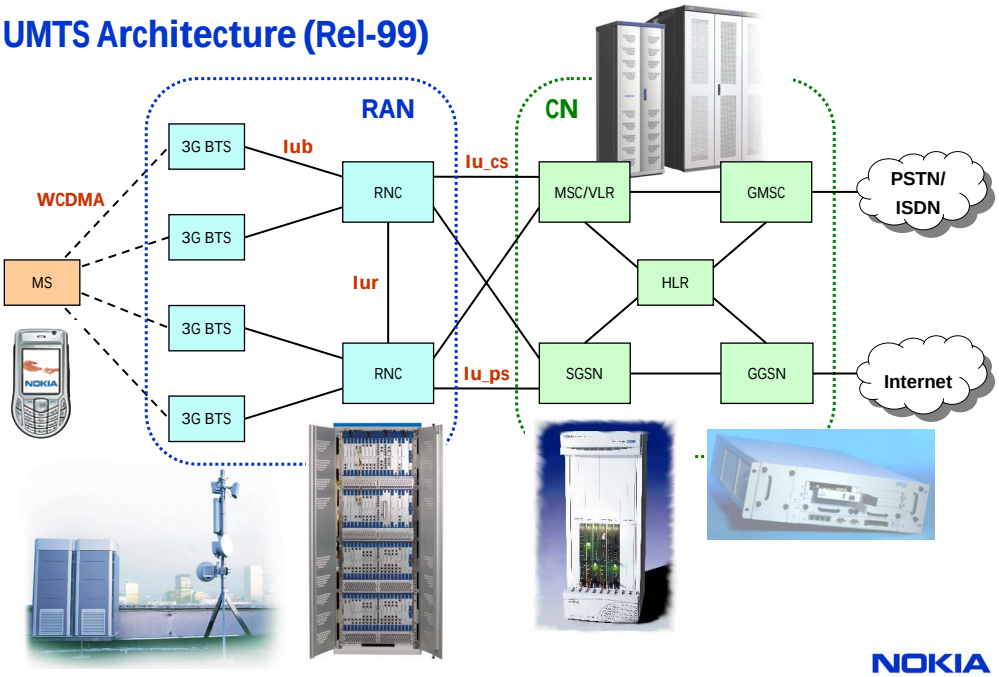
UMTS Architecture (Rel-99)



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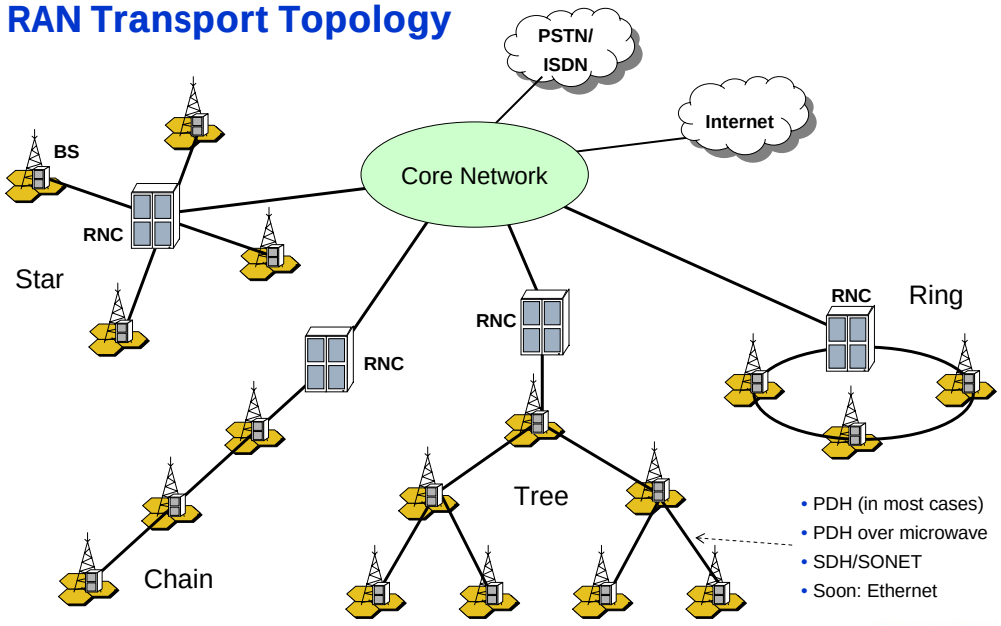
RAN Transport Topology



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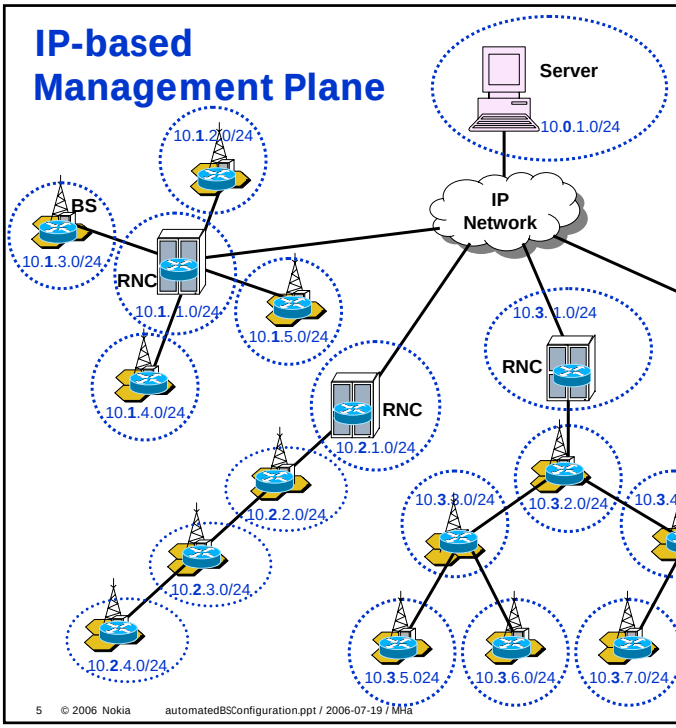
IP-based Management Plane



Several IP hosts in one BS and at BS site →

- One IP subnet per BS and RNC
- IP router in BS and RNC

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Problem

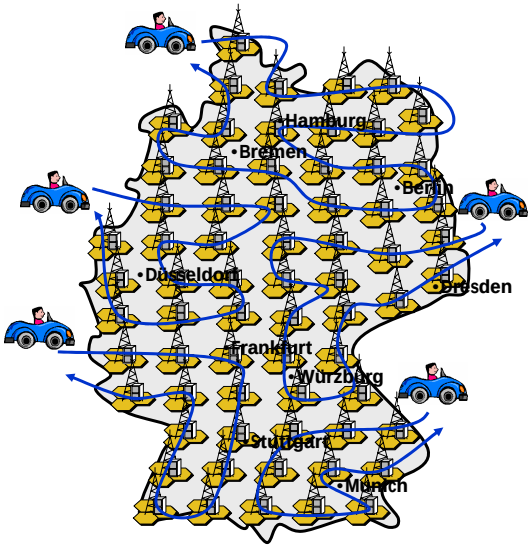
Up to **several 1000** Base Stations in the Radio Access Network (RAN).

Some Base Stations may be even far away in **remote areas**

→ takes **long time** to get to the sites and to configure the BS …

Skilled personnel needed to do commissioning on-site

→ **very expensive** …



Solution:

See next slides …

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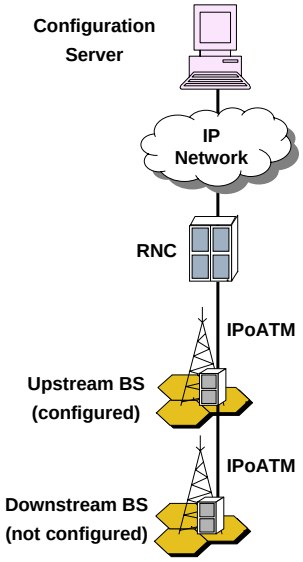
Automated configuration of a Base Station



Plug and Play Base Station:

- A new Base Station (BS) is delivered to the site.
- All cables are connected.
- BS is powered on.
- BS configures itself ***automatically*** to get the IP connectivity for network management.
- BS automatically accesses the configuration server and downloads its specific configuration file (created during network planning phase and stored on the configuration server beforehand).
- BS takes the configuration file into use.
- Now the BS is configured with its planned settings.

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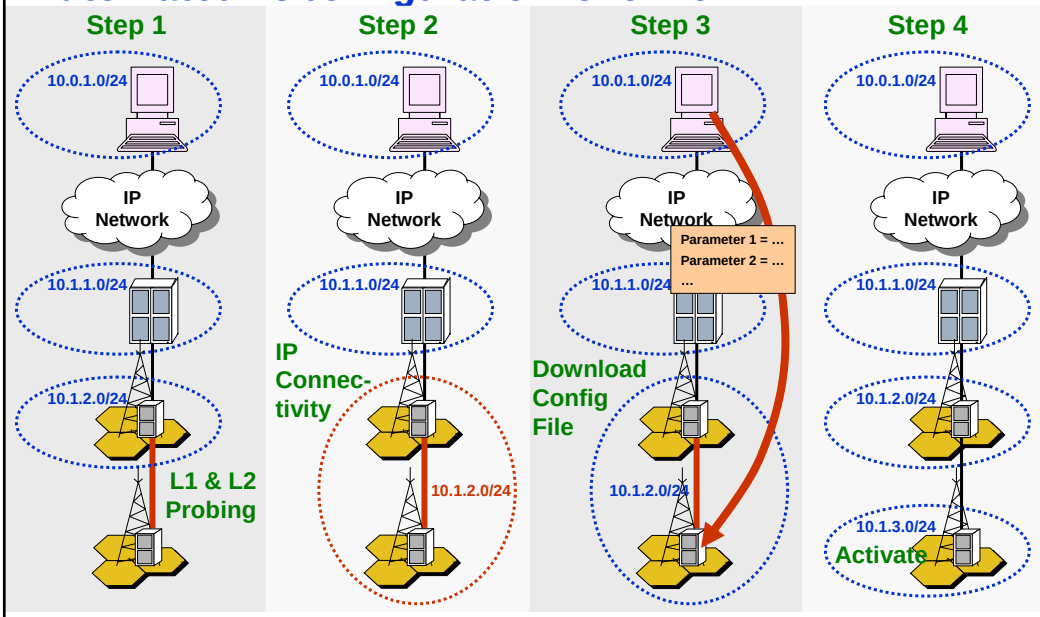
Automated BS Configuration: Overview



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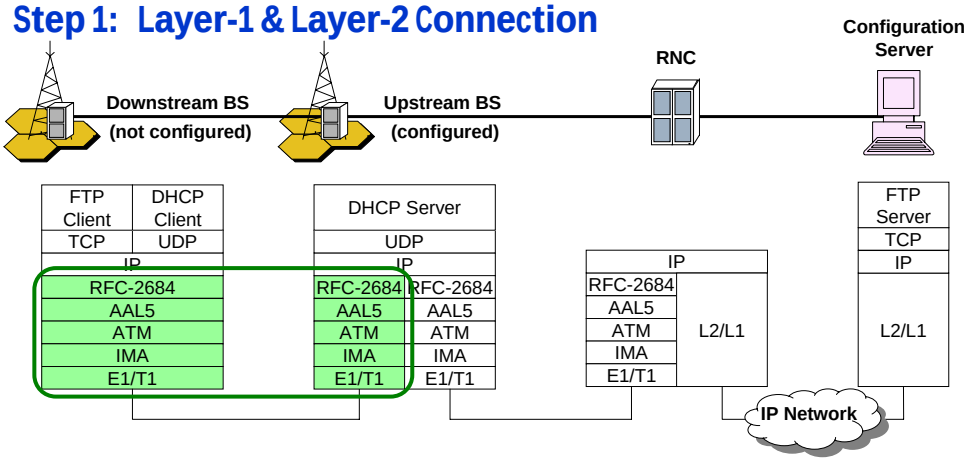
Step 1: Layer-1 & Layer-2 Connection



- The new BTS is not configured.
- The new BTS uses a trial and error method to get Layer-1 and Layer-2 connectivity by trying out **any reasonable combination** (there could be hundreds!) of PHY and IMA settings.
- This process stops when there is **no active alarm anymore** (e.g. Loss-of-Signal, Loss-of-Frame, Loss-of-Cell-Delineation).
- ATM and AAL5 may have **default values** (e.g. VPI, VCI = 1, 32).

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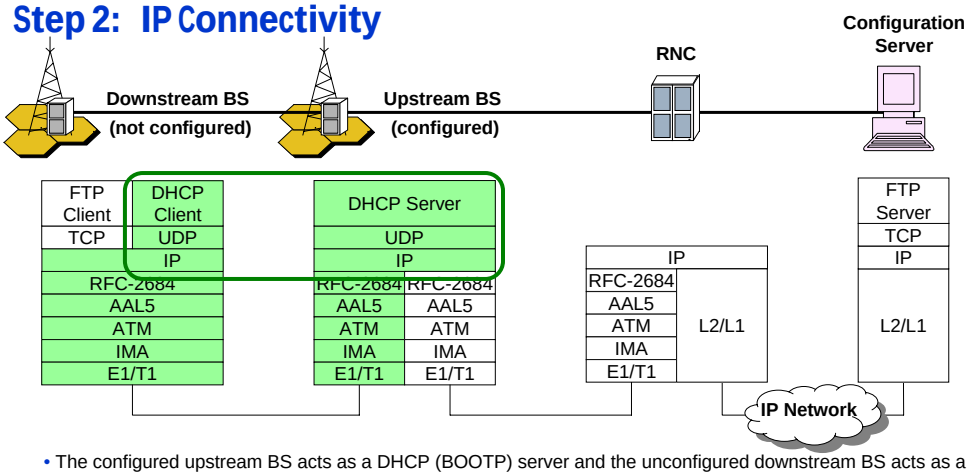
Step 2: IP Connectivity



- The configured upstream BS acts as a DHCP (BOOTP) server and the unconfigured downstream BS acts as a DHCP (BOOTP) client (some adaptations are needed to make DHCP or BOOTP run across a P2P link).
- The upstream BS assigns an IP address **from its own subnet** to the downstream BS.
- The downstream BS configures the upstream BS as default router, and the upstream BS configures a host route to the downstream BS.
- Thus the downstream BS temporarily becomes a member of the subnet of the upstream BS and has immediately IP connectivity to the configuration server. There is **no need to update routing tables in other routers**.

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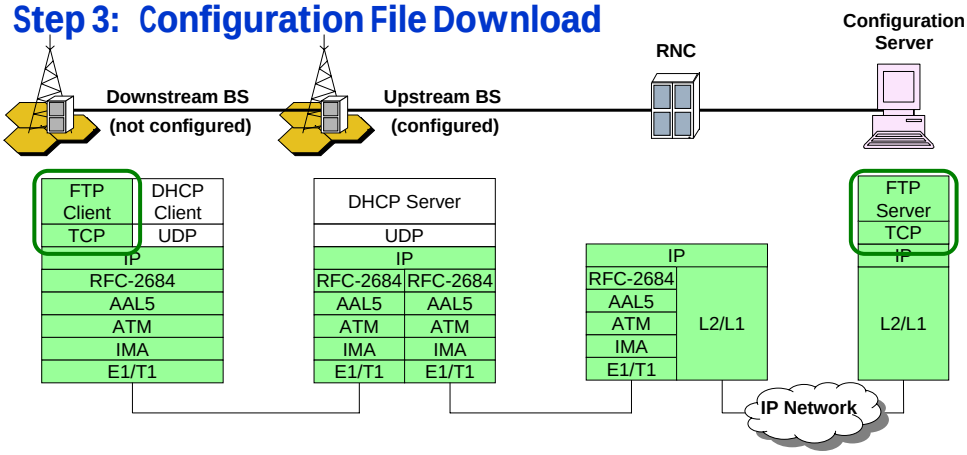
Step 3: Configuration File Download



- Via DHCP, the downstream BS has also learned the IP address of the configuration server.
- On the configuration server, there is a **specific configuration file** for the downstream BS. This configuration file is a result of network planning, which has been done beforehand.
- The pathname may contain a **unique BS hardware identifier**. The BS can read its hardware identifier and construct the pathname from this. Alternatively, the pathname can also be included in the DHCP reply.
- The downstream opens an FTP session and downloads its specific configuration file from the configuration server.

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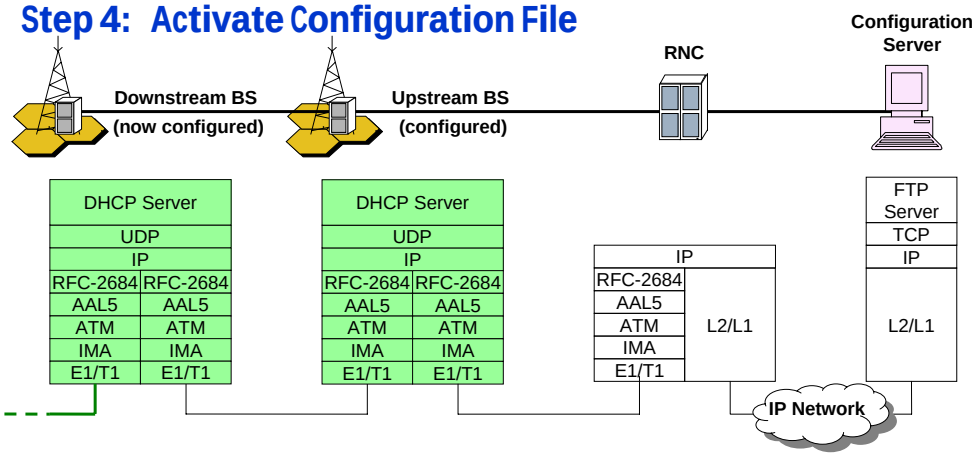
Step 4: Activate Configuration File



- The new BS operates now with its **planned settings**.
- The new BS has now its **own IP subnet** according to network planning.
- The new BS has now **IP routing functionality** (for the management plane).
- The new BS can now **act as upstream BTS for another downstream BS, which is not yet configured.**

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Proof-of-Concept

- PoC was done in the context of a diploma thesis.
- AXC was used as platform. AXC is the embedded transport node of the Nokia UltraSite 3G base station.
- Coding was done in CORBA Script and C/C++.
- More than 1000 Layer-1/Layer-2 configurations were automatically tested: One AXC („upstream“) was controlled by a script which loaded the different configurations, and a second AXC („downstream“) had to find out a compatible configuration automatically. Convergence was achieved in all cases.
- 3 AXC were available to model RAN star, chain and ring topologies. 1 AXC was already configured, the other two were unconfigured. A fourth AXC acted as configuration server. Automated configuration (Layer-1, Layer-2, IP connectivity with lending IP address via BOOTP, FTP download and activation of specific configuration file) worked in all cases.

AXC

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Conclusion

- After Base Station (BS) installation done by assemblymen, skilled technicians need to visit the BS site for commissioning tasks.
- This on-site BS commissioning is time consuming and expensive.
- A method for automated BS commissioning was presented, so that a site visit of skilled technicians is unnecessary.
- No prior physical, data link or IP layer configuration in a new BS is needed.
- A Proof-of-Concept implementation demonstrates that the method works.
- The same method is also applicable for BS recovery: When a BS looses its management connection (e.g. because of remote misconfiguration), it can revert to the not-configured state.

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