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Implementation of the Mid Term Guidelines (MTG) in the real network project

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Agenda

- Implementation of MTG in Serbia and Montenegro for Mobile Operator Mobtel
- GSM/GPRS network as a first step in transition of existing 2G network towards IMT-2000:
 - GSM (Evolved) Core Network
 - GPRS protocols and coding schemes
 - EDGE/EGPRS implementation
 - some examples of Radio-Network statistics
 - definition and descriptions of major KPIs
- Pre-commercial trial WCDMA/UMTS network




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Implementation of MTG

- **Transition towards IMT-2000**
 - A core network with links to the PSTN, ISDN, the Internet/Intranet and external mobile and data network
 - Radio Access Network based on the radio-interface IMT-2000 CDMA Direct Spread (WCDMA/UMTS)
 - Dual-mode and multi-mode terminals allowing subscribers to enjoy services on pre-IMT-2000 and IMT-2000 network

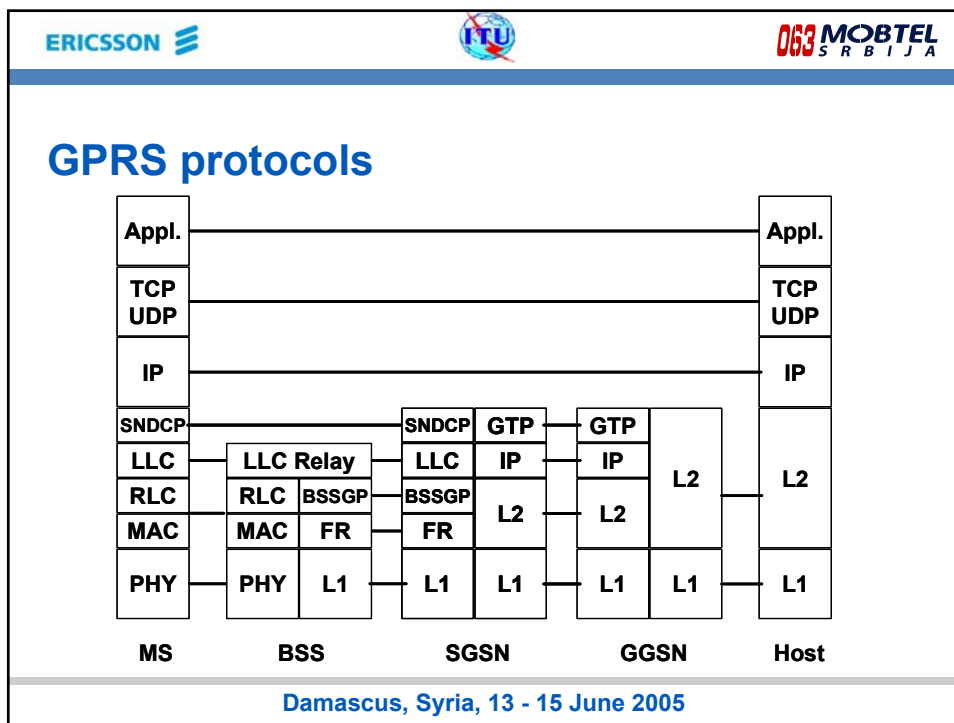
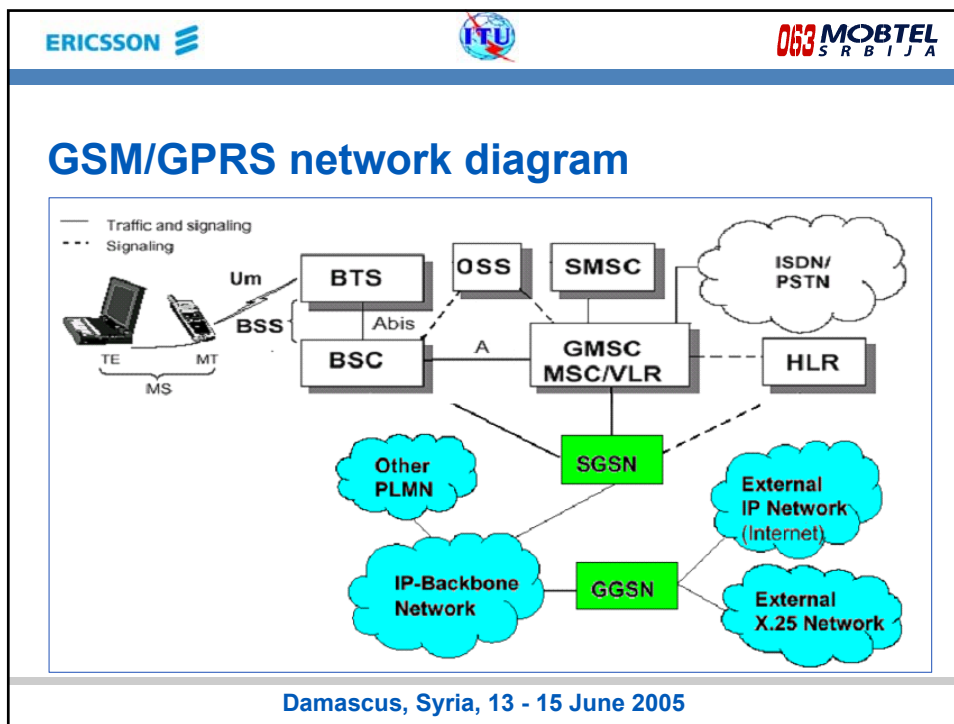
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GSM (Evolved) Core Network

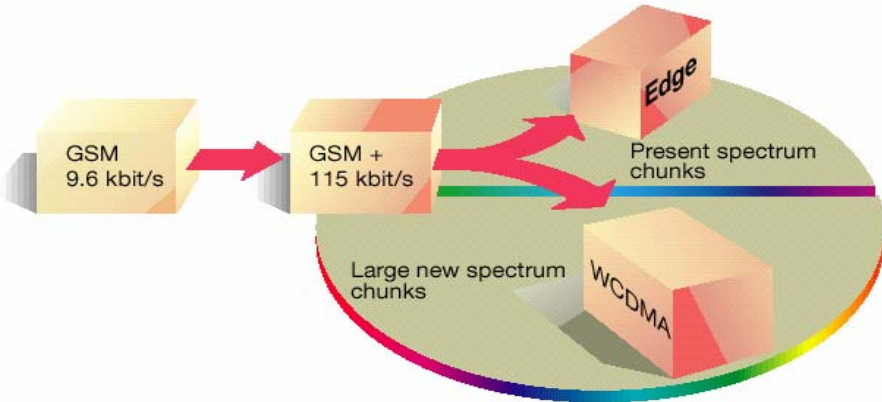
- **For the support of packet data services, GSM (Evolved) Core Networks have been complemented by IP-based GPRS-backbone networks providing a specific fast Mobile Management to the packet data services, capable of handling fast handovers for real-time packet data services (Mid Term Guidelines)**

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Network upgrades

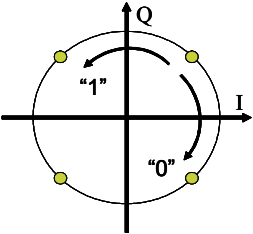


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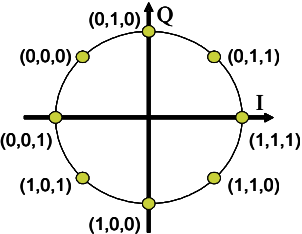
EDGE – 8 PSK modulation

Currently:
GMSK Modulation



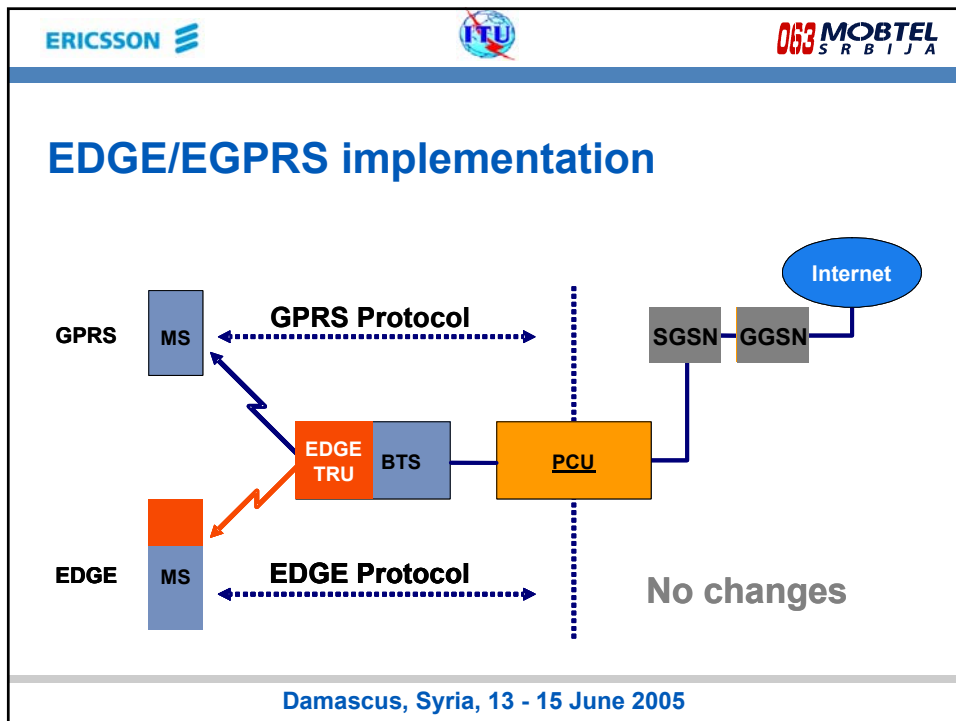
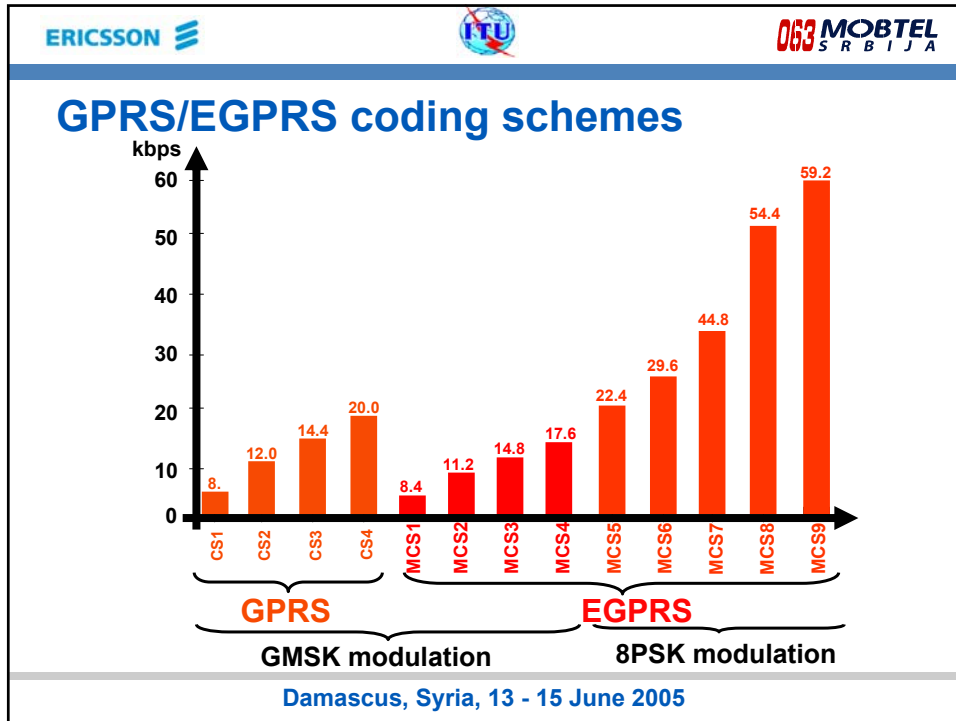
“1 bit per symbol”




EDGE:
8PSK Modulation



“3 bits per symbol”

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Radio Network Performance (Circuit Switched)

- **Accessibility** – relates to blocked calls
- **Retain ability** – relates to dropped calls
- **Integrity** – relates to speech quality
- **All of these can be measured and translated to into a user perception of service quality**




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Radio Network Performance (Packet Switched)

- **It is much more difficult to define counters and formulas and relate these to the user perception of service quality**
- **There are two main reasons:**
 - **GPRS/EDGE (EGPRS) system has many layers of protocols**
 - **GPRS/EDGE (EGPRS) is a bearer for a number of different applications, so user perception of network performance can vary depending on application used in session**




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Radio Network Performance (Packet Switched)

- The Key Performance Indicators (KPIs) focus on the main task – transfer of IP packets and are grouped into following areas:
 - Level one performance indicators – directly related to the ability to transport IP packets (for example the IP throughput on cell level)
 - Level two performance indicators - indirectly related to the ability to transport IP packets. They should be used for trouble-shooting purposes to identify the specific factors that are causing the level one indicators to show poor performance




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Radio Network Performance (Packet Switched)

- The factors that can affect the user perception of the GPRS/EDGE (EGPRS) services:
 - Quality of the radio link
 - Circuit Switched (CS) traffic load
 - Packet Switched (PS) traffic load
 - Channel allocation and reservation
 - MS capability
 - Users mobility and QoS profile
 - Operator parameter setting
 - TCP/IP and other effects




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Radio Network Performance PS Level One - IP throughput

- IP throughput (measured on LLC layer) - similar to "modem speed" concept for fixed internet
- The factors that can affect:
 - Poor radio link quality (Level two)
 - Less PDCH reserved than requested by user (Level two – Multi slot utilisation)
 - PDCH reserved by other users (Level two – GPRS traffic load)
 - QoS scheduling prioritizing different users
 - Delays in setup of downlink Temporary Block Flow (TBF)




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Radio Network Performance PS Level One - IP throughput

- The factors that could affect the IP throughput but are not included in the measured IP throughput:
 - Discard of the contents of the IP buffer in the MS or in the PCU (Level one – IP buffer discard)
 - Cell reselection during transfer (Level one – discards due to flush)
 - Delays in setup of uplink Temporary Block Flow (TBF)




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Radio Network Performance PS Level One - IP throughput

- **Additional factors:**
 - The total time to perform a data transfer
 - Effects of protocol layers above the LLC layer (for example TCP slow start)
 - Outside events that cause IP packets to be retransmitted by the TCP protocol




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Radio Network Performance PS Level One - IP throughput

- **The Mobile Station capability is another factor that can impact the measured IP throughput. Factors are:**
 - GPRS or EDGE (EGPRS) capable
 - Multi-slot capability (Level two – Multi slot utilisation)
 - Frequency band capability
 - 3GPP Release of the mobile station




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Radio Network Performance PS Level One - IP buffer discards

- IP throughput measures the speed with which the IP packets are shipped to and from user
- IP packets can't transfer to user – the entire contents of the IP buffer will be discarded (user experience is dependent on the application running)
- The contents of the IP buffer may be discarded due to inter Routing Area or Inter Cell Reselection – “planned” IP buffer discard




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Radio Network Performance PS Level One - IP buffer discards

- Absolute number of IP buffer discards is a relevant performance indicator
- It is suggested to calculate the number of IP buffer discards per data transfer session minutes




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Radio Network Performance PS Level Two – Radio Link Quality

- The quality of each users radio link determines the maximum IP throughput they can achieve
- The perfect radio link quality is represented by:
 - Close to 12 kbit/s for CS-1/2 transfers
 - Close to 20 kbit/s CS-1/2/3/4 transfers
 - Close to 59 kbit/s for EDGE (EGPRS) transfers




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Radio Network Performance PS Level Two – Mobility

- The mobility of the user will affect the IP throughput
- If they remain in one cell for the duration of the data session than there will be no impact
- If they move rapidly between cells there will be a large impact
- User experiences due to cell reselection is very dependent on the application type




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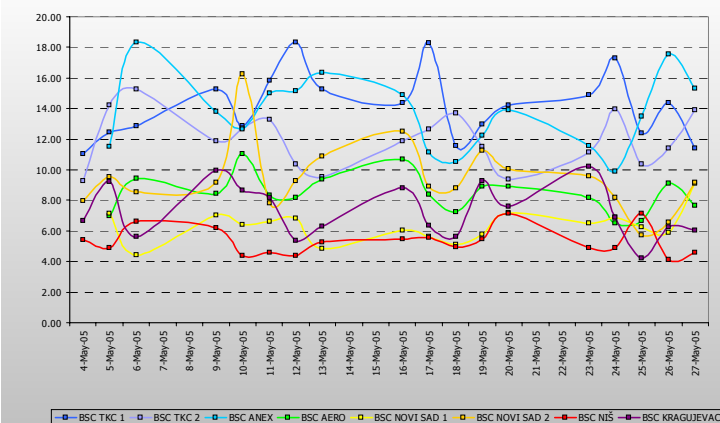
GPRS/EGPRS radio network dimensioning

- The objective is that GPRS/EGPRS users will experience an estimated throughput on application level
- The throughput achieved is depended on the channel capabilities, amount of GPRS and EGPRS traffic, interference environment, Mobile Station multi slot class and the type of traffic generated by the users
- It is based on Radio Network statistics

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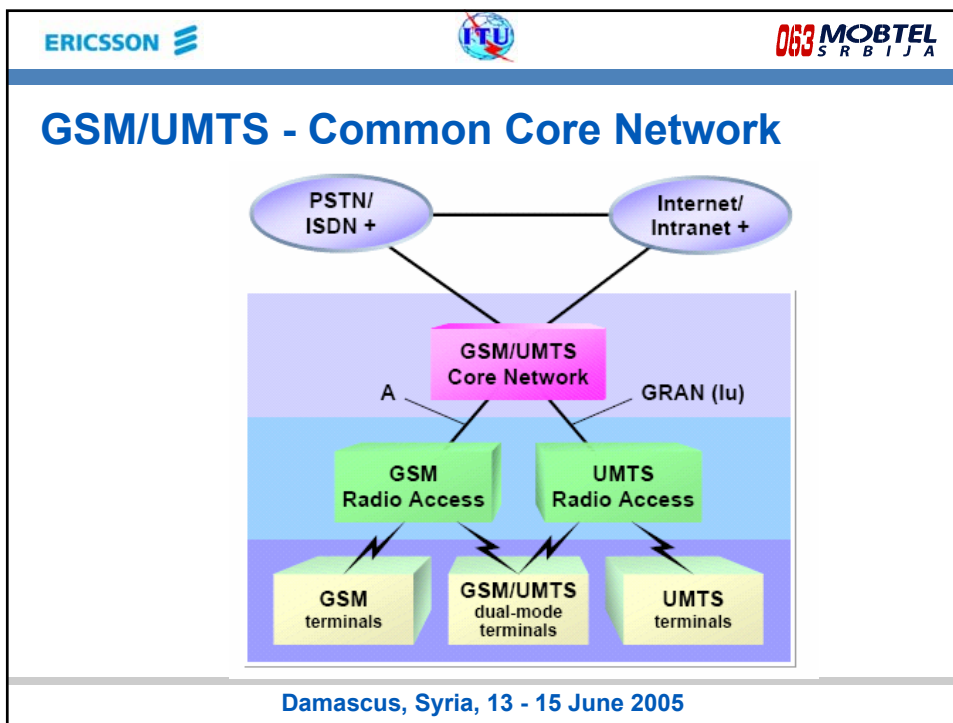
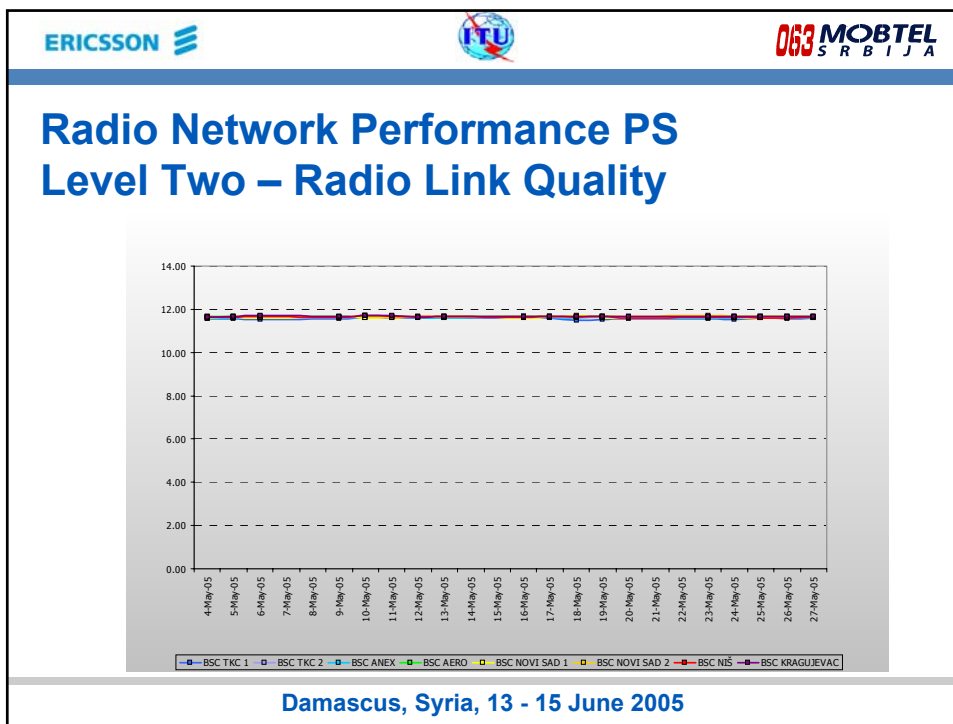







Radio Network Performance PS Level One - IP buffer discards



Date	BSC TKC 1	BSC TKC 2	BSC ANEX	BSC AERO	BSC NOVI SAD 1	BSC NOVI SAD 2	BSC NIŠ	BSC KRAGUEVAC
4-May-05	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0
5-May-05	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0
6-May-05	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0
7-May-05	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0
8-May-05	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0
9-May-05	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0
10-May-05	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0
11-May-05	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0
12-May-05	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0
13-May-05	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0
14-May-05	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0
15-May-05	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0
16-May-05	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0
17-May-05	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0
18-May-05	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0
19-May-05	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0
20-May-05	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0
21-May-05	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0
22-May-05	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0
23-May-05	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0
24-May-05	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0
25-May-05	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0
26-May-05	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0
27-May-05	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0

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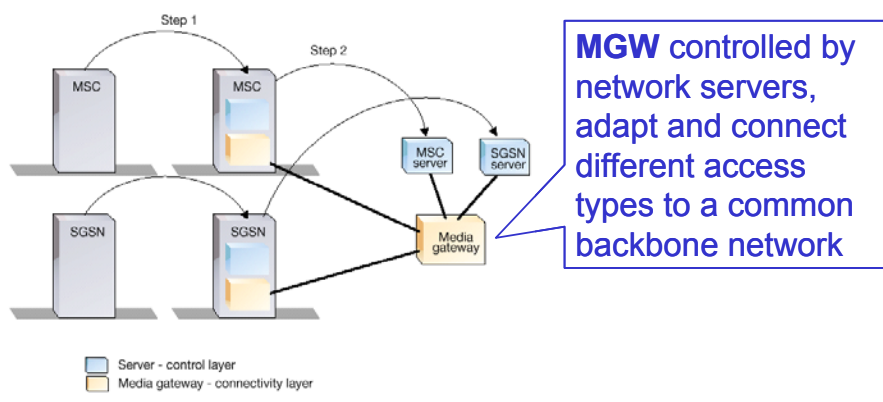
Core Network upgrades

- Horizontally layered network architecture
- Separation of control and connectivity layer
- Network elements are evolving to adapt to new architecture (control and connectivity)



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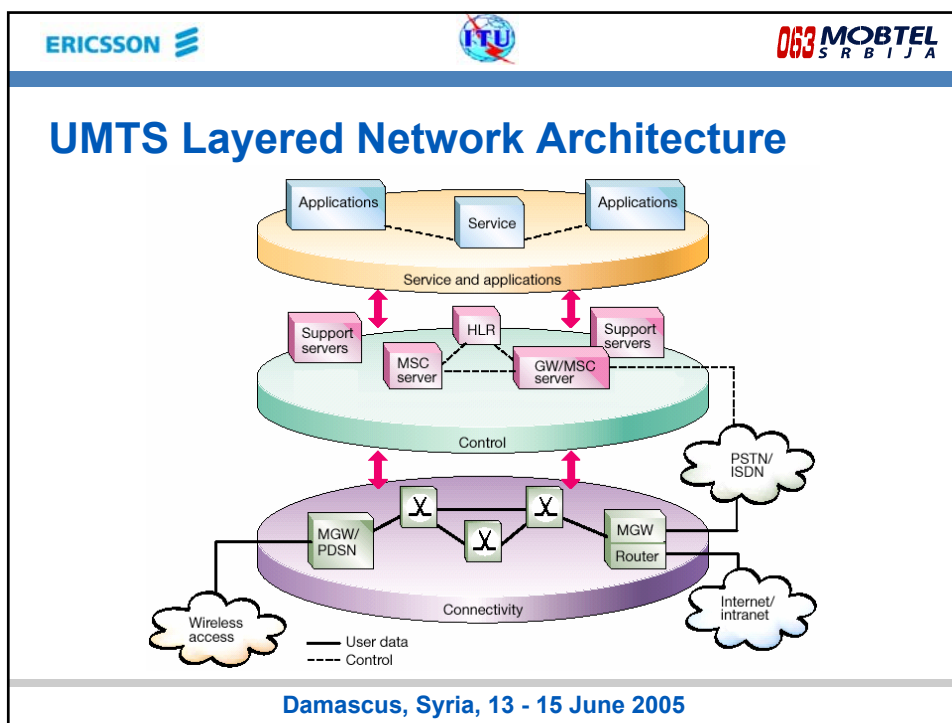
Horizontally Layered Network Architecture






MGW controlled by network servers, adapt and connect different access types to a common backbone network

Legend:
 Server - control layer
 Media gateway - connectivity layer

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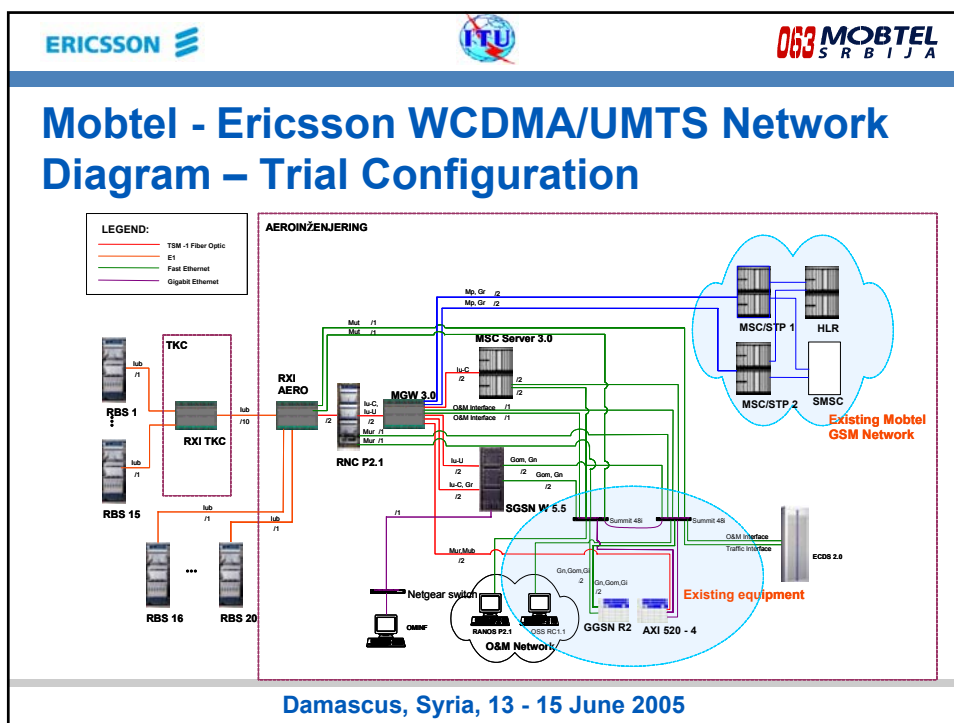


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Radio Access Network

- **IMT-2000 CDMA Direct Spread (WCDMA/UMTS):**
 - A spread spectrum system based on direct sequence
 - It is spectrally efficient – high data rates
 - Flexibility to manage multiple traffic types (voice and data)
 - HSDPA (High Speed Downlink Packet Access) is an enhancement – achieves high speeds through the addition of higher order modulation such as 16 QAM

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Thank you for your attention !

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