

3G Evolution



Chapter: 8

WCDMA evolution: HSPA and MBMS

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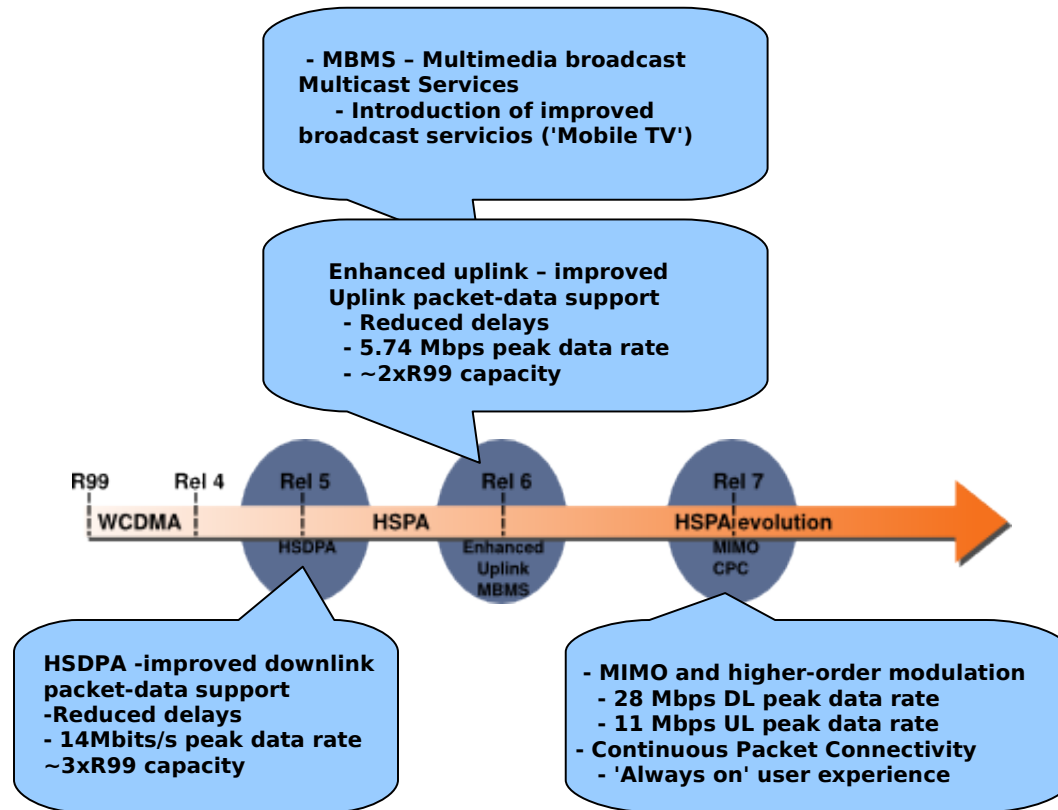
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Outline



- Evolution
- HSPA and MBMS
- Multiple Access
- Direct Sequence Spread Spectrum
- Network Architecture
- Protocol Architecture
- Physical Layer
- Channelization Codes
- Asynchronous Operation
- Power Control
- Soft handover
- Packet Data Session

WCDMA: Evolution



*Image inspired "3G evolution HSPA and LTE Mobile Broadband"

WCDMA: HSPA and MBMS

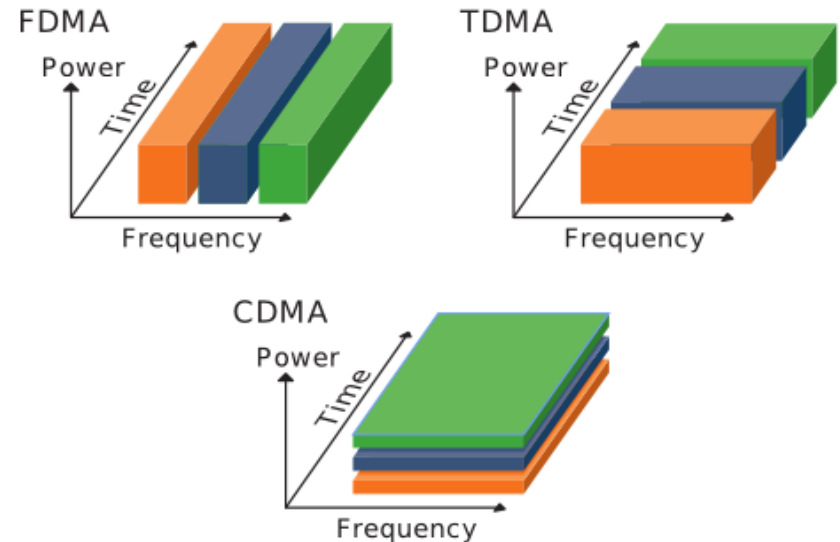


- HSPA (More details in further chapters)
 - Evolution of WCDMA
 - 14Mbps in DL
 - 5.8Mbps in UL
- MBMS (Further explanation in Chapter 12)
 - Enables broadcasting services such as TV, radio, traffic reports, etc.

WCDMA: Multiple Access



- CDMA
 - Multiple users share physical medium in time and frequency
 - Based on interference robustness
 - All user have same carrier frequency
 - Each user has a unique code
 - Benefits from multi path environment

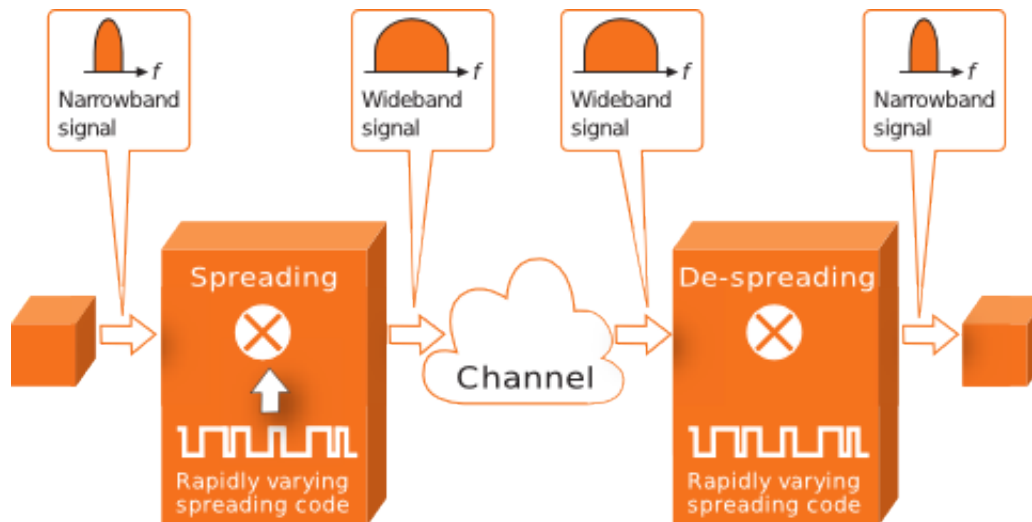


*Image courtesy of Ericsson AB

WCDMA: DS-SS

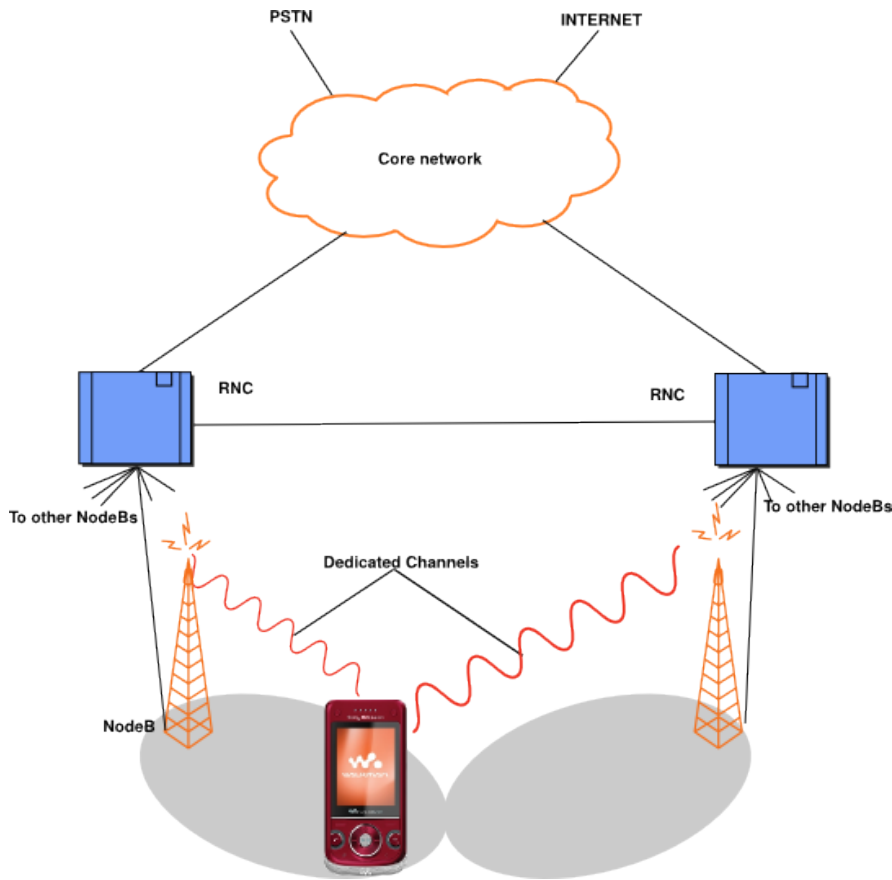
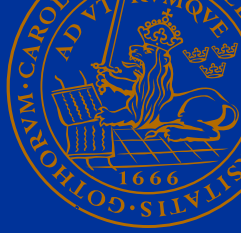


- Direct Sequence Spread Spectrum
 - Same carrier frequency
 - Looks like noise if correct spreading code is not used
 - To recover the transmitter signal the receiver needs the spreading code



*Image courtesy of Ericsson AB

WCDMA: Network Architecture



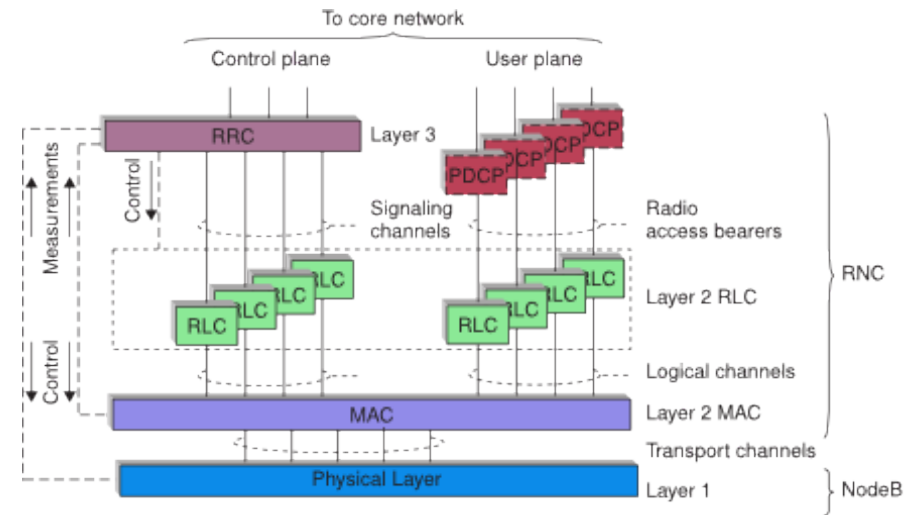
- An UE communicates with one or more NodeBs
- NodeB is responsible for
 - FEC
 - Modulation
 - Spreading
- RNC in charge of
 - Control of one or more NodeBs
 - Charge of call set up
 - QoS
 - Radio resources (ARQ)

*Image inspired "3G evolution HSPA and LTE Mobile Broadband"

WCDMA: Protocol Architecture



- PDCP
 - Performs header compression
- RLC
 - IP packet segmentation
 - ARQ protocol
- MAC
 - Interfaces logical channels and transport channels
- PHY
 - Coding, spreading, modulation, etc.

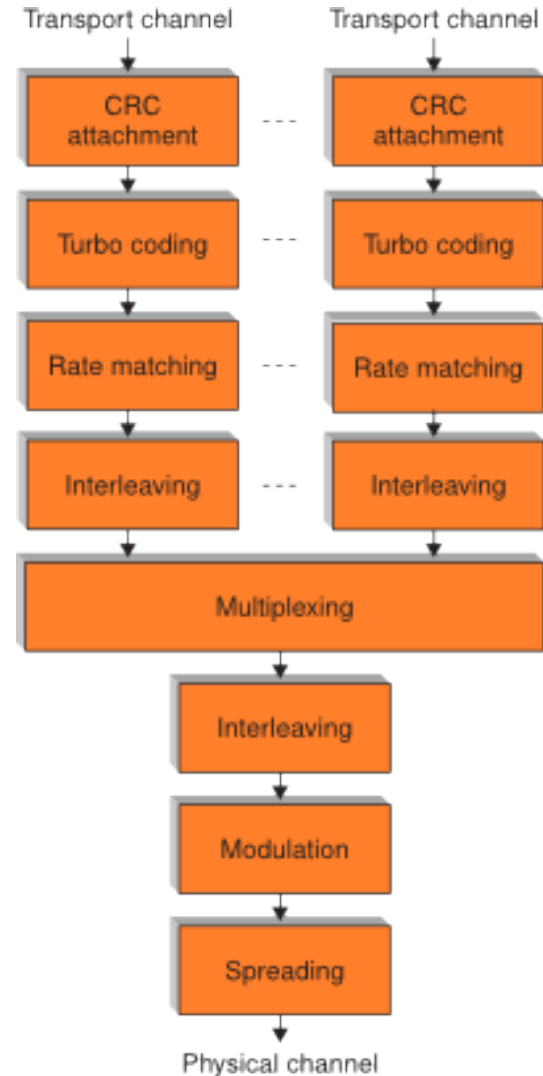


*Image inspired "3G evolution HSPA and LTE Mobile Broadband"



WCDMA: Physical Layer

- 3.84Mchip/s
- Turbo coder 1/3
- QPSK for DL
- BPSK for UL
- Every specific spreading codes corresponds to a each physical channel
- CPICH reference channel for DL

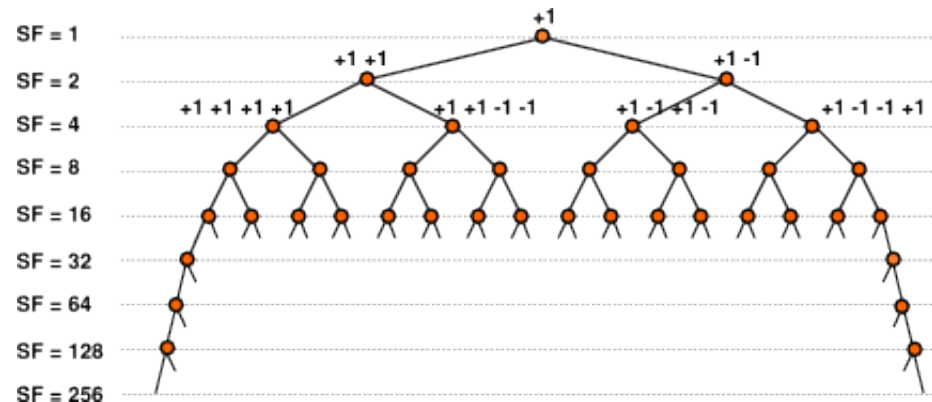


*Image inspired "3G evolution HSPA and LTE Mobile Broadband"

WCDMA: Channelization Codes (OVSF)



- Mutual orthogonality
- OVSF must be selected from different branches
- Different OVSF provide different spreading factors
- Different Spreading factors provide different data-rates
- Spreading factor is selected by the MAC layer
- Some channelization codes are pre-allocated (CPICH, cell specific information, etc)



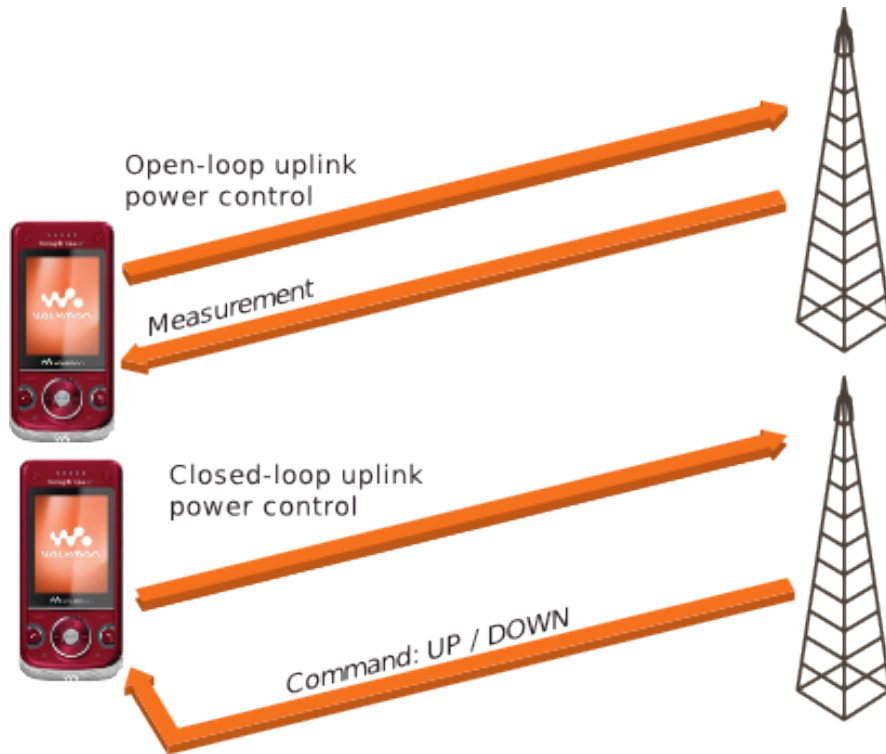
*Image inspired "3G evolution HSPA and LTE Mobile Broadband"

WCDMA: Asynchronous Operation



- WCDMA does not require inter-base station synchronization (no GPS dependency)
- Advantage
 - Reduced deployment efforts
- Drawback
 - BS interference to other BS
 - More challenging cell-search procedure
 - Complicated handover implementation

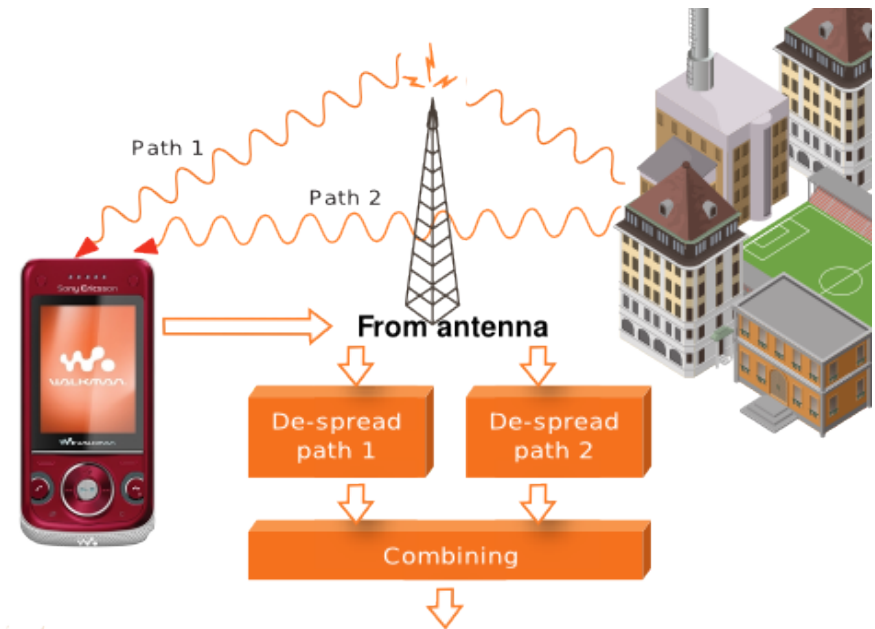
WCDMA: Power control



- Formally named fast closed/closed loop power control
- Attempts to avoid the near-far problem by:
 - measuring the UE signal 1500 times/sec
 - Regulating the transmission power of both UE and BS

WCDMA: Soft handover

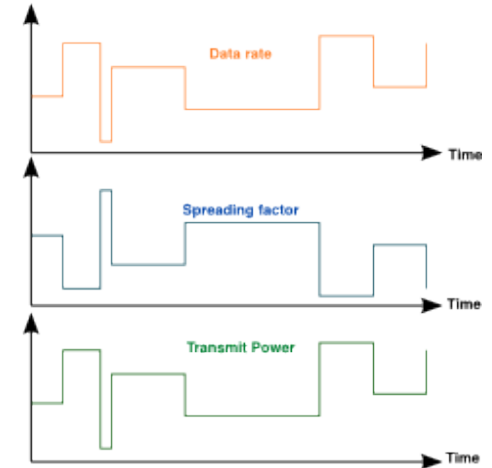
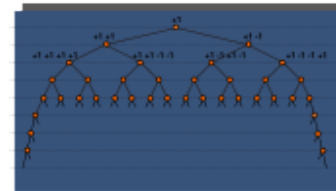
- The UE communicates with multiple cells simultaneously (active set)
 - The RNC determines based on measurements which cells are part of the active set
 - Provides diversity against fast fading in both DL and UL
 - Typically a rake receiver is used
 - “Or of the downs” ensures that average power is kept low



*Image is courtesy of Ericsson AB

WCDMA: Packet Data Session

- UE: Cell search (connection request)
- RNC: Channelization codes available
- RNC: Interference level
- RNC Connection established
- Transmission power varies according to traffic pattern

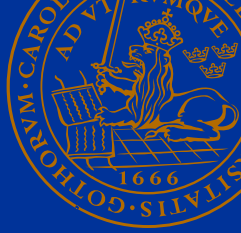


*Image inspired Ove Edfors, lecture on WCDMA



WCDMA: Summary

- HSPA is the evolution of WCDMA
- Spread Spectrum
- A major milestone in mobile telecommunication
- Flexible radio interface
- Transmission power dependent on traffic pattern
- Sensitive to inter-cell interference
- Sensitive to near-far problem



- Thank you for your attention