L1/L2 Handoff Considerations

based on Universal Mobile Telecommunications System (UMTS)

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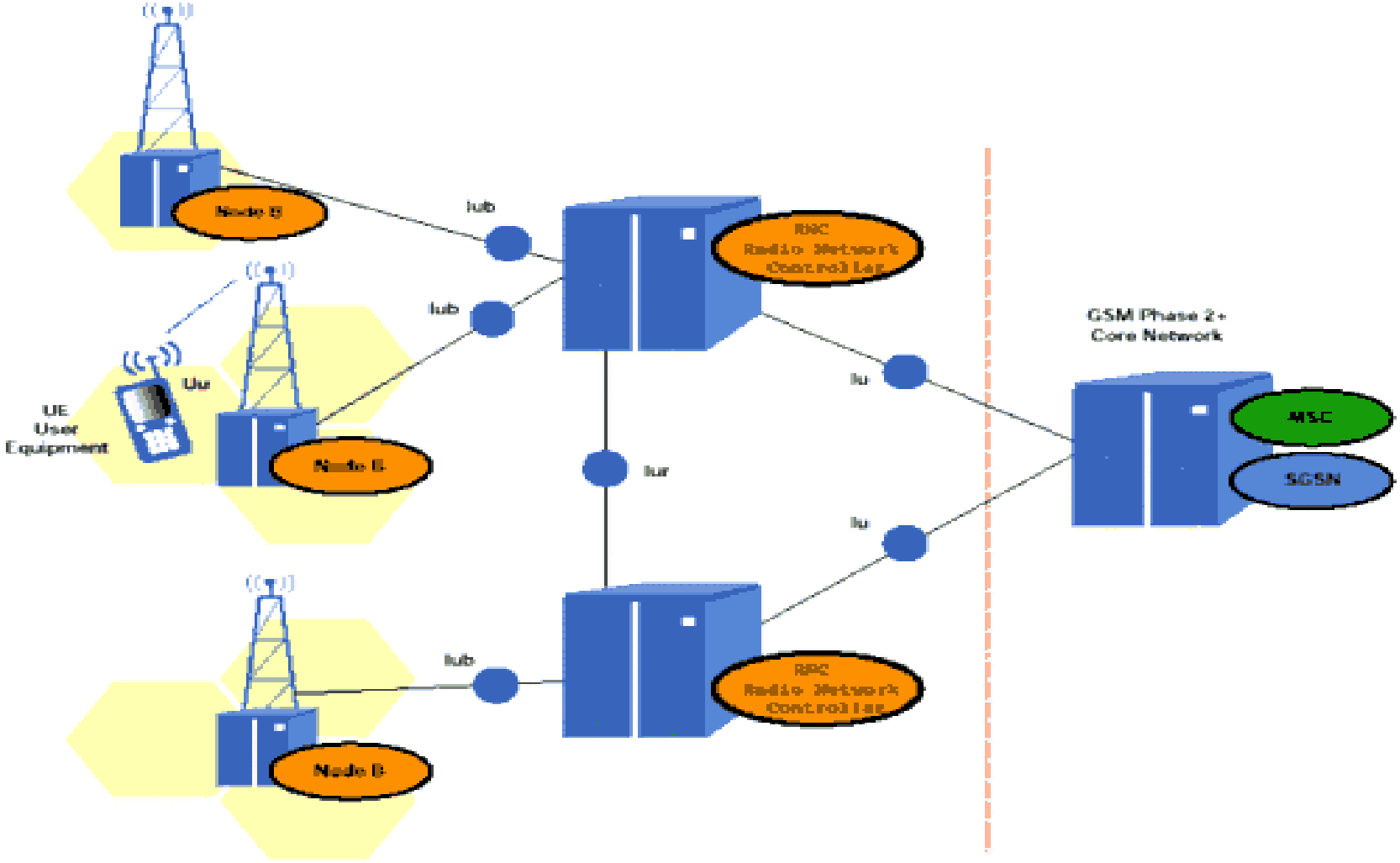
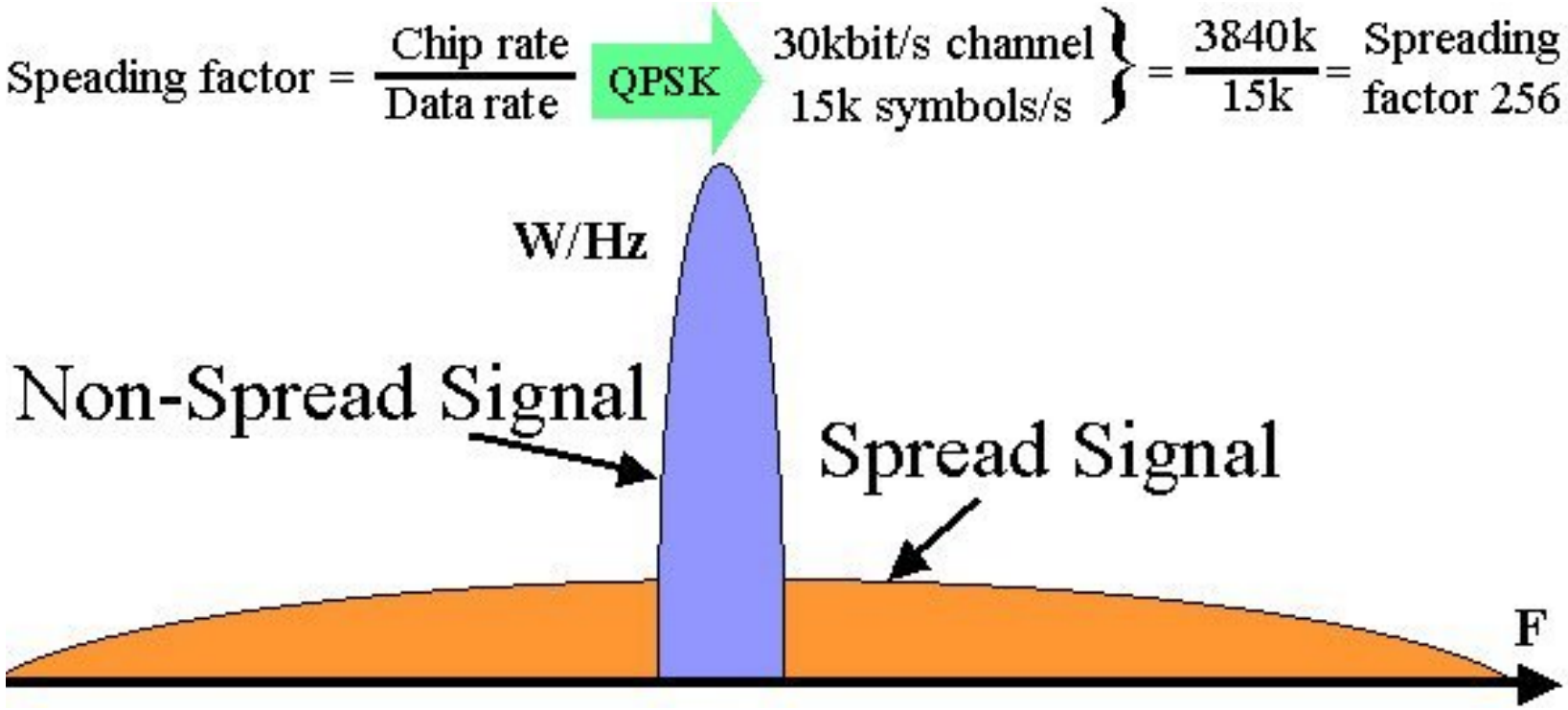
UTRAN Architecture



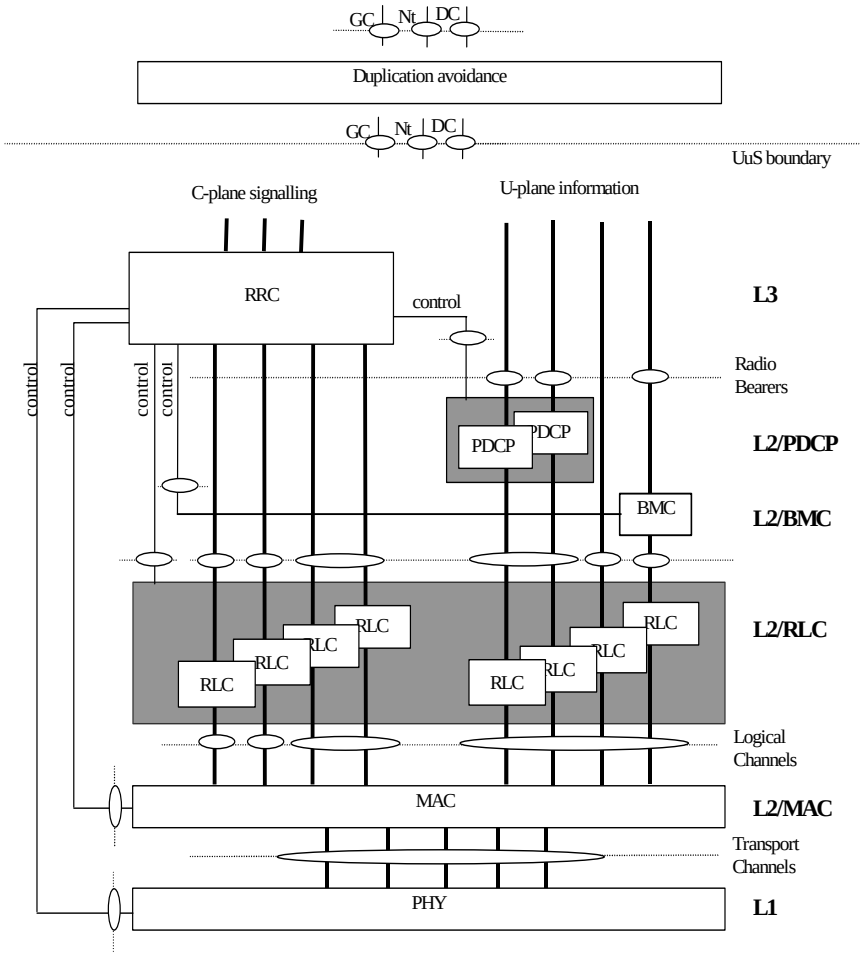
UTRA and cdma2000 based on Code Division Multiple Access(CDMA)



Universal Terrestrial Radio Access (UTRA) L1/L2 functions

- L1
  - Physical (PHY)
- L2
  - Medium Access Control (MAC)
  - Radio Link Control(RLC)

- Broadcast/Multicast(BMC)
- Packet Data Convergence Protocol(PDCP)



Mobility Functions

- Cell Reselection
- Handover

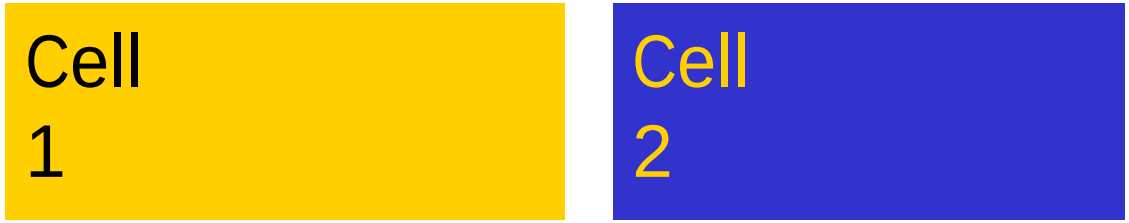
Handover Types

- Intra-RAT (Radio Access Technology)
  - Intra-Frequency
    - Hard
    - Soft
  - Inter-Frequency
    - Intra-Mode (TDD <>TDD)
    - Inter-Mode (FDD<>TDD)
- Inter-RAT
  - UMTS<>GSM
  - UMTS <>WLAN

Soft and Hard Handover

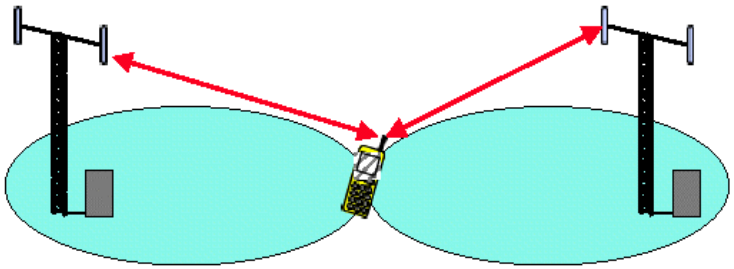
Soft Handover

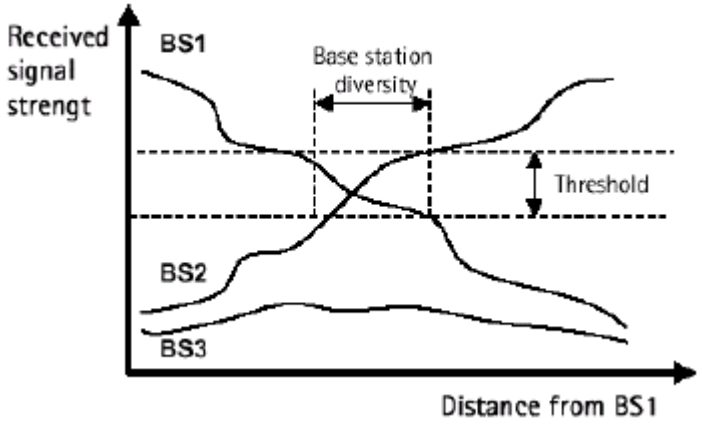
Hard Handover



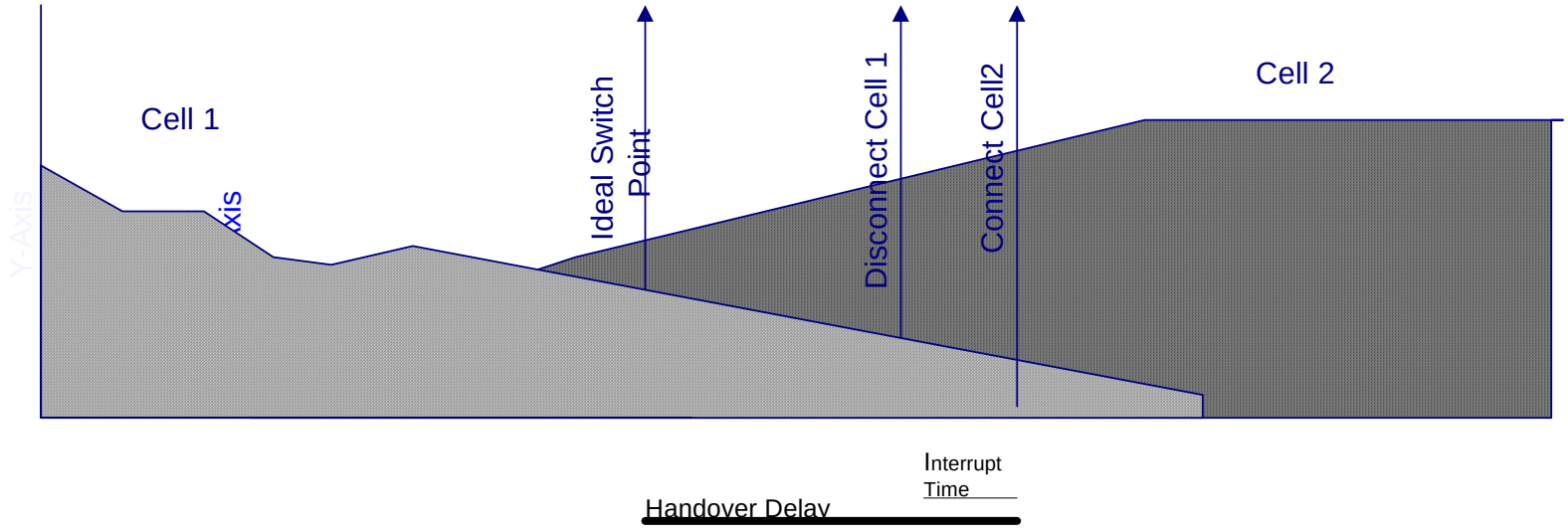
Soft Handover is well suited to CDMA

- User Equipment (UE) is connected to several access points at the same time.
- The soft handover function includes
  - measurement phase,
  - decision algorithm in UTRAN
  - ACTIVE SET UPDATE procedure.
- Spreading Factor and Rake Receiver permit simultaneous processing of multiple transmissions
- Rake Combining of transmissions from different Base Stations similar to multipath processing





Hard Handover Time Line

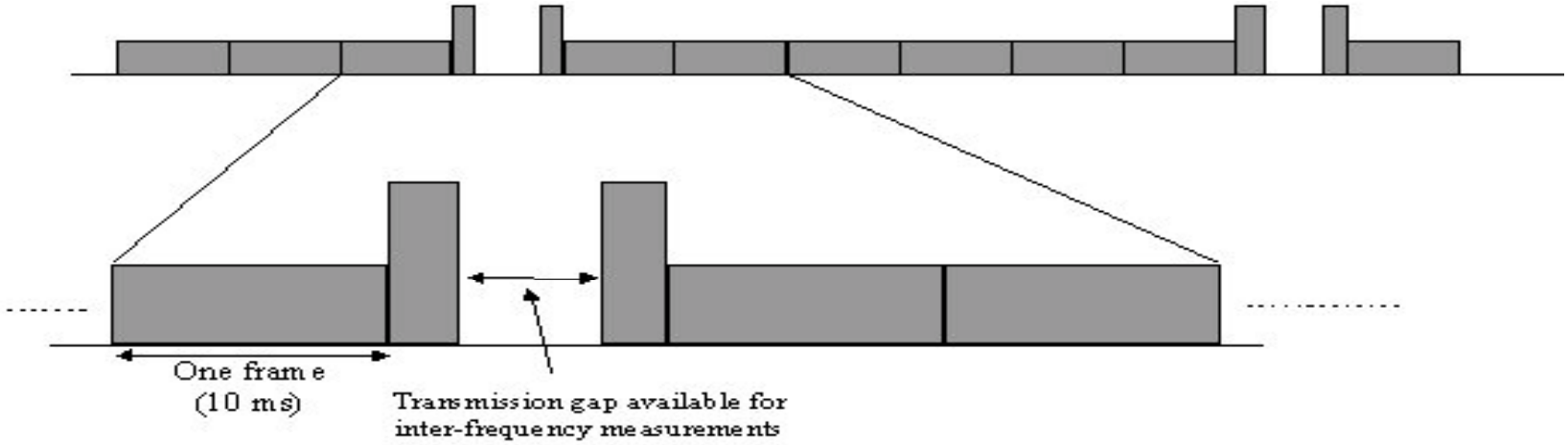


- Delay
  - Signal to Interference Ratio measurement
  - Higher Layer Signaling
  - Decisions in Radio Network Controller
- Interruption Time
  - Cell search and synchronization
  - Acquire in-sync indication from network

General Measurement Requirements

- Pilot power, Signal to Noise Ratio
  - Basis for handover
- Identification of a new cell
  - Within a specified time period
- Two basic criteria for reporting
  - Periodic Reporting
  - Event Triggered Reporting

Compressed Mode



- **Required for Inter-frequency measurements**
- **Single Receiver UE's must be given time to make the necessary measurements on the different WCDMA carrier frequency.**
- **1 to 7 slots per (15 slot) frame can be allocated for the UE to perform this intra frequency (hard handover).**
  - **Can either be in the middle of a single frame or spread over two frames.**

UTRA Measurements

Measurements by UE

CPICH RSCP (Received Signal Code Power)
CPICH Ec/Io
UTRA Carrier RSSI
GSM carrier RSSI
Transport channel BLER
UE transmitted power
SFN-CFN observed time difference
SFN-SFN observed time difference
UE Rx-Tx time difference

Observed time difference to GSM cell
P-CCPCH RSCP
UE GPS Timing of Cell Frames for UE positioning

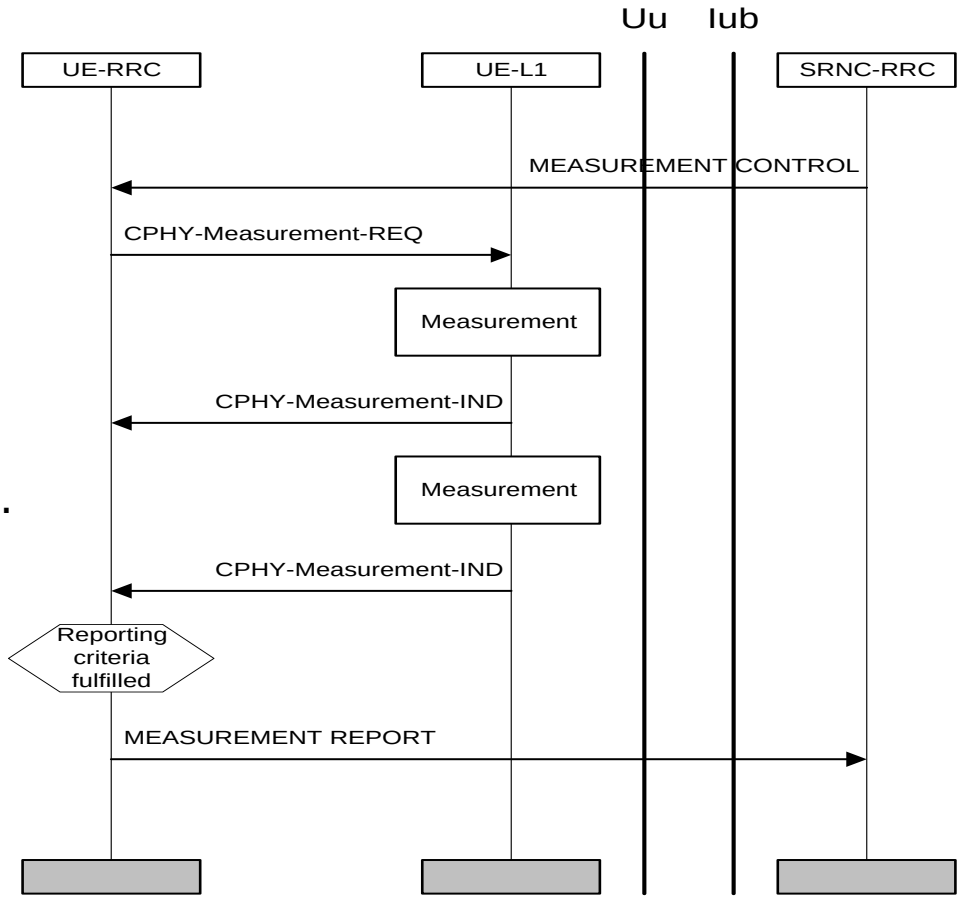
Measurements by Network

Received total wideband power
SIR
SIRerror
Transmitted carrier power
Transmitted code power
Physical channel BER
Round trip time
Transport Channel BER
UTRAN GPS Timing of Cell Frames for UE positioning
PRACH/PCPCH Propagation delay
Acknowledged PRACH preambles
Detected PCPCH access preambles

Acknowledged PCPCH access preambles
SFN-SFN observed time difference

Handover Measurement Reporting

- The Network Radio Resource Controller sends MEASUREMENT CONTROL message to the UE
  - Measurement type
  - The radio links to evaluate
  - The reporting criteria
  - Measurement identity number.
  - The UE configures L1 to start measurements.
- When measurement reporting criteria are fulfilled the UE sends a MEASUREMENT REPORT message.



Practical Issues

- Power / Battery Life
- Size, Weight
- Complexity
- Derived Guidelines
  - Permit single receiver design
  - Permit UE to sleep when not connected
- Time synchronized Base Stations
  - cdma2000, cdmaOne™ – yes
  - UTRA FDD - no
  - UTRA TDD - not required, but optional

References

- WCDMA for UMTS, Radio Access for Third Generation Mobile Communications, Harri Holma and Antti Toskala, John Wiley & Sons, Ltd, 2000
- Websites:
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    - http://www.eie.polyu.edu.hk/~ckleung/tcnet/ss/panght/
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