

3G Evolution



Chapter: 13

LTE and SAE: Introduction and Design Targets

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Outline

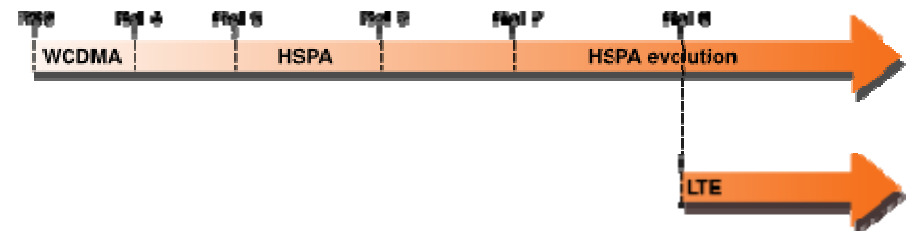


- Evolution
- System Architecture Evolution
- LTE Design Targets
 - Capabilities
 - System Performance
 - Deployment Related Aspects
 - Architecture and Migration
 - Radio Resource Management
 - Complexity and General Aspects
- SAE Design Targets
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- Chapter Summary



LTE and SAE: Evolution

- 2G: Mainly Voice
- 2.5G: Packet Services
- 3G: WCDMA
- 3G Extension: HSPA
- Beyond 3G:
 - Two Parallel tracks
 - LTE
 - HSPA Evolution



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

LTE and SAE: System Architecture Evolution



- Core Network Architecture support for LTE in terms of:
 - Evolution of 3GPP core network
 - Simplified architecture
 - Full IP-Based
 - Higher throughput than legacy
 - Lower latency than legacy
 - Support for multiple RANs
 - Mobility between RANs

LTE and SAE: LTE Design Targets



- Capabilities
- System Performance
- Deployment –related aspects
- Architecture and migration
- Radio resource management
- Complexity
- General Aspects

LTE and SAE: LTE Design Targets - Capabilities

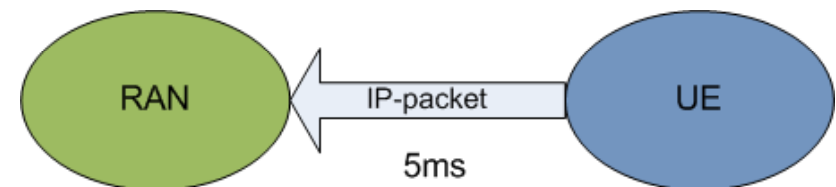
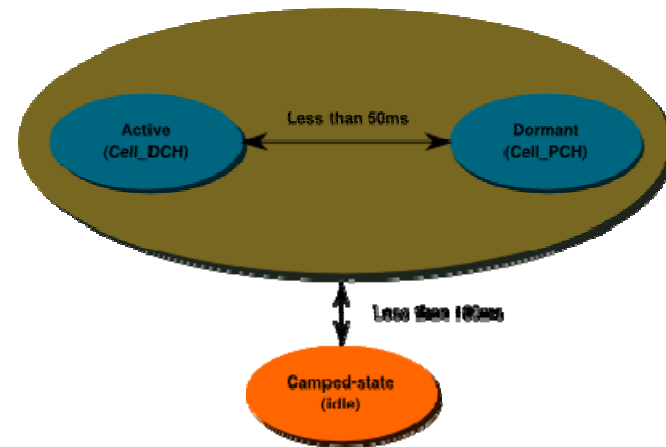


- Peak Data Rate
 - 100Mbps DL and 50Mbps UL @ 20MHz BW
 - 5bps/Hz DL
 - 2.5bps/Hz UL
 - 2 Rx antennas 1 Tx antenna
 - Simultaneous max peak rate in FDD only



LTE and SAE: LTE Design Targets - Capabilities (2)

- Latency
 - Control-Plane transition time
 - Less than 100ms from R6-Idle Mode to R6-CELL_DCH
 - Less than 50ms from R6-CELL_PCH to R6-DCH
 - User-Plane
 - Less than 5ms in a unload condition



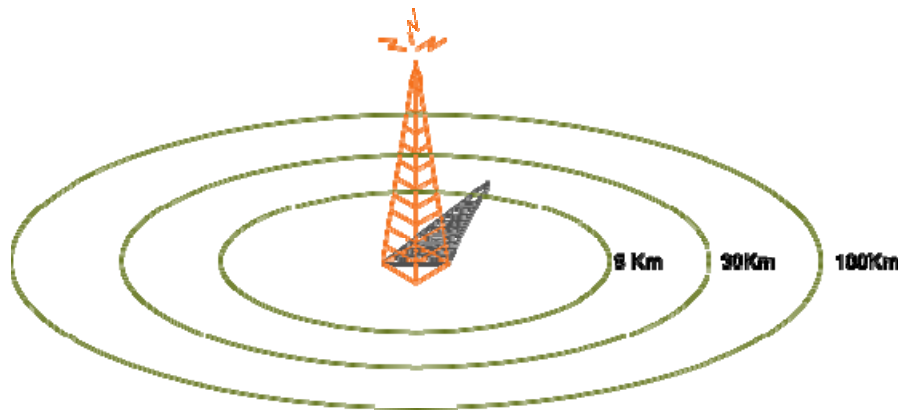
*Image Courtesy 3GPP "TR 25.913 Requirements for E-UTRA and E-UTRAN"

LTE and SAE: LTE Design Targets - System Performance

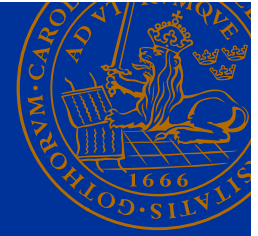


- User throughput target
 - Average user: 3x to 4x better than R6
 - Cell Edge: 5th percentil of the user distribution
- Spectrum efficiency defined as
 - Average user: 2x to 4x (DL), 2x to 3x (UL) better than R6
 - Cell Edge: 2x to 3x (DL), 2x to 3x (UL) better than R6
- Mobility
 - 0→15Km/h : Maximum performance
 - 15→120Km/h : High Performance
 - 120→350Km/h: Mantain connection

LTE and SAE: LTE Design Targets - System Performance (2)



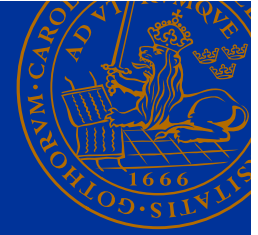
- Coverage
 - Up to 5km cell range: Normal Performance
 - Up to 30Km cell range: Slight degradation
 - Up to 100Km cell range: no requirements set
- MBMS
 - Broadcast mode
 - Unicast mode
- Network Synchronization
 - Int-site synch required
 - Yet, has to be supported



LTE and SAE: LTE Design Targets - Deployment Related Aspects

- Deployment Scenarios
 - Stand Alone
 - Integrated with existing RAT
- Coexistence 3GPP RATs
 - Interruption times
 - Broadcast (LTE) to Unicast(GSM)
- Spectrum Flexibility
 - Spectrum different size
 - Diverse arrangements
- Spectrum Deployment

	Non-real time	Real time
LTE → WCDMA	500 ms	300 ms
LTE → GSM	500 ms	300 ms



LTE and SAE: LTE Design Targets - Deployment Related Aspects (2)

- Spectrum Flexibility
 - Spectrum different size
 - Diverse arrangements
- Spectrum Deployment
 - Same operator, area, adjacent channels
 - Same area, diff operator, adjacent channels
 - Overlapping/adjacent spectrum at country borders
 - Deployment in steps



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

LTE and SAE: LTE Design Targets - Architecture and Migration

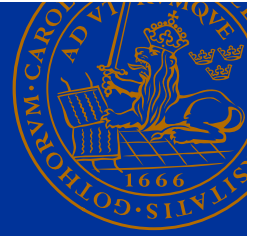


- A single LTE RAN should be agreed
- Packet Based, real time conversational traffic
- Minimize single points of failure
- Minimized number of interfaces
- RNL and TNL not excluded if improvement in system performance is required
- Support for end-to-end QoS
- QoS considers various types of traffic
- Minimized delay for traffic.

LTE and SAE: LTE Design Targets - Radio Resource Management

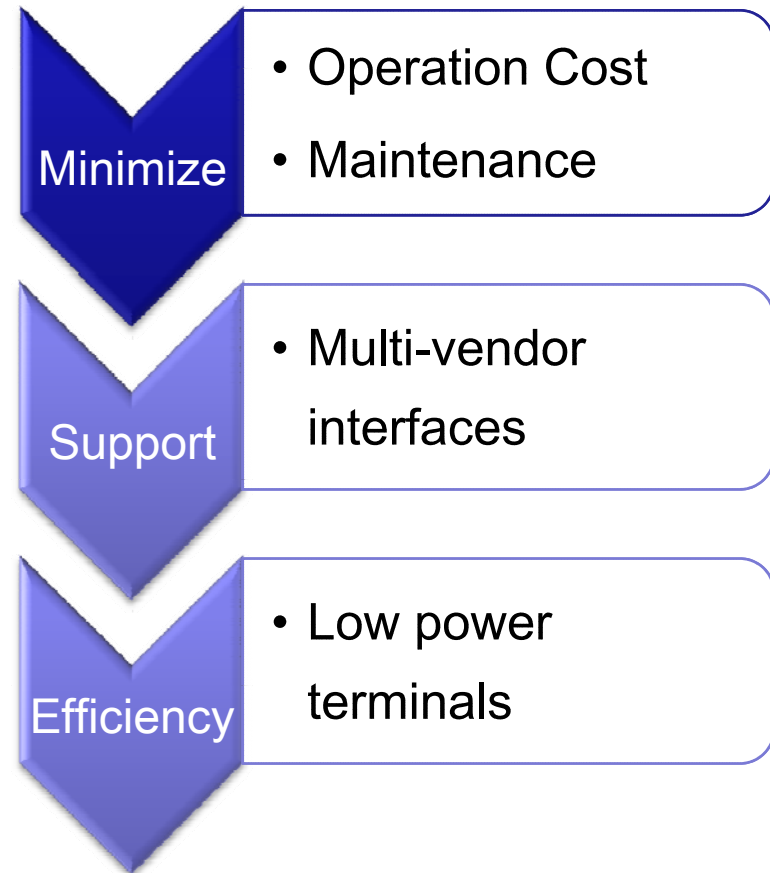


- Enhanced support for end-to-end QoS
 - Higher layer signaling
- Efficient support for transmission of higher layers
 - IP header compression
- Support load sharing and policy management across different RATs
 - Support end-to-end QoS during HO between RATs



LTE and SAE: LTE Design Targets - Complexity and General Aspects

- Complexity addressed
 - Overall system
 - Mobile terminal
- General Aspects
 - Minimize operation cost
 - Minimize maintenance cost
 - Multi-vendor interfaces
 - Low power mobile terminals





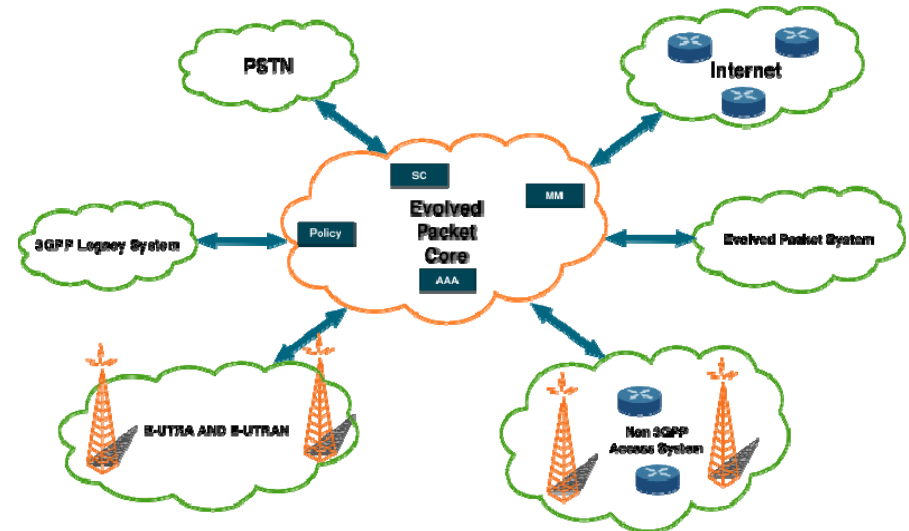
LTE and SAE: SAE Design Targets

- High level user and operational aspects
- Basic capabilities
- Multi-access and seamless mobility
- Man-machine interface aspects
- Performance requirements for the evolved 3GPP system
- Security and privacy
- Charging aspects

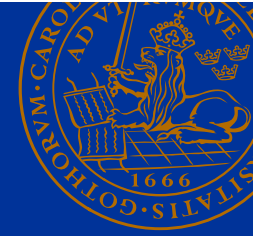


LTE and SAE: SAE Design Targets - Inter-operability

- Inter-operability between more RATs than LTE even others than 3GPP's
- Roaming
- Inter-working with packet-based and circuit-switched networks

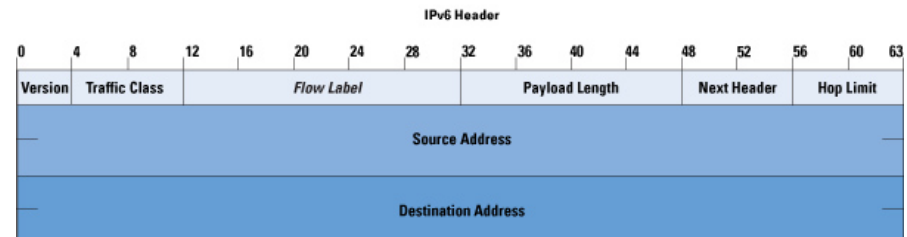
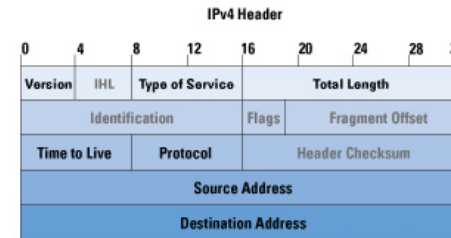


*Image Courtesy 3GPP "TS 22.278 Service Requirements for E-Packet System"



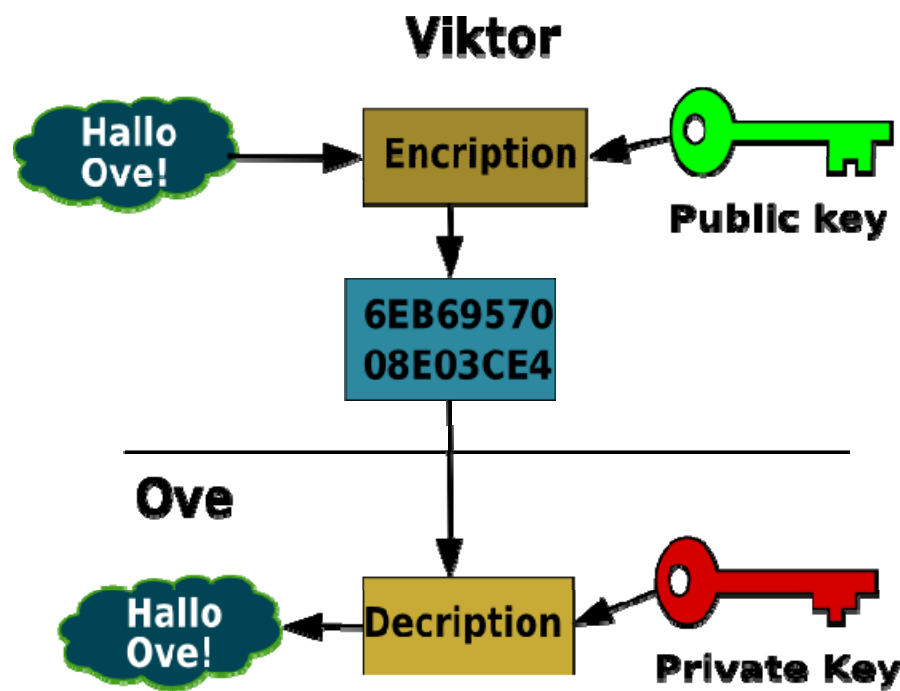
LTE and SAE: SAE Design Targets – Services

- Support for services like
 - Voice
 - Video
 - Messaging
 - Data transmission
- Support for IPv4 and IPv6
 - Included mobility from one of the other
- Support for QoS
 - Smooth mobility between 3GPP RATs



*Image Courtesy of CISCO

LTE and SAE: SAE Design Targets – Security and Charging Models



- Internet-like security mechanism
 - Level of user privacy
 - Identity protection
- Charging models
 - Calling party pays
 - Flat rate
 - Charge based on QoS
 - Data volumes

Chapter summary



- LTE
 - Higher data rate than legacy
 - Better coverage and performance
 - Flexible and scalable deployment
 - Designed from both, system and mobile terminal perspective
- SAE
 - Inter-operability between more RATs than LTE even non-3GPP
 - Simplified from predecessors (redundant features removed)
 - More secure than legacy
 - Faster than legacy
 - Better performance than legacy