3GPP TSG RAN WG2 LTE ad-hoc
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Sophia Antipolis, France

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Agenda item: 3.1

Targets and Principles for Long-Term Evolution of Radio Link Layer

Source: Nokia

Document for Discussion

Key Requirements for Radio Link Protocol - Latency

- Significantly reduced C-plane latency
  - a) transition time (excluding downlink paging delay and NAS signalling delay) of less than 100 ms from a camped-state, such as Release 6 Idle Mode, to an active state such as Release 6 CELL_DCH, in such a way that the user plane is established
  - b) transition time (excluding DRX interval) of less than 50 ms between a dormant state such as Release 6 CELL_PCH and an active state such as Release 6 CELL_DCH
- Specifications shall enable an E-UTRA U-plane latency of less than 5 ms in unload condition (ie single user with single data stream) for small IP packet, e.g. 0 byte payload + IP headers
  - One-way transit time between a packet being available at the IP layer in either the UE/RAN edge node and the availability of this packet at IP layer in the RAN edge node/UE (to be clarified once the architecture is clear)

From 25.913 v. 2.1.0

Key Requirements for Radio Link Protocol - Other

- Efficient support of the various types of services, especially from the PS domain (e.g. Voice over IP, Presence)
- System complexity shall be minimized in order to stabilize the system & inter-operability in earlier stage and decrease the cost of terminal & UTRAN. For these requirements, the following shall be taken into account:
  - a) Minimize the number of options
  - b) No redundant mandatory features
  - c) Reduce the number of necessary test cases, e.g. Reduce the number of states of protocols, minimize the number of procedures, appropriate parameter range and granularity
- C-plane capacity: The system should be able to support a large number of users per cell with quasi instantaneous access to radio resources in the active state. It is expected that at least 200 users per cell should be supported in the active state for spectrum allocations up to 5 MHz, and at least 400 users for higher spectrum allocation. A much higher number of users is expected to be supported in the dormant and camped state.

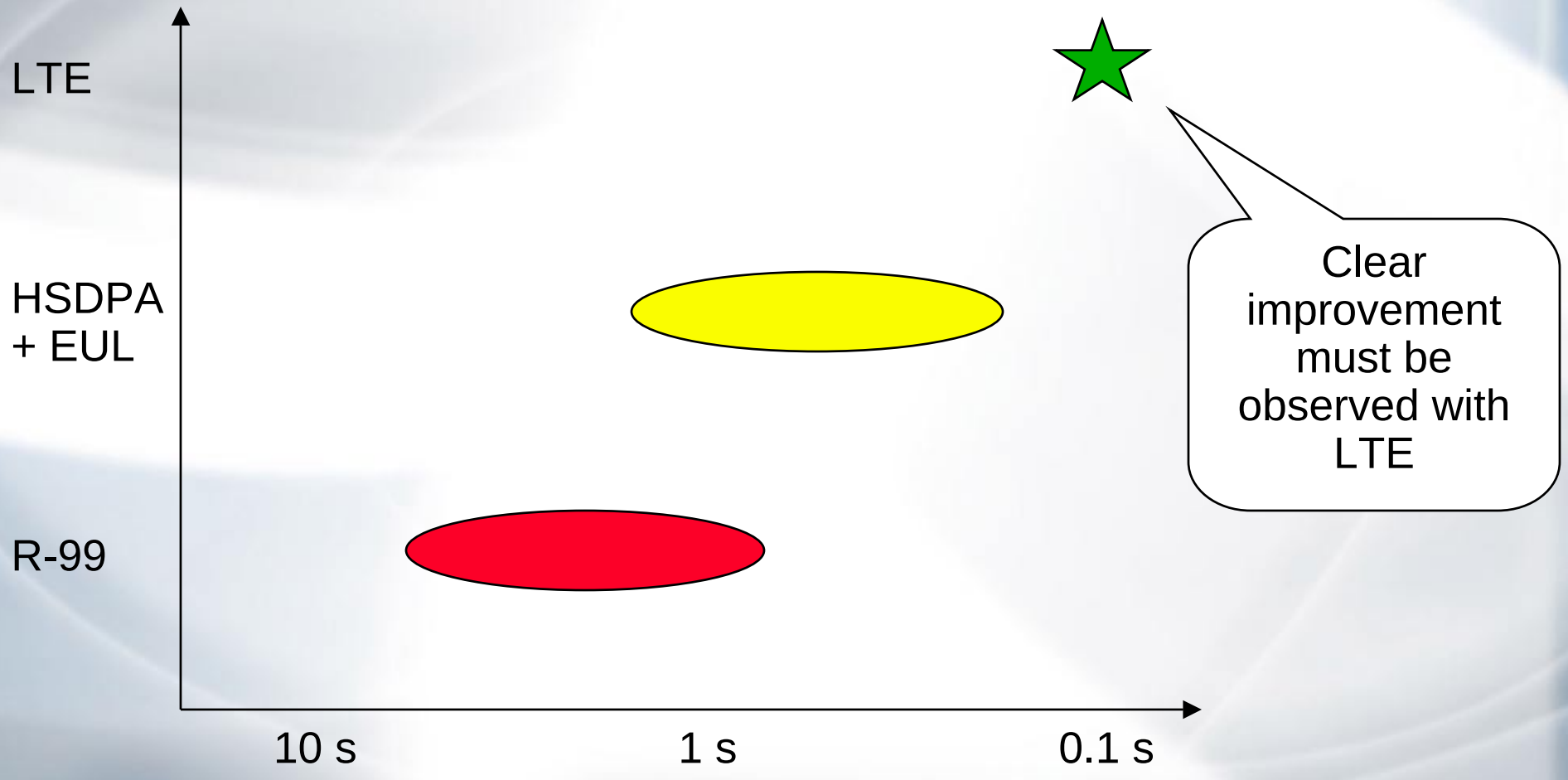
From 25.913 v. 2.1.0

Packet-Optimized Radio Link

- WCDMA L2 was designed to give ultimate flexibility for simultaneous CS and PS traffic
  - Target met with the cost of considerable complexity in configurations
- Long-Term Evolution to be optimized for packet traffic
  - Fast, simple, robust packet relay

- => It must be critically analyzed, what functionality in current radio link protocol specifications is beneficial for LTE

Channel Setup Time Improvements



Causes for C-plane Latency

- In current UTRA(N) the request to send U-plane packets triggers multiple setup procedures between different termination points on different protocol levels (RRC, GMM, SM, …)
- To improve latency without increasing cost, set-up signalling at traffic start-up time should be minimized
- Redundant procedures should be removed
  - All necessary preparations to be done at power-up time
    - Terminal authenticated and given all necessary addresses to transmit or receive packets
- In the scope of radio link protocols, the target should be to simplify the design in such a way that no over-the-air radio bearer setup negotiation is needed to start communication

No UE-NW Negotiated Radio Layer Bearers

- Present-day cellular systems configure radio access based on bearers
  - Bearer establishment in the beginning of the connection increases perceived end-user latency
  - Pre-establishing bearers before they are needed creates unnecessary context and wastes network resources
  - Bearer re-establishment increases service interruption
- Packet-based services are highly dynamic in nature

➔ No UE-NW setups for radio bearers

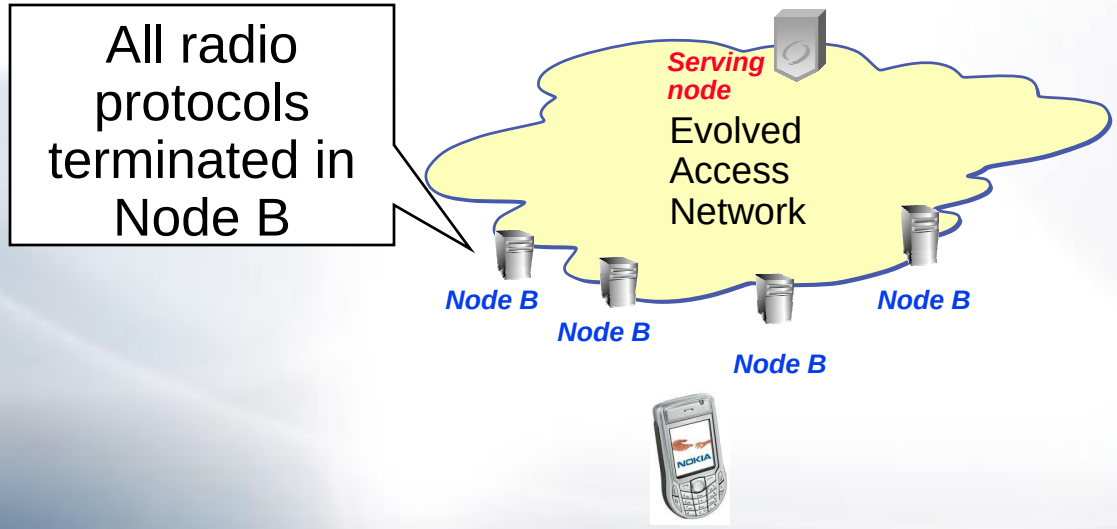
- NW based radio resource management still preferred for better system capacity
  - Uplink buffer occupancy measurement reports are needed
- Aim for common services to work on default parameters
  - Approximately like having the same pre-configured “TFCS” for all
  - Most flow QoS-related parameters only needed at the transmitter
    - Local service setup at the transmitting node enough
    - ARQ based on transmitter information

Comparisons to Current Radio Bearer Model

- The radio interface without pre-establishments for radio bearers can be compared to current WCDMA in (at least) two ways
  - One default radio bearer with no associated QoS
    - Packet flows and their QoS profiles are implicitly established within the default radio bearer
  - Multiple radio bearers with implicit establishment
    - A new flow with default parameters is created by the transmitting node
- If both UE and NW L2 entities have to be configured with other than default parametrization, the initial default configuration can be optimized during the connection (synchronous reconfiguration)

U-plane Latency Reduction

- Mostly a requirement for the physical layer
  - Physical layer frame length, interleaving etc.
- Termination of all radio link signalling and retransmission in Node B will help to
  - Reduce signalling transmission within RAN
  - Reduce latency, especially when combined with retransmission



Optimization for Packet Traffic

- HSPA is already offering good support also for packet-based real-time services
- LTE will further enhance this capability
- In order to dynamically support a large amount of packet-switched traffic, the capacity of shared channels must be maximized
  - No more DCH support
- Resulting in significant simplifications in radio protocols
  - Reduced number of transport channels
  - Reduced amount of context information per UE
  - Reduced number of radio protocol states
  - Better power-saving capabilities
    - E.g. VoIP: With 0.5ms L1 TTI and 20ms speech frame, rx/tx could switch off up to 97.5% of the time (in reality the figure will be lower, but still attractive)
- To benefit from reduced complexity, the new RRC must not be an extension to the current one!
- From radio link protocol point-of-view, connection to only one Node B at a time is preferable and allows significant simplifications
  - Gain from macro diversity cannot be evaluated on radio link protocol basis

What needs to be done

- Major improvements to both C-plane and U-plane latency
  - Best c-plane start-up latency is achieved, if no over-the-air signalling is necessary to start traffic
    - No parameter exchange necessary at start-up time
  - Further decrease C-plane and U-plane latency by terminating radio functionality in the Node B
- Reduced complexity in radio protocols
  - Radio protocol optimization for packet traffic
    - All services provided by shared channels
    - Reduced number of radio protocol states
    - Better power-saving capabilities
  - If performance targets can be met without soft handover, further simplifications to radio protocols are possible
- In order to get full benefit from these simplifications, radio protocols must not be extensions to the current CS+PS versions!