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Motivation for LTE-WiFi Aggregation

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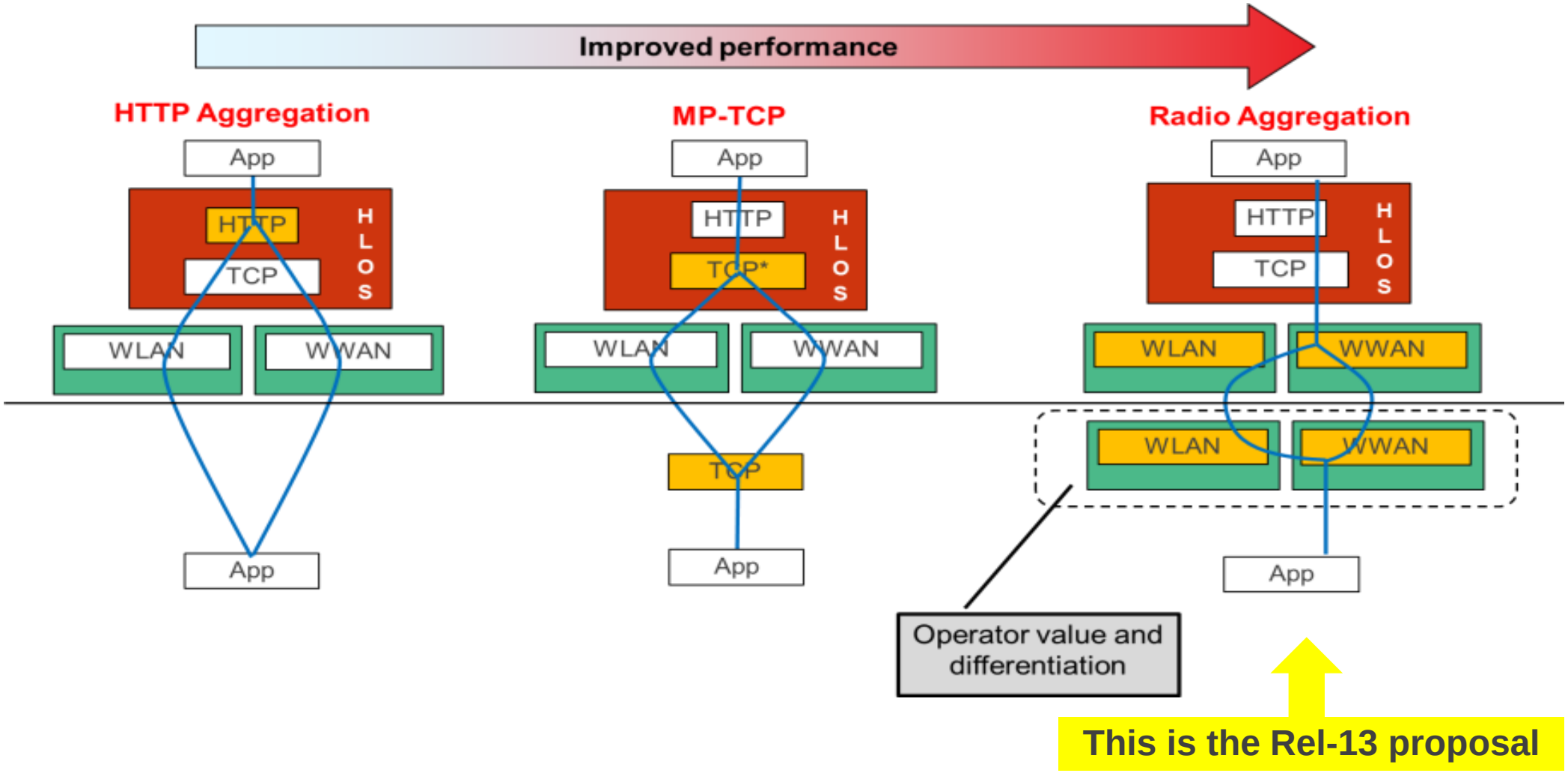
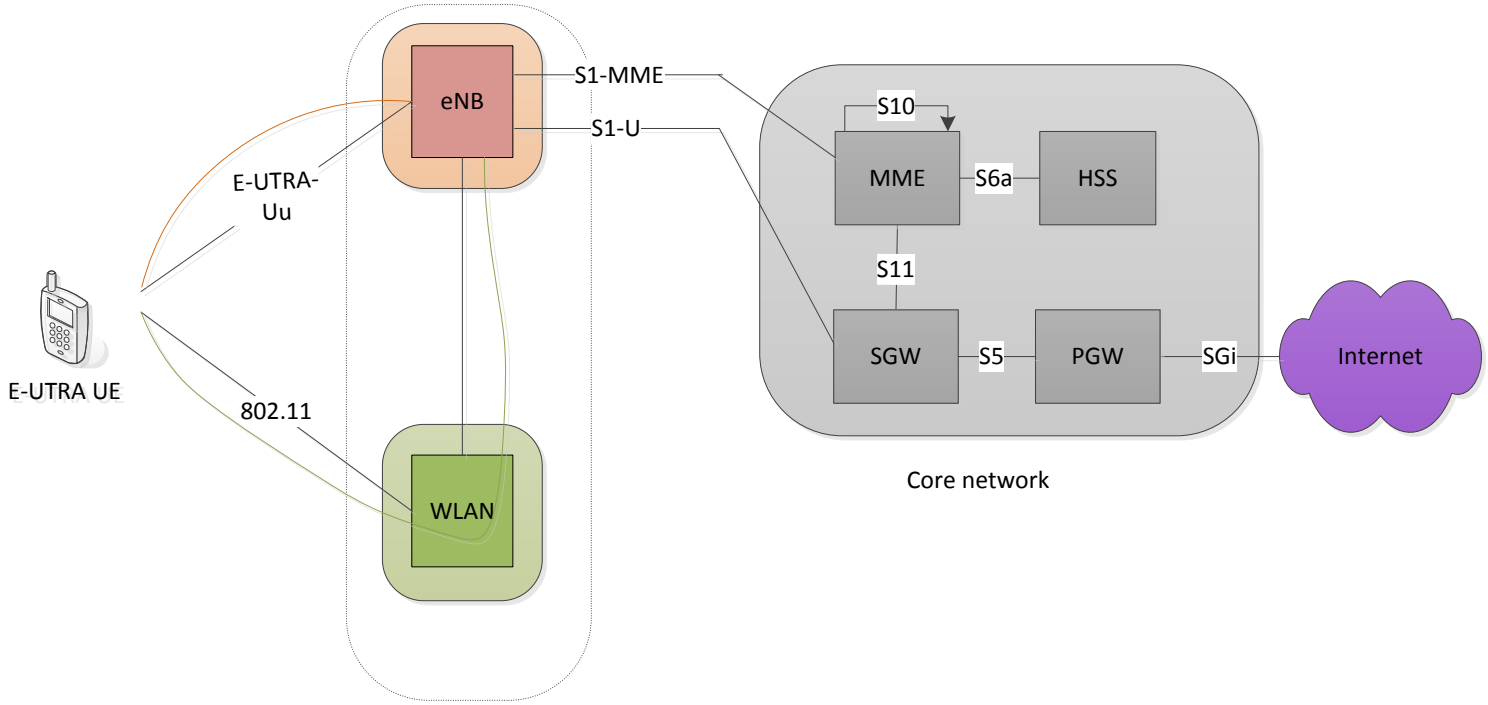
Motivation

- Current CN-based WLAN offloading solutions are useful for service & policy management but not efficient for radio and system performance:
  - No framework to jointly optimize radio link resources based on channel & load conditions
    - Application flows can not be aggregated on both links
  - They also do not allow tight control of WLAN offloading due to device centric methods
- Other device-based solutions for Cellular+WiFi aggregation create fragmentation & remove operator value:
  - E.g. HTTP Aggregation or Multipath TCP
  - See next slide
- **RAN-level Aggregation of LTE and WiFi provides many benefits**:
  - Dynamic allocation of resources based on radio and load conditions
  - Higher aggregate user throughput & system throughput
  - Unified network control and management of offloading and available resources (similar to LTE CA and DC)
  - Real-time load balancing
  - Minimal or no impact on core network and applications
  - RAN-level seamless handover support

E-UTRAN/WLAN Aggregation solutions (device based & operator-centric)



RAN Aggregation Architecture



- S1-U and S1-MME are terminated at the eNB; no impact on CN
- The interface between eNB and WLAN is left to implementation for collocated and will be standardized for non-collocated deployment:
  - The WLAN end-point of the interface is a reference point and where it is implemented (AP, AC, or another entity) is outside the scope of this SI/WI (and 3GPP in general)
  - Many features of the interface (protocol, flow control etc.) can be based on the Dual Connectivity solution
- No impact on 802.11; all control signaling for aggregation is on carried on Uu

Analysis of Aggregation

- eNB will serve as the anchor for both user and control plane:
  - No changes to the MME and S-GW/P-GW are needed
- The proposal is to use PDCP level aggregation of LTE and Wi-Fi, where a PDCP PDU can be served on either LTE or WiFi:
  - This does not mean that the granularity of eNB decision has to be per PDU and an implementation can make scheduling decisions over a longer time
- Initially both RLC and PDCP were considered as aggregation options. The choice of PDCP was mainly motivated by its adoption for Dual Connectivity (DC):
  - This will enable re-use of the standardization as well as UE and eNB implementation of DC
  - Aggregation is much simpler than DC since there is a single RRC and RRM at the eNB
- Aggregation above PDCP (at the eNB) has several disadvantages:
  - A new reordering layer will be needed to deliver packets in order to the upper layers and not to impact TCP
  - Common PDCP security can not be used
  - Re-use of Dual Connectivity features and building blocks will not be feasible

Analysis of Aggregation cont'd

- Advantages of PDCP aggregation compared to CN based offloading options (including "solution-3"):
  - Much higher system and user throughput due to real-time scheduling and the ability to use both radio links simultaneously for each data bearer
  - Control of data switching directly by the eNB instead of relayed through UE
  - Faster switching between LTE and Wi-Fi since CN switching requires signaling between the UE and CN
  - Better control of data delivered over WiFi via the standardized interface (e.g. flow control)
  - No impact on CN as data bearers are terminated at the eNB
  - Improved mobility since eNB can communicate with WLAN directly over the standardized interface
    - Other LTE Handover features such as data forwarding, along with PDCP Status Reporting, can also be enabled on the interface
  - Common PDCP security
  - Re-use of Dual Connectivity features and building blocks

3GPP Rel-13 proposal

- Proposing to consider both collocated and non-collocated scenarios
  - A single solution which are applicable to both cases are targeted in RAN2
  - The main difference for non-collocated will be the additional backhaul interface between E-UTRAN and WLAN and associated control signaling and data transfer on this interface

- The SI will be RAN2-led; the work on backhaul interface and signaling for the non-collocated case will be joint with RAN3.
  - The RAN3 part will avoid duplicating work for eNB-WLAN interface which is also being studied in the Multi-RAT SI.

- Interaction with SA2 will happen to study the co-existence with previous (Rel-12 and before) offloading solutions

Thank you

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