Pre-congestion notification in mobile networks

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ICCRG

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Scope of the draft

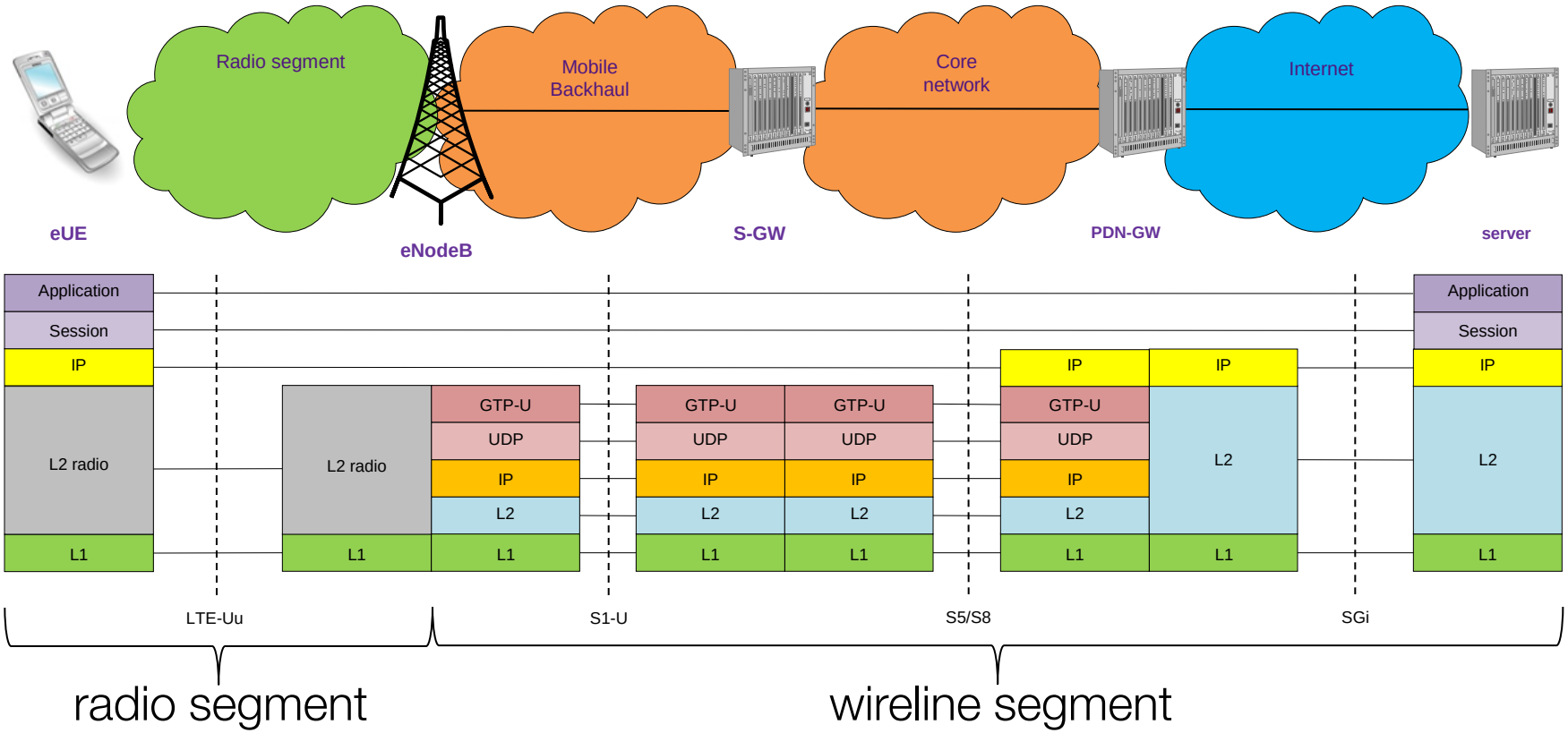
- Problem statement: which mechanisms might need to be documented to detect/manage congestion in mobile networks? In particular, ECN marking algorithms over radio segment.

- 1- Early/pre-congestion notification algorithms (e.g. ECN marking) usually significantly different for wireline/radio segments => not documented in general for the radio

- 2- ECN bits = unique signal for notifying a pre-congestion related to two separate segments with very different algorithms
  - potential benefits of being able to identify where the congestion comes from?

- 3- Counting the volume of congestion in the radio segment should take into account the radio conditions of the terminals

Radio and wireline segments in mobile networks (LTE/EPC example, data plane)



- Two IP layers in presence in the backhaul and core portions:
  - IP E2E layer: the end-to-end IP layer related to the end application
  - IP TNL layer: the transport IP layer which supports the GTP tunnel

Proposals

1. Typical behaviors of early/pre-congestion notification algorithms (e.g. ECN marking) in the radio segment should be documented somewhere.

2. The signal indicating a pre-congestion over the radio segment should be discussed. The main question is in particular to determine whether the ECN bits of the IP E2E layer correspond to the best signal or if a separate signal should be defined.

3. For the use cases where congestion-volume are counted (as discussed in the IETF ConEx WG), the radio conditions of the UE are taken into account in the count, e.g. via the introduction of a multiplicative factor, or with a pre-congestion notification probability (e.g. ECN marking probability) taking into account the radio conditions, …

thank you

questions?

Pre-congestion notification algorithms differ in general for radio and wireline segments

- Wireline segment: well-documented algorithms (e.g. RFC3168, RFC 2309…)
- Radio segment: more complex in general, and not really documented => Clear benefits in providing more details
  - An important aspect to be considered for the radio segment: a UE in poor radio conditions will need much more radio resources to reach the same throughput compared to a UE in good radio conditions, because less efficient Modulation and Coding Schemes are used
- Radio algorithms may therefore consider several parameters:
  - Average queue length exceeding a threshold, as for RED
  - Amount of radio resources used by a particular UE and/or by all the active UEs of the cell
  - Radio conditions of a particular UE

ECN bits in IP E2E layer: a single signal to carry pre-congestion notification related to two separate segments

- The standardized ECN coding in the header of IP E2E layer packets leads to having a unique signal for communicating to the receiver of the flows pre-congestion information potentially related to two separate segments, with very different notification algorithms
- Hence, pre-congestion located in the radio segment cannot be distinguished from those of the wireline segment
- Question raised: are there potential benefits in being able to identify where the congestion comes from (e.g. using separated signals)?
  - the initial ECN mechanism assumes that it is not required, but under the assumption that the ECN marking criteria are consistent over the entire network (not the case for the examples of mobile networks provided)
  - the exact answer may be more complex depending on the actions expected at the end device in case of ECN marking (interaction with TCP? congestion-volume counting? other?)
- The main question is in particular to determine whether the ECN bits of the IP E2E layer correspond to the best signal for indicating a pre-congestion happening in the radio segment

Congestion-volume counting over the radio segment should take into account the UE radio conditions

- Because UEs in bad radio conditions require more radio resources to reach the same throughput compared to UEs in good radio condition, it is proposed to take into account the radio conditions of the UE in the congestion-volume count when addressing the use cases discussed in IETF ConEx WG
- Alternative 1: each byte marked as pre-congested may be weighted by a multiplicative factor depending on the UE radio conditions instead of simply counting the number of bytes transmitted over the radio segment during a pre-congestion period.
- Alternative 2: pre-congestion notification probability (e.g. ECN marking probability) would take into account the radio conditions of the UE. Basically, the packets of a UE in bad radio conditions would be marked more often under pre-congestion periods than those of a UE in good radio conditions.
- This type of mechanism would provide incentive to end users in bad radio conditions to delay their non-urgent network consumptions.