



RP-160992

Motivation for reduced latency TDD Frame Structure for LTE

Huawei, HiSilicon, CATT

Background

- Existing TDD frame structure type 2 has limitations on achievable latency reduction gains due to limited DL-UL switching points in a radio frame.
- In the latency reduction SI (RP-150465), reducing TTI duration and introducing additional subframe type with more DL-UL switching points were studied and evaluated for TDD.
- In the RAN1#85 meeting, the following agreements were achieved [1][2]
 - It is recommended to support a design that is based on 1-slot sTTI for sPDSCH/sPDCCH/sPUSCH/sPUCCH for FS2 TDD in Rel-14
 - It is recommended to consider enhancements including other shorter sTTI duration(s), and additional DL-UL switching points/ additional subframe types for FS2 TDD latency reduction in Rel-15
- Following the above recommendation, additional DL-UL switching points/additional subframe types shall be supported for TDD latency reduction in Rel-15
 - Shorter sTTI duration(s) than the slot-based sTTI duration shall also be supported for TDD in Rel-15.

■ [1] 3GPP, “Draft Minutes report of 3GPP TSG RAN WG1 #85 v0.1.0”, Nanjing, China, May 23-27, 2016.

■ [2] TR 36.881 Study on latency reduction techniques for LTE.

Reduction of U-plane Latency

- U-plane latency is one of the key targets for both LTE evolution and NR.
- A TDD frame structure based on additional subframe type can significantly reduce the U-plane latency for TDD.
 - Up to 40% U-plane latency reduction in DL and Up to 30% U-plane latency reduction in UL can be achieved [3][4], compared to without additional subframe type under the same sTTI

Table 1. Example of average U-plane latency with 10% HARQ BLER for enhanced TDD with additional subframe types [3]

Short TTI		FDD	TDD-LTE (config1 DSUUD)	Enhanced TDD[3] (Example)
1-slot sTTI	UL	2.4ms	3.49ms	2.92ms
	DL	2.4ms	2.93ms	2.8ms
2-symbol sTTI	UL	0.6857ms	1.92ms	1.10ms
	DL	0.6857ms	1.43ms	1.00ms

Much higher than 1ms

Close to 1ms with 10% HARQ

Lower than 1ms with 0% HARQ (UL:0.97ms, DL:0.81ms)

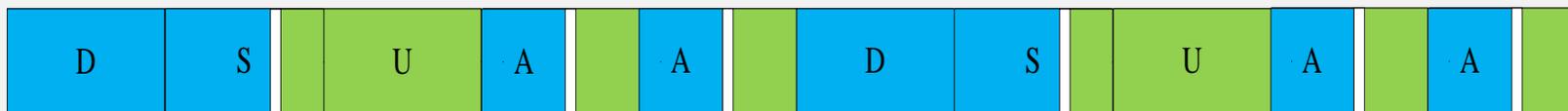


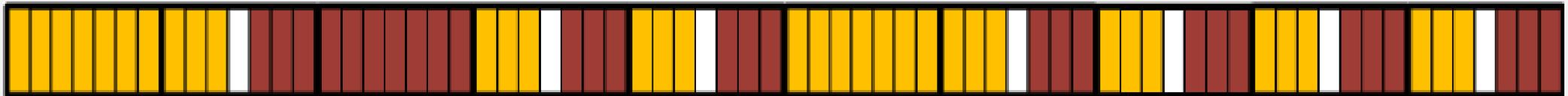
Figure 1. Example of TDD frame structure with additional subframe type [3]

■ [3] R1-164070, “Discussion on U-plane latency for TDD,” Huawei, HiSilicon

■ [4] R1-164236, “TDD system design for shortened TTI and related procedures for latency reduction,” CATT

Gain of User Perceived Throughput

- User perceived throughput is one of the key targets for both LTE evolution and NR.
- A TDD frame structure based on additional subframe type can significantly increase the user perceived throughput for TDD.
 - Up to 34% UPT gain and up to 47% user packet delay reduction can be achieved by TDD frame structure with additional subframe type with 0ms core network delay, compared to 2-symbol sTTI without additional subframe type
 - Up to 29% UPT gain and up to 41% user packet delay reduction can be achieved by TDD frame structure with additional subframe type with 6ms core network delay, compared to 2-symbol sTTI without additional subframe type



■ Figure 2. Example of TDD frame structure with additional subframe type with 2-symbols TTI length [6]

■ [5] R1-164823, “Summary of performance evaluation for latency reduction in TDD,” Huawei, HiSilicon

■ [6] R1-164237, “TDD system performance evaluation of latency reduction,” CATT

■ [7] R1-164637, “System-level performance evaluation for TDD,” ZTE

Tentative WI Objectives

- The objective of this work item is to specify the following for TDD
 - Specify additional subframe type(s)
 - The duration and arrangement of the DL part, GP, and UL part in the additional subframe type(s)
 - The signaling indication of the additional subframe type
 - Specify transmission duration shorter than 1-slot for sPDCCH/sPDSCH/sPUCCH/sPUSCH
 - At least 2-symbol sTTI shall be supported for both DL and UL
 - Aim to reuse the design in Rel-14 latency reduction WI as much as possible
 - The work item should also specify base station and UE core requirements to support the above features
 - The work item shall maintain backward compatibility