3GPP TSG RAN Meeting #73
New Orleans, USA, September 19 - 22, 2016

RP-161709
AI: 10.11.1

Discussion on the scope and timeline of Shortened TTI and processing time for LTE

Huawei, HiSilicon, SK telecom, China Unicom, CATR

Background

- A work item on shortened TTI and processing time for LTE was approved in RAN#72
  - Core part target completion date Sep. 2017

- Scope including
  - Processing time reduction for legacy 1ms TTI, for FS1/2/3
  - For FS1, sPDCCH/sPDSCH/sPUSCH/sPUCCH design based on
    - 2-symbol and 7-symbol for sPDCCH/sPDSCH
    - 2-symbol, 4-symbol , and 7-symbol for sPUSCH/sPUCCH with possible down selection on supported sTTI duration
  - For FS2, sPDCCH/sPDSCH/sPUSCH/sPUCCH design based on 7-symbol
  - Both CRS based and DMRS based sPDCCH/sPDSCH included
  - Both CA and non-CA included

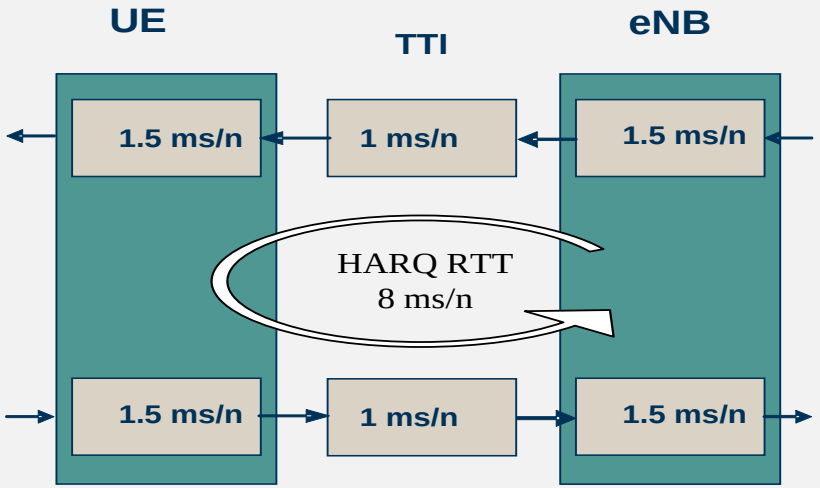
Motivations

- The scope of current shortened TTI and processing time WI is large
- Several sub-features can be decoupled and introduced in a phased approach
- Availability of key shortened TTI sub-features in Rel-14 provides smooth and continuous LTE evolution
- Need to carefully balance the Rel-14 scope and the available TUs

SLS observations (cited from TR36.881)

- “The results of all sources reveal that shortening TTI length can have great benefits in terms of user perceived throughput and latency.”
- “All sources with results for different core network delays show that gains when operating with shorter TTI reduce with larger core network delay but are still very high at low load.”
- “In most cases, in the favourable situations for TTI shortening, gains are larger with TTI lengths shorter than slot based TTI.”
- “Most sources show that short TTI may have a benefit in terms of reduced average system resource utilization.”

Benefits of sTTI on reduced latency



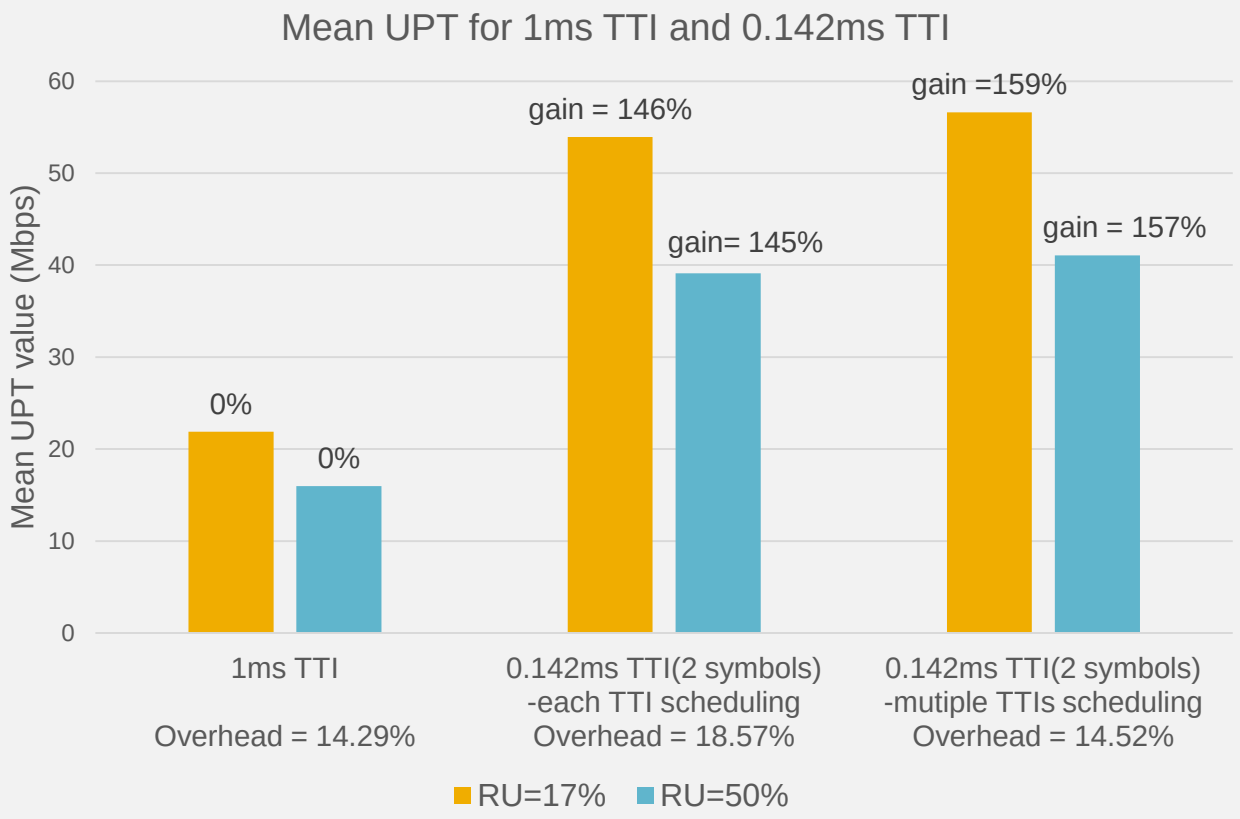
TTI	UP latency
7-symbol	2.4ms
2-symbol	0.68ms
ITU-R 5G req	1ms

UL latency components

Component	Description	Time
1	Average waiting time for PUCCH (1 TTI SR period)	0.5 * TTI
2	UE sends Scheduling Request (SR) on PUCCH	1 * TTI
3	eNB decodes Scheduling Request and generates the Scheduling Grant	3 * TTI
4	Transmission of Scheduling Grant	1 * TTI
5	UE Processing Delay (decoding of grant + L1 encoding of UL data)	3 * TTI
6	Transmission of UL data	1 * TTI
7	Data decoding and processing in eNodeB	3 * TTI
8	Backhaul(CN/Internet) transmission (to App server)	5ms
Total		12.5TTI+5ms

TTI length	UL Latency
1ms	17.5ms
7-symbol	11.25ms
4 or 3-symbol	8.125ms
2-symbol	6.79ms

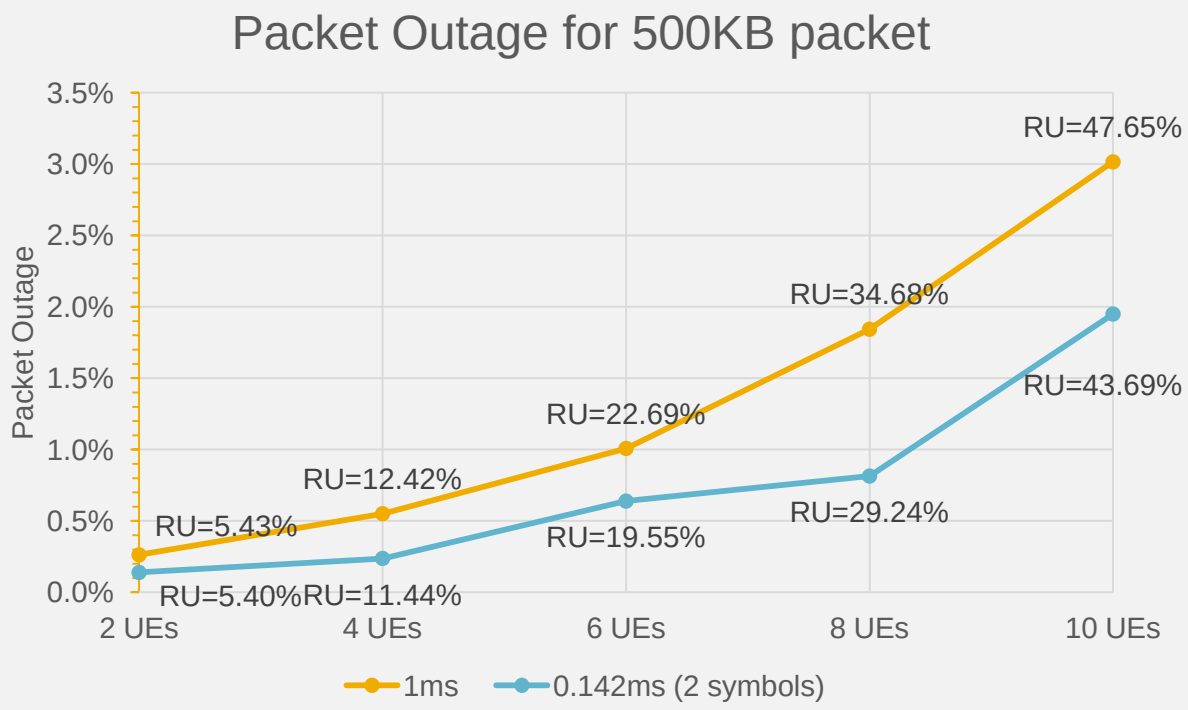
Benefits of sTTI on TCP throughput

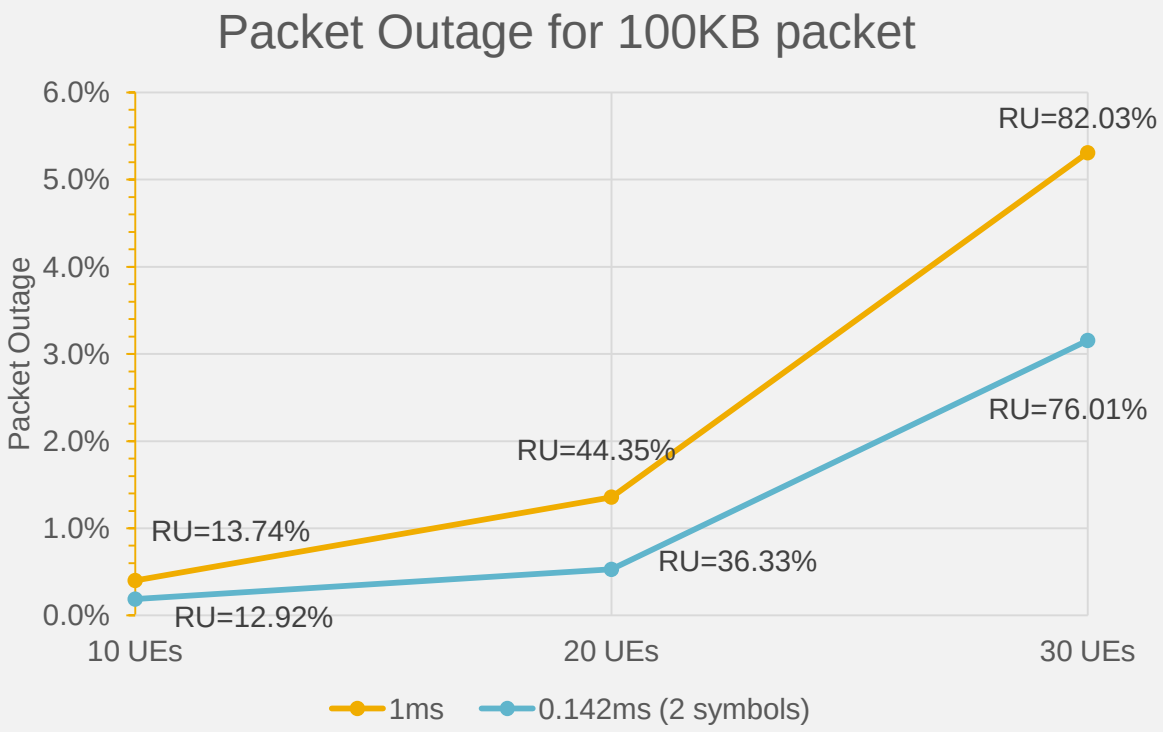


parameter	Value
Layout	19 Macro eNBs, 3 sectors per site
Bandwidth	20MHz
Number of UEs	10UEs per macro cell
Traffic mode	FTP model 3
FTP file size	0.5MByte
UE speed	3km/h
CN delay	0ms
Antenna configuration	2Tx(eNB), 2Rx(UE), Cross-polarized
TCP	modeled

2-symbol sTTI achieves significantly gain than 1ms TTI

Benefit of sTTI on reduced packet outage probability





Parameters	Value
Traffic model	FTP model 3
Transmission scheme	CRS based
Packet size	0.5, 0.1 MByte
CN delay	0 ms

2-symbol sTTI supports 40% more UEs compared to 1ms TTI @ 1% packet outage

Proposals

- Adopt a phased approach for introducing sTTI features

- At least complete the following objectives for Rel-14 inclusion
  - 2-symbol sTTI for sPDCCH/sPDSCH/sPUSCH/sPUCCH for FS1
  - CRS based sPDCCH/sPDSCH for FS1
  - DL CA and UL non-CA for FS1

RAN1

- DL and UL sTTI pattern
- CRS based sPDCCH: search space, time-frequency config
- sDCI: one or two-level sDCI and detailed contents
- CRS based sPDSCH: TBS determination, RE mapping
- sPUSCH: DMRS, TBS determination, RE mapping
- sPUCCH: formats
- DL/UL HARQ/scheduling timing
- UCI on sPUSCH
- Collision handling
- CSI measurement and reporting

RAN2

- Impacts on DRX, HARQ, SPS, etc
- Potential impacts on PHR, etc
- UE capability and RRC configuration

RAN4

- Impact on RF, RRM
- Demod tests

TU allocations

current

	2016.10	2016.11	2017.2	2017.4	2017.5	2017.8	2017.10	2017.11	2018.2
RAN1	2	2	3	3	2	2			
RAN2		0.5	0.5	0.5	0.5	0.5			
RAN4 RF core		0.5	1	1	1	1			
RAN4 RD core		0.5	1	1	1	1			
RAN4 RF perf							0.5	0.5	0.5
RAN4 RD perf							1.5	1.5	1.5

proposed

	2016.10	2016.11	2017.2	2017.4	2017.5	2017.8	2017.10	2017.11	2018.2
RAN1	2	2	6	3	2	2			
RAN2		0.5	0.5	0.5	0.5	0.5			
RAN4 RF core		0.5	1	1	1	1			
RAN4 RD core		0.5	0.5	0.5	0.5	0.5			
RAN4 RF perf				0.25	0.25	0.25	0.25	0.25	0.25
RAN4 RD perf				0.5	0.5	1	0.5	1	1

perf for Rel-14 scope

perf for Rel-15 scope

Considering treating sTTI in Jan 2017 ad-hoc meeting, if deemed necessary

THANK YOU

www.huawei.com

Copyright©2014 Huawei Technologies Co., Ltd. All Rights Reserved.

The information in this document may contain predictive statements including, without limitation, statements regarding the future financial and operating results, future product portfolio, new technology, etc. There are a number of factors that could cause actual results and developments to differ materially from those expressed or implied in the predictive statements. Therefore, such information is provided for reference purpose only and constitutes neither an offer nor an acceptance. Huawei may change the information at any time without notice.

HUAWEI