



# MediaTek Rel-16 Priorities

## AS Aspects

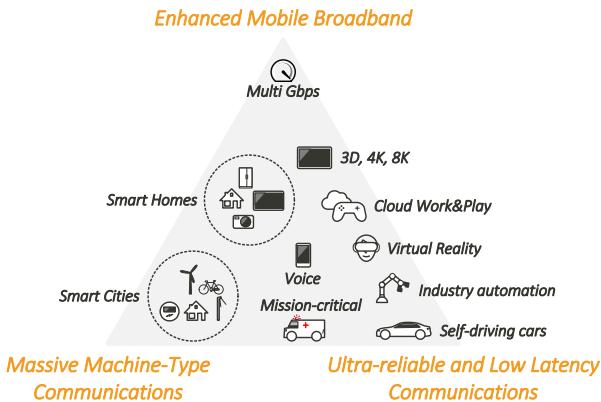
**Companion to SP-180347**

# Outline

- Key directions
- Priorities
- Cross-TSG harmonization

# Key Directions

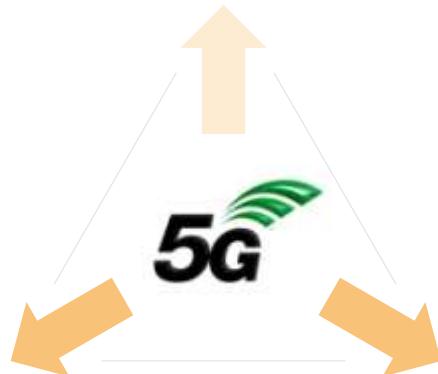
Rel-15 – 3GPP foundation for IMT2020



Technology enablers for IMT2020

eMBB focus, URLLC enablers, IoT LPWA leverage (EPS), V2X

Rel-16 – Improve, while leveraging, Rel-15



“Service”-driven  
enablers and enhancements

URLLC, IoT, Verticals, eMBB enh.



Overall  
efficiency improvements

System-wide enhancements from AS to NAS

# MediaTek Priorities

## NR and E-UTRA

# Priorities

NR – Establish a solid base	E-UTRA – Leverage existing base	NB-IoT – Grow beyond existing base
<ul style="list-style-type: none"><li>• Maximize re-use of Rel-15 implementation</li><li>• Expand NR footprint beyond<ul style="list-style-type: none"><li>• eMBB</li><li>• traditional MNO markets</li></ul></li><li>• Increase NR overall efficiency</li></ul>	<ul style="list-style-type: none"><li>• Evolution with strong justification only i.e. clear undeniable market demand</li></ul>	<ul style="list-style-type: none"><li>• LPWA as target</li><li>• Increase overall efficiency</li><li>• 5GC connectivity</li></ul>

# Priorities – Summary

NR		
High	Mid	Neutral
NR Unlicensed ( <i>ongoing</i> )	NR V2X	NR NTN
NR MIMO	Positioning	Data collection, MDT, SON
NR Voice/Video/TCP	NR mmW mobility	6-24GHz
NR Power Consumption	NR NOMA ( <i>ongoing</i> )	NR IAB ( <i>ongoing</i> )
NR URLLC		Remote interf. management
NR Spectrum utilization (Fast Scell activation, mmW DL Sub-6 UL)		NR-IoT
		NR aerials

E-UTRA		
High	Mid	Neutral
Mobility enhancements (robustness)	TDD DL MIMO SRS Enhancements	WTTc/UL CPE enh
High speed train		V2X Advanced Rx
IoT (NB-IoT-based)		

# NR High Priority Items

# NR Low Power – Scope

## RAN1-led

### Scope

- eMBB
- FR1
- Connected mode enhancements for L1 setting switching, access procedure and assistance, carriers management and measurements
- Idle mode enhancements for paging, measurements and mobility management
- Applicability to NR unlicensed

RAN1: 2 TUs / meeting Aug 2018 – June 2019

RAN2: at least 1 TU / meeting

NOTE: DRX, Schedule Request deemed part of access procedure and assistance

# NR Low Power – Motivation

## RAN1-led

- NR UE power consumption driven by
  - Wide bandwidth operation
  - 4-Rx and 4-layer operations
  - Shorter TTI and timing requirements
  - Reduced and distributed sync resources
- Goal to make NR energy efficient
  - a) Improvements in user experience brought by NR (e.g. data rates) should not be challenged by a potential deterioration of UE battery life
  - b) Need to outperform LTE
  - c) Need to provide minimal power consumption whenever possible
- Need to study fundamental improvements to major power-consuming operations:
  - PDCCH-only
  - (Small) data delivery
  - Synchronization for long DRX and IDLE
- See [RP-180350](#) (RAN#79) and [R1-1804070](#) (RAN1#92-Bis)
- NOTE: Rel-15 UE may also benefit from the study

# NR MIMO – Scope

## RAN1-led

### Scope

- (N1) MU-MIMO enhancements
  - Linear combination codebook beyond rank 2
- (N2) Multi-TRP/panel Tx/Rx, including
  - Downlink control signaling enhancement
  - CSI feedback enhancement
  - QCL assumptions
- (N4) UL-MIMO enhancements
  - Codebook enhancement
- (N6) Beam management
  - Beam selection/reporting
  - UL beam management
  - Control channel BM

RAN1: min. 3 TUs / meeting

MIMO topics are big (e.g. Multi-TRP is comparable to CoMP in LTE that was a dedicated WID) hence large amount of TU

# NR MIMO – Motivation

## RAN1-led

- (N1) Boost system throughput in all scenarios
- (N2) Improve NR robustness, especially for mmW
  - Positive side-effect on URLLC
- (N4) Fix Rel-15 UL MIMO sub-optimal codebooks
- (N6) Good support for mobility, especially for mmW

# NR Voice, Video, TCP Enh. – Scope RAN2-led

Scope	
Voice	<ul style="list-style-type: none"><li>UDC (for initial SIP message)</li></ul> <p>NOTE: from system standpoint all mobility/IW mechanisms are defined in Rel-15 except SRVCC to UTRAN CS (Rel-16)</p>
	~1 TU for two meeting cycles (UDC)
Video	<ul style="list-style-type: none"><li>TCP Ack prioritization</li></ul> <p>See TCP (i.e. same TU used)</p>
TCP	<ul style="list-style-type: none"><li>Achieving and maintaining TCP high throughput in presence of time-varying mmW blocking</li><li>TCP Ack prioritization</li></ul> <p>1 – 2 TU / meeting for all of the above</p>

# NR Voice, Video, TCP Enh. – Motivation

## RAN2-led

- Large SIP messages can result in e.g. HO failure in bad channel conditions (e.g. cell edge)
  - Compression can reduce the likelihood of RLF
  - SIP/SigComp (allowing DEFLATE and LZSS) is complex and not used with E-UTRA/NR (see IR.92, TS24.229)
- Significant drop of TCP throughput results from
  - Head-of-line blocking i.e. ACKs blocked by pending data
  - Blocking at high frequencies – frequent with mmW
- Solutions to tackle the above are required to prevent significant degradation of performance, and to fully exploit data rates offered by NR
- Other: TCP ACK volume increases as data rate increases, using valuable radio resources
  - Reduction of TCP ACK can preserve high throughput while ensuring better use of radio resources

# NR URLLC – Scope RAN1-led

## Scope

- UL Grant-Free transmission enhancements
  - Framework enhancement
  - Intra-UE multiplexing
- CSI feedback enhancements
- PUCCH reliability enhancements
- HARQ feedback procedures for URLLC
- URLLC specific power sharing with eMBB
- Performance improvements for cell-edge UEs

RAN1: 3 TU / meeting, RAN2: 1TU / meeting

# NR URLLC – Motivation

## RAN1-led

- Complete Rel-15

Enhancements	Motivation	Reliability	Latency	Spectral Efficiency
UL grant-free	Current framework does not meet Reliability+Latency joint targets	✓	✓	
CSI feedback	To boost performance in terms of reliability and spectrum efficiency	✓		✓
PUCCH reliability	NACK-to-ACK errors impact reliability in DL Tx. Power efficient schemes need to be adopted to satisfy the URLLC requirements.	✓		
HARQ feedback procedures	Rel-15 HARQ feedback designed for eMBB – not suitable for low latency		✓	
Per-UE power sharing with eMBB	Simultaneous URLLC and eMBB use not accounted for in Rel-15	✓	✓	
Cell-edge performance	Improve coverage for services with high reliability	✓		

# NR Spectrum utilization – Scope RAN1-led

## Scope

- Enhanced CA operation for fast Scell activation
- Pairing between SUL in sub6 & DL in mmWave

RAN1: 1~2 TU / meeting (Note new BC expected from RAN4)

# NR Spectrum utilization – Motivation

## RAN1-led

- Fast SCell activation for improved UE performance in terms of throughput and power consumption
  - Increased usage of small cells with NR
  - Increased challenges with high frequencies e.g. frequent blocking, needing prompt recovery
  - Better CA use
- Tackling challenging deployments with mmW
  - Enabling UL in sub-6 when DL uses mmW

# IoT – Scope RAN1-led

## Scope

### NB-IoT

- Efficiency, power consumption, mobility
- Mobility During Data transmission
- IRAT Cell Reselection (GERAN, LTE)
- Higher Order modulation DL
- HARQ Ack feedback enh. for UL transmission
- Link Adaptation Enhancements
- Scheduling enhancements (multi-TB, cross-carrier)
- Also 5GC connectivity (RAN2-led) need to be addressed

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### NR

- Co-existence/co-deployment with NB-IoT
- (Non LPWA NR-IoT)

RAN1: 2 TU / meeting    RAN2: 1~2 TU / meeting

# IoT – Motivation RAN1-led

- NB-IoT footprint is expanding – crucial technology for LPWA IoT
- Power efficiency and deep coverage remain defining characteristics of NB-IoT
- Room for further improvements of NB-IoT capabilities
  - Mobility incl. iRAT mobility to allow service continuity in misc. deployment scenarios
  - Radio resource usage and overall efficiency as a function of coverage/link quality
    - Adaptation to coverage and link quality: better radio resource usage, better power efficiency
    - Faster DL data Tx when possible: better radio resource usage, improved service quality
    - HARQ feedback enhancements: better latency for better power efficiency

# NR Medium Priority Items

## Motivations

# NR Medium Priority Items – Motivations

Topic	Key Motivation
• V2X	<ul style="list-style-type: none"><li>• Complements V2X via E-UTRA</li><li>• NR V2X to fulfill V2X Stage 1 requirements E-UTRA can fulfill, and latest ones</li></ul>
• Positioning	<ul style="list-style-type: none"><li>• High accuracy can enable new opportunities</li><li>• Minimizes dependencies on other technologies</li><li>• Can help when GNSS is unavailable e.g. Indoor</li><li>• Complements V2X</li></ul>
• NR mobility (mmW)	<ul style="list-style-type: none"><li>• Enable mobile mmW</li></ul>
• NR NOMA	<ul style="list-style-type: none"><li>• Improve spectrum efficiency</li></ul>

# LTE Items

# LTE Enhancements

LTE		
High	Mid	Neutral
Mobility enhancements (robustness) [SI]	DL MIMO SRS Enhancements	V2X Advanced Rx [SI – RAN4]
High speed train		WTTc/UL CPE enh [SI]
IoT (NB-IoT-based) – see IoT slide		
RAN1: 2TU/meeting RAN2: 1~2TU/meeting		

# LTE Enhancements

## Motivation

Topic	Key Motivation
Mobility robustness	<ul style="list-style-type: none"><li>• Service continuity</li></ul>
High speed train	<ul style="list-style-type: none"><li>• Realistic scenario with ~500km/h train e.g. in China, Japan</li></ul>
DL MIMO	<ul style="list-style-type: none"><li>• SRS enhancements (Virtual Cell ID, coverage, power control, trigger/configuration of semi-persistent SRS)</li></ul>
V2X Advanced Rx	<ul style="list-style-type: none"><li>• Ok to have new performance requirements</li></ul>
WTTc/UL CPE enh [SI]	<ul style="list-style-type: none"><li>• Clarifications needed</li></ul>

# **Cross-TSG harmonization**

## Coherence and timely finalization

# Cross-TSG harmonization

- Need to ensure a coherent system-wide evolution in Rel-16
  - Avoid orphan features i.e. AS (resp. NAS) features lacking NAS (resp. AS) enablers in the same release
- The next few slides provide an analysis of the current proposals in RAN (email discussions) and SA2
  - Observation: no fundamental contradiction between ongoing RAN and SA2 discussions however some items need clarification (see next slide ▲ )
- Other: alignment work
  - AS (resp. NAS) impacts might not always be envisaged at the inception of a new NAS (resp. AS) feature
    - however it is important that these impacts be identified as soon as possible to avoid detrimental impact on feature completion
  - Proposal:
    - NAS (resp. AS) impacts from a new AS (resp. NAS) proposal should be indicated at SA#82/Dec 2018 at the latest

# Ongoing RAN discussions [1/2]

## Ongoing WI (SI)

	Topic	TDoc	System-wide impact [To be confirmed by RAN]	Link to ongoing/new Rel-16 Stage 2 SI/WI
Ongoing WI	NR NOMA	<a href="#">RP-171043</a>	No	N/A
	NR Unlicensed ▲	<a href="#">RP-180229</a>	Yes – “USOS-like” <sup>(2)</sup>	No corresponding SI/WI however simple alignment based on EPS USOS should be possible
	NR NTN <sup>(1)</sup>	<a href="#">RP-171450</a>	No (only channel modelling and deployment scenarios)	N/A
	V2X evaluation <sup>(2)</sup>	<a href="#">RP-171093</a>	No	N/A
	NR IAB	<a href="#">RP-172290</a>	Unknown	N/A

NOTE 1: Channel models and deployment scenarios. NTN = non-terrestrial networks i.e. Satellite

NOTE 2: USOS ([SP-160117](#)) – enabling accounting of unlicensed spectrum use (WiFi, LTE) for charging and network planning purpose

NOTE 3: Evaluation methodology for new V2X *use cases* for NR and LTE

# Ongoing RAN discussions [2/2]

## Moderated email discussions (No approved WI/SI yet)

	Topic	TDoc	System-wide impact [To be confirmed by RAN]	Link to ongoing/new Rel-16 Stage 2 SI/WI
Ongoing email discussions (NR)	NR Vo/Vi/TCP	<a href="#">RP-180397</a>	No	N/A – potential alignment work
	NR Low Power	<a href="#">RP-180229</a>	Unknown	N/A – potential alignment work
	NR MIMO	<a href="#">RP-180578</a>	No	N/A
	IoT/MTC	<a href="#">RP-180581</a>	Potential	FS_CIoT_5G
	NR URLLC	<a href="#">RP-180432</a>	Potential	FS_5G_URLLC
	NR Mobility	<a href="#">RP-172515, 2564, 2325, 2414</a>	Unknown (RAN Internal mobility)	N/A
	NR Positioning	<a href="#">RP-180319</a>	Yes	FS_eLCS
	NR V2X	<a href="#">RP-180426</a>	Yes	FS_eV2XARC
	B/Mcast	<a href="#">RP-180499</a>	Yes	Proposed SA2 SI ? ( <i>not seen again at SA2#127bis</i> )
	NR Flexible duplex	<a href="#">RP-180323</a>	No	N/A
	Others		<i>Discussions have not started</i>	TBC
	NR spectr. utiliz.	<a href="#">RP-180380</a>	No	N/A
	NR >52.6GHz	<a href="#">RP-180320</a>	No	N/A
	FS 6-24GHz	<a href="#">RP-180455</a>	No	N/A
	NR coverage eval	<a href="#">RP-180220</a>	No	N/A
	FS NR NTN	<a href="#">RP-180182</a>	Yes	Proposed SA2 SI
	NR remote interf.	<a href="#">RP-180311</a>	No	N/A
	MDT, SON etc.	<a href="#">RP-180462</a>	No	N/A
LTE	LTE Enh. <sup>(1)</sup>	<a href="#">RP-180223, 363, 369, 222, 238, 375, 436</a>	TBC	TBC

NOTE 1: Other than IoT, MIMO, Broadcast

# SA2-led studies – Rel-16

## Ongoing and new proposals

	WI	TDoc	Title	RAN Impact	Link to ongoing Rel-16 RAN discussion
Ongoing SI	FS_eNA	<a href="#">SP-170383</a>	Study of enablers for Network Automation for 5G	NG-RAN	MDT, SON, Big data
	FS_CIoT_5G	<a href="#">SP-170801</a>	Study on Cellular IoT support and evolution for the 5G System	NG-RAN	Yes – IoT/MTC, Arch. Option 5
	FS_ATSSS	▲ <a href="#">SP-170411</a>	Study on Access Traffic Steering, Switch and Splitting support in the 5G system architecture	NG-RAN + N3IWF	No corresponding RAN discussion
	FS_ENTRADE	<a href="#">SP-170934</a>	Study on encrypted traffic detection and verification	No	N/A
	FS_5WWC	▲ <a href="#">SP-170380</a>	Study on the Wireless and Wireline Convergence for the 5G system architecture	Unknown (RAN3?)	TBC
	FS_eV2XARC	<a href="#">SP-170590</a>	Study on architecture enhancements for 3GPP support of advanced V2X services	E-UTRAN, NG-RAN	Yes – V2X
	FS_eLCS	<a href="#">SP-170937</a>	Study on Enhancement to the 5GC Location Services	NG-RAN	Yes – Positioning
	FS_eIMS5G	<a href="#">SP-171052</a>	Study on Enhanced IMS to 5GC Integration	No	N/A
	FS_LLC_Mob	<a href="#">SP-171069</a>	Study on EPC support for Mobility with Low Latency Communication	E-UTRAN?	TBC – LTE enh.?
	FS_ETSUN	<a href="#">SP-170743</a>	Study on Enhancing Topology of SMF and UPF in 5G Networks	No	N/A
	FS_PARLOS	<a href="#">SP-170382</a>	Study on Stage 2 for PARLOS (NOTE: EPS related)	Unknown	N/A
	FS_5G_SRVCC	▲ <a href="#">SP-180120</a>	Study for single radio voice continuity from 5GS to 3G	NG-RAN	None for RAN2
	FS_eSBA	<a href="#">SP-180117</a>	Study on Enhancements to the Service-Based 5G System Architecture	Unknown	Not necessary
	FS_eNS	<a href="#">SP-180121</a>	Study on Enhancement of Network Slicing	Unknown	Not necessary
	FS_5G_URLLC	<a href="#">SP-180118</a>	Study on enhancement of URLLC supporting in 5GC	Unknown	TBC: URLLC?
	FS_EPS_URACE	<a href="#">SP-180119</a>	Study on enhancement of systems using EPS for Ultra Reliability and Availability using commodity equipment	E-UTRAN	TBC – LTE enh.?
	FS_AAI_LTE_NR	<a href="#">SP-180122</a>	Study on Application Awareness Interworking between LTE and NR	Unknown	Not necessary

# SA2-led studies – Rel-16

## Ongoing and new proposals

	WI	TDoc	Title	RAN Impact	Link to ongoing Rel-16 RAN discussion
Proposed SI	<TBD>	<a href="#">S2-185519</a>	Study on Architecture aspects of using satellite access in 5G	"NG-RAN + N3IWF" [?]	Yes – NTN
	<TBD>	<a href="#">S2-184505</a>	Study on 5G Multicast / Broadcast Service	NG-RAN	Yes – B/Mcast
	<TBD>	<a href="#">S2-185520</a>	Study on Support of flexible LADN	Unknown	N/A
	<TBD>	<a href="#">S2-185521</a>	Study on Enhanced support of Vertical and LAN Services	Unknown	N/A
	<TBD>	<a href="#">S2-185522</a>	Study on System architecture for next generation real time communication service	No	N/A
	<TBD>	<a href="#">S2-185524</a>	Study on optimisations on UE radio capability signalling	Yes	Not per se however been discussed in RAN2

# Thank You!