



3GPP TSG RAN Meeting #79
Chennai, India, March 19-22, 2018

RP-180319

Email discussion summary for Rel-16 SI proposal on NR Positioning

Agenda Item: 9.1.1

Source: Intel Corporation

Document for: Discussion

Introduction

Status Update

- RAN WG email discussion on NR Positioning was triggered on Feb 23, 2018
 - Moderator - Intel / Contact point - Seunghee Han
 - E-mail discussion tag [NR Positioning] – Ongoing in RAN WG e-mail reflector
- Discussion contents
 - Overview of SI submission proposals on NR Positioning
 - Outline of positioning work by 3GPP SA/RAN WGs
 - Summary of positioning use cases and requirements
 - Draft proposal on NR Positioning SI objectives
- Main inputs and discussion points of RAN e-mail discussion on NR Positioning

NR Positioning E-mail Discussion

Overview of 3GPP Work on 5G Positioning

3GPP SA Work

- Service requirements for next generation new services and markets ([TS 22.261](#))
- SMARTER use cases and potential positioning requirements ([TR 22.862](#))
 - Study is completed. Need for highly accurate positioning is identified
- Study on positioning use cases (5G_HYPOS) ([TR 22.872](#))
 - Study is ongoing. Latest update of use cases and requirements is available in ([S1-180246](#))

3GPP RAN Work

- Study on indoor positioning enhancements for UTRA and LTE ([TR 37.857](#))
 - Study is completed. Main focus is on emergency services and requirements for indoor UEs
- Study on scenarios / requirements for next generation access technologies ([TR 38.913](#))
 - Study is completed. Report formulates potential requirements to be targeted by 5G system

Overview of NR Positioning E-mail Discussion

Summary of Positioning Use Cases

Emergency Services

- Mission critical / emergency situations (e.g. E911 call, accident, fire, etc.)

General eMBB use cases / scenarios

- Positioning for indoor / outdoor scenarios

Vehicular related use cases

- Automated driving / road traffic monitoring

Aerials (Low Altitude Drones)

- Transport by drones, landing, geo-localized images (geo-stamp)

Factories of Future (Industry 4.0)

- Location of trolleys / track their movement

IoT (Logistics / Asset Tracking, etc)

- Warehouse, package delivery, supplies registry, equipment tracker
 - low complexity battery-powered sensors

Location Based Services

- Car parking / bike tracking / advertisement push / wearable tracking / augmented reality

Overview of NR Positioning E-mail Discussion

RAN1-led SI Proposals on NR Positioning (RAN#78)

Tdoc #	Titles	Company
RP-172371	Motivation for new Study Item on NR UE Positioning	CATT
RP-172398	Motivation for SI on NR positioning support	Intel Corporation
RP-172746	New SID: Study on NR positioning support	Intel Corporation, CATT, Qualcomm Inc
RP-172553	Motivation for new SI on high accuracy/low latency NR positioning	Ericsson GmbH, Eurolab
RP-172552	Study on high accuracy/low latency NR positioning	Ericsson GmbH, Eurolab

Inputs from RAN proposals and 3GPP RAN/SA work were taken into account for preparation of initial objectives for NR Positioning SI

NR Positioning SI

Initial Draft of Objectives – Under Discussion

- Study RAT dependent positioning technologies based on both Uu and PC5 [RAN1]
 - Define operating scenarios targeting commercial use cases as well as regulation
 - Define evaluation methodologies and deployment scenarios including at least:
 - ✓ Indoor and outdoor deployment scenarios covering Urban and Suburban areas
 - ✓ System parameters including operating bands below and above 6GHz
 - ✓ User dropping procedures
 - ✓ Performance metrics to evaluate vertical/horizontal positioning and the overall positioning accuracy and latency
- Study potential solutions of positioning technologies for RAT dependent positioning and hybrid of those [RAN1, RAN2]
 - For RAT dependent technologies, the study is based on measurement of NR signals for DL/UL/SL transmission
- Study of positioning architecture for location services, functional interfaces, protocol, and procedures for supporting NR dependent and hybrid of NR dependent and independent positioning technologies on both Uu and PC5 (if needed; otherwise, need to be confirmed) [RAN2, RAN3]

Comments on initial draft NR positioning SI objectives are welcome

Main Inputs and Discussion Points

On Sidelink Positioning

Sidelink Positioning – Companies Expressed Diverse Views

- In scope of NR positioning SI (Deutsche Telekom, Intel)
 - Ranging based on a sidelink might not only be relevant for V2X
- In scope of NR-V2X SI (Qualcomm, LGE)
 - Sidelink is an essential component for V2X study (resource allocation aspects)
 - V2X use cases, channel, deployment models and requirements are quite different
- In both scopes of NR positioning SI and NR-V2X SI (CATT, Huawei)
 - General architecture / protocols / technologies of V2X positioning under NR-pos SI
 - PC5 protocol / SL ranging / network assisted positioning under NR-V2X SI
- Out of current release scope / In scope of later releases (Ericsson, SONY, Nokia)
 - NR sidelink concepts are yet to be studied in 3GPP

Potential Conclusion

- ⇒ Keep V2X specific sidelink positioning in the scope of NR-V2X SI
- ⇒ Study generic sidelink positioning in application to other use cases than V2X in later releases
- ⇒ V2X use cases are in the scope from DL/UL interface perspective

Main Inputs and Discussion Points

On Diverse Use Cases / Requirements

Use Cases and Scenarios

- Diverse use cases and requirements need to be addressed (e.g. use cases IoT, V2X, factory, emergency, etc.)
- Not only regulatory use case but also commercial use case vs. prioritization on regulatory use case (e.g. E911) on NR carrier

Potential Conclusion

- ⇒ Define a representative number of evaluation scenarios to cover diverse use cases
 - Starting point (based on Ericsson's proposal)
 - One use case representing indoor, such as a factory (e.g. Indoor Office as a baseline)
 - One use case representing outdoor, such as UMi-street canyon and UMa scenario
 - One macro deployment from 37.857
- ⇒ IoT use cases (UEs with narrow BW) are in scope

Main Inputs and Discussion Points On Performance Metrics

Performance Metrics

- Latency of acquiring UE position – important for automotive use cases

Potential Conclusion

- ⇒ Latency should be considered
- ⇒ Details of performance metrics can be discussed by RAN1 as a part of evaluation methodology

NR Positioning SI

Revised Potential Draft of Objectives – Under Discussion

- Study RAT dependent positioning technologies based on ~~both-Uu and PC5~~ [RAN1]
 - Define a representative number of evaluation scenarios to cover diverse use cases targeting commercial use cases as well as regulation
 - One use case representing indoor, such as a factory (e.g. Indoor Office as a baseline)
 - One use case representing outdoor, such as UMi-street canyon and UMA scenario
 - One macro deployment from 37.857
 - ~~Define operating scenarios targeting commercial use cases as well as regulation~~
 - Define evaluation methodologies considering the above evaluation scenarios and ~~deployment scenarios~~ including at least:
 - ✓ ~~Indoor and outdoor deployment scenarios covering Urban and Suburban areas~~
 - ✓ System parameters including operating bands below and above 6GHz
 - ✓ User dropping procedures
 - ✓ Performance metrics to evaluate vertical/horizontal positioning and the overall positioning accuracy and latency
- Study potential solutions of positioning technologies for RAT dependent positioning and hybrid of those [RAN1, RAN2]
 - For RAT dependent technologies, the study is based on measurement of NR signals for DL/UL/~~SL~~ transmission
- Study of positioning architecture for location services, functional interfaces, protocol, and procedures for supporting NR dependent and hybrid of NR dependent and independent positioning technologies on ~~both-Uu and PC5~~ (if needed; otherwise, need to be confirmed) [RAN2, RAN3]
- Note1: IoT use cases (UEs with narrow BW) are in scope
- Note2: Latency of positioning fix should be considered and the details of performance metrics can be discussed by RAN1 as a part of evaluation methodology

Backup

Overview of Use Cases and Potential Requirements

Positioning Use Cases (5G_HYPOS)

Use cases		Potential requirements per use cases							
		Environment of Use	Accuracy	Velocity	Avail.	Update rate	TTFB	Latency	Other KPI
5.2.1	Bike sharing	5G coverage - Outdoor	2m Horizontal		90 %		10s	1s	
		Bounded area - Outdoor	0.2m Horizontal		99 %		10s	1s	
5.2.2	Augmented Reality	Outdoor - 5G coverage	1-3m Horizontal	2 m/s 10deg.	80 %	1 - 10 Hz	10s	1s	Low Energy
5.2.3	Wearables	5G coverage - Outdoor	2m Horizontal		90 %	30s - 300s	10s		Power saving mode
		Bounded area-Outdoor/Indoor	2m Horizontal		99 %	1s - 30s	10s	1s	
5.2.4	Advertisement push	5G coverage - Outdoor	3m Horizontal		90 %			60s	
		Bounded area-Outdoor/Indoor	3m Horizontal		90 %			60s	
5.2.5	Flow management	Bounded area - Outdoor/Indoor	10m Horizontal		80 %	10s	10s		
5.3.1	Patient location (in Hospital)	Bounded area - Outdoor/Indoor	3m Horizontal		99 %			60s	
5.3.2	Patient location (out Hospital)	5G coverage Outdoor/Indoor	200m Horizontal		99 %				
5.3.3	Trolley	Bounded area - Outdoor/Indoor	0.5m Horizontal		99 %			20ms	
5.3.4	Waste management	5G coverage - Outdoor	3m Horizontal		99 %	2h - 1 day		60s	Low energy (15 years)
5.4.1	Emergency call	5G coverage Outdoor/Indoor	50m Horizontal 3m Vertical		95 %		30s	60s	Reliability/ Confidence
5.5.1	Traffic Monitoring & Control	5G coverage - Outdoor	1-3m Horizontal 2.5m Vertical		95 %	10 Hz	10s	30ms	Antispoofing Antitampering
5.5.2	Road User Charging	5G coverage - Outdoor Bounded areas (tunnels)	<1m (across track) 3m (along track)	2 m/s	99 %	1 Hz	10s		Antispoofing Antitampering

Note: most use cases also feature potential requirements on modes of operation, intended for the UE, the Network or for the 5G system.

Overview of Use Cases and Potential Requirements

Positioning Use Cases (5G_HYPOS)

	Use cases	Potential requirements per use cases							
		Environment of Use	Accuracy	Velocity	Avail.	Update rate	TTF	Latency	Other KPI
5.6.1	Asset tracking and management	5G coverage - Outdoor	10-30m Horizontal	5 m/s	99 %	300s-1day			
5.6.1	Asset tracking and management	Bounded area - Outdoor	1m Horizontal		99 %	1s	1s bounin ded area		20 mJ/fix (average), Antispoofing, Antitampering, support for "out of coverage" positioning
5.7.1	UAV (Data analysis)	5G coverage - Outdoor Bounded area - Outdoor	0.1m Horizontal 0.1m Vertical	0.5 m/s 2 deg.	99 %		10s		Low Energy, Antispoofing, Antitampering
5.7.2	UAV (Remote control)	5G coverage - Outdoor	0.5m Horizontal 0.3m Vertical		99 %			150ms	Antispoofing Antitampering
		Bounded area - Outdoor	0.5m Horizontal 0.1m Vertical		99.9 %			150ms	Antispoofing Antitampering
5.8.1	Support multiple different location service	5G coverage - Outdoor	2m Horizontal		90 %		10s	1s	Management of different KPI and positioning services
		5G coverage - Indoor	0.1m Horizontal		99 %		10s	1s	
5.8.2	Support location capabilities negotiation	5G coverage							Support + negotiation of positioning methods (incl. hybrid)

Overview of Use Cases and Potential Requirements

SMARTER Use Cases and Potential Positioning Requirements (TR 22.862)							
Use Case	Accuracy						
Higher Accuracy Positioning Outdoor with High Speed Moving	<1m Up to 200km/h	[PR 5.4.3-001] The 3GPP system shall support higher accuracy location capability less than [3m] at [80%] of occasions In for services requiring a lower position accuracy (e.g., deliver dense packages from a warehouse to a delivery truck then to a delivery location), the 3GPP system should support high positioning accuracy (e.g., 0.5 m) in both outdoor and indoor, along with high density of the location tracing devices up to (e.g., 1 million devices per km ²), and high mobility at minimum of 100 km/h.				10 Hz	
Higher Accuracy Positioning with Low Speed Moving (including Indoor and Outdoor)	<1m Indoor and Outdoor	NOTE: [80%] of occasions means the probability of achieving the accuracy in total sampling [PR 5.4.3-002] The 3GPP system shall support location estimation of UE in less than [10] seconds when the information is requested by user					
Higher Accuracy Positioning for Low Altitude UAV in Critical Condition	Please refer to 5G HYPOS Aerials/Drones	[PR 5.4.3-003] The 3GPP system shall support different configuration for accuracy according to different service requirements					
Higher Accuracy Positioning for mIoT	Please refer to 5G HYPOS	[PR 5.4.3-004] Power consumption due to the continuous use of positioning service shall be minimized [PR 5.4.3-005] The 3GPP system shall support co-existence with legacy 3GPP positioning service and migration to higher accuracy positioning service					
Service Requirements for Next Generation New Services and Markets (TS 22.261)							
Use Case	Horizontal Accuracy	Vertical Accuracy	Latency	TTF	Availability	Power consump.	Rate
Mobile objects on factory floor	0.5m		500 ms		99.99%		

