3GPP TSG-SA WG1 Meeting #95
Electronic Meeting, 23 August - 2 September 2021

S1-213140

Rel-18 Proposal for ProSe Extreme Range

Source: Apple

Evolution of 3GPP device-to-device communications

- Since Rel-12, a number of 3GPP solutions have been defined for D2D
- Each solution targeted a different set of use cases, e.g. V2X and Public Safety
- Focus has been on range within 1km for latency-sensitive applications needing relatively high data rates

- From a service perspective, a gap exists for lower data rate applications that need a larger range, which can be used for a wider range of applications

	Rel-12 LTE D2D	**Rel-14/15 LTE V2X**	**Rel-16 NR V2X**	**Potential gap**
Frequency Band	400/700 MHz 2-2.5 GHz	5.9 GHz (B47)	5.9 GHz (n47) unlicensed 2.6 GHz (n38) licensed	Licensed Unlicensed
Intended usage	Public Safety, commercial	V2X	V2X	Commercial, Public Safety, Maritime
UE speed	-	500 km/h Relative speed	250 km/h Absolute speed	Lower speed
Target range	550m to 1km LOS* (Trials for Discovery)	~1.2km LOS** (Trials)	1km^{+} LOS	Longer range
Target latency	-	20 ms	3 ms	Relaxed latency
Max. data rate	-	10 Mbps	10 Mbps	Low data rate

* https://www.qualcomm.com/media/documents/files/lte-direct-trial-whitepaper.pdf
** https://www.qualcomm.com/media/documents/files/c-v2x-technology-overview.pdf

$^{+}$1000m communication range defined in TS 22.186

Potential use cases

- Scenarios where users are normally unable to connect to a network
  - Range of existing D2D solutions not enough to enable communications
  - Usage restriction for a number of existing D2D solutions
- In poor coverage and out of coverage* areas:
  - Remote areas - rural regions, sparsely populated areas
  - ‘Deep’ indoor areas - large shopping malls, basements

- Commercial applications*:
  - Text / Voice Messaging
  - Location sharing+

- Verticals usage:
  - Public Safety** coverage extension
  - Maritime communications

+Location sharing based on existing methods available today

*Unlicensed spectrum to be used for out of coverage commercial use cases
**Public Safety usage requires licensed spectrum

Proposal: Extreme Range ProSe

- Extend the communication range of ProSe beyond the range capabilities in Rel-17 and earlier releases
  - Intended target maximum range = [3km] non-line-of-sight
  - Service characteristics at the maximum communication range:
    - Relative UE speed up to 4km/h (pedestrian speed)
    - Data rate [100kbps]
    - Latency [1s]

- Applicable for unlicensed (non-operator managed*) spectrum and licensed (operator managed*) spectrum
  - Usage in unlicensed spectrum:
    - in network coverage
    - out of network coverage
  - Usage in licensed spectrum:
    - in network coverage
    - out of network coverage for Public Safety only

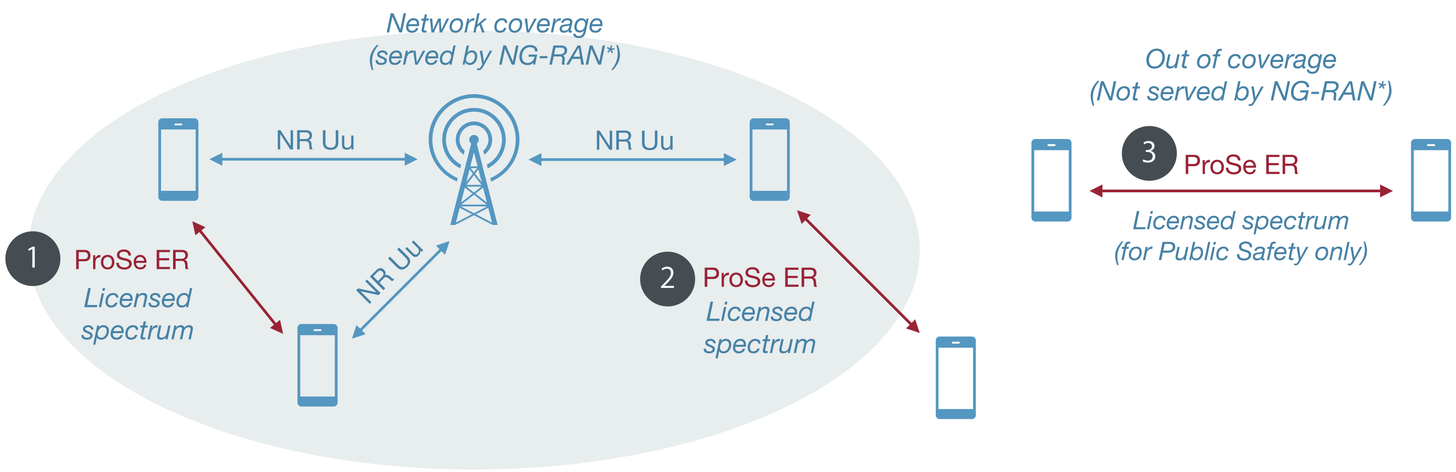
*Terminology as defined in TS 23.304

Motivation for 3km range

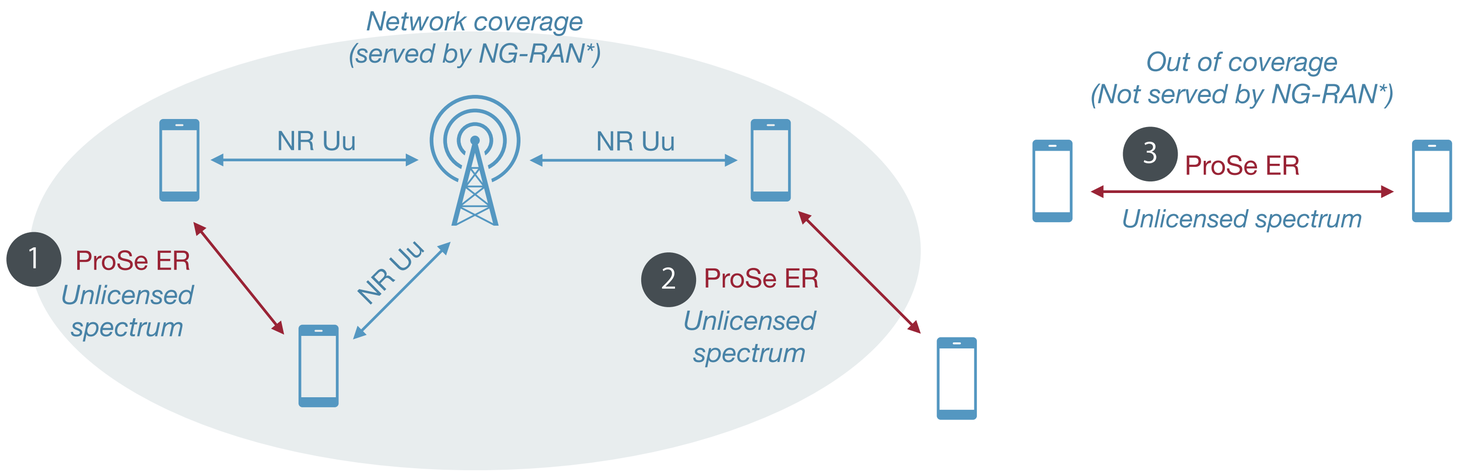
- Existing 3GPP D2D solutions have a range of ~1km
- Intention to challenge this range: what is the best 3GPP can do?
- While also balancing the long range with a realistic data rate and latency
  - To achieve a usable set of applications and maintain a reasonable user experience

Spectrum and Coverage Aspects

Licensed spectrum (operator managed*)

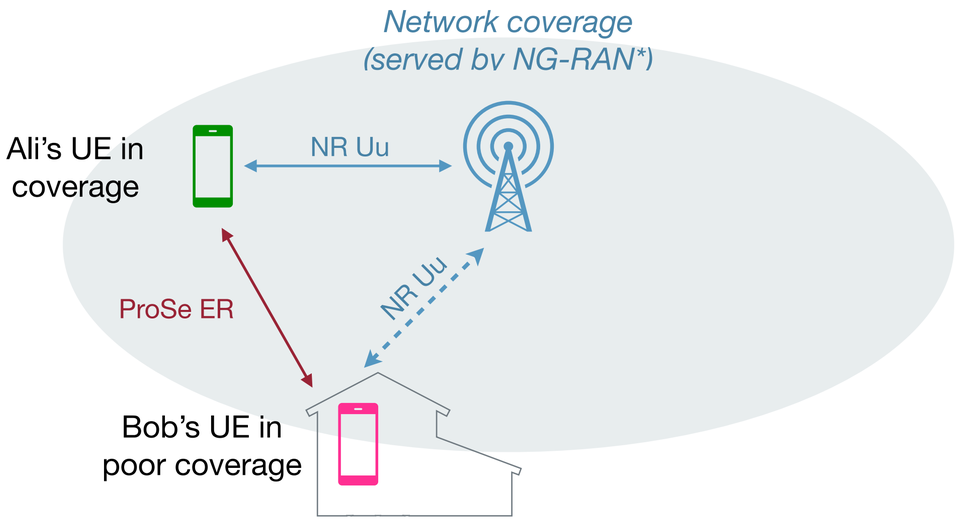


Unlicensed spectrum (non-operator managed*)



*Terminology as defined in TS 23.304

Potential use case - in coverage using licensed spectrum



- Assumptions:
  - Ali and Bob are within 3km range
  - Bob's UE is in poor coverage area
  - Ali's UE can be either in a good coverage area or poor coverage area

- Ali and Bob go for a shopping trip, Bob goes to the shopping mall, an area with poor coverage, and Ali goes to a nearby cafe
- Bob's UEs can still detect the cell and read the broadcast information, but it cannot transmit data successfully to the network
- Later, Bob wants to send a text message to Ali, to ask where she is so that they have lunch together
  - Bob's UE cannot send the message to Ali via the network due to poor coverage
  - Bob's UE cannot use ProSe to send the message to Ali as the range is insufficient
  - Bob's UE uses ProSe ER to successfully send the message to Ali, and Ali sends a message to Bob using ProSe ER, suggesting to meet at her favourite restaurant

*Terminology as defined in TS 23.304

Expected KPIs vs Range

Relative distance @ max range
@ relative speed 4km/h

Expected KPIs:
- Data rate [100kbps]
- Latency [1s]

Relative distance < max range
@ relative speed 4km/h

Expect ***better*** performance:
- Data rate > [100kbps]
- Latency < [1s]

Other points

- Proposal is an optional feature intended for any type of device, e.g.:
  - Smartphones
  - Wearables

- Proposal intends to re-use ProSe framework defined in Rel-17 and earlier
- For example (not an exhaustive list):
  - ProSe discovery and communications aspects (TS 23.304)
  - ProSe authorisation and provisioning aspects (TS 23.304 clause 5.1.1)
  - ProSe security aspects (TR 33.847)

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