3GPP TSG RAN meeting #91-e **RP-210492**
Electronic Meeting, March 16 - 26, 2021

Agenda Item: 10.6.1
Source: Sateliot[1]
Title: Kepler perspective: NB-IoT NTN must reach normative phase in Rel-17

Document for: Discussion

1. Prepared with input from Kepler (3GPP Guest Member)

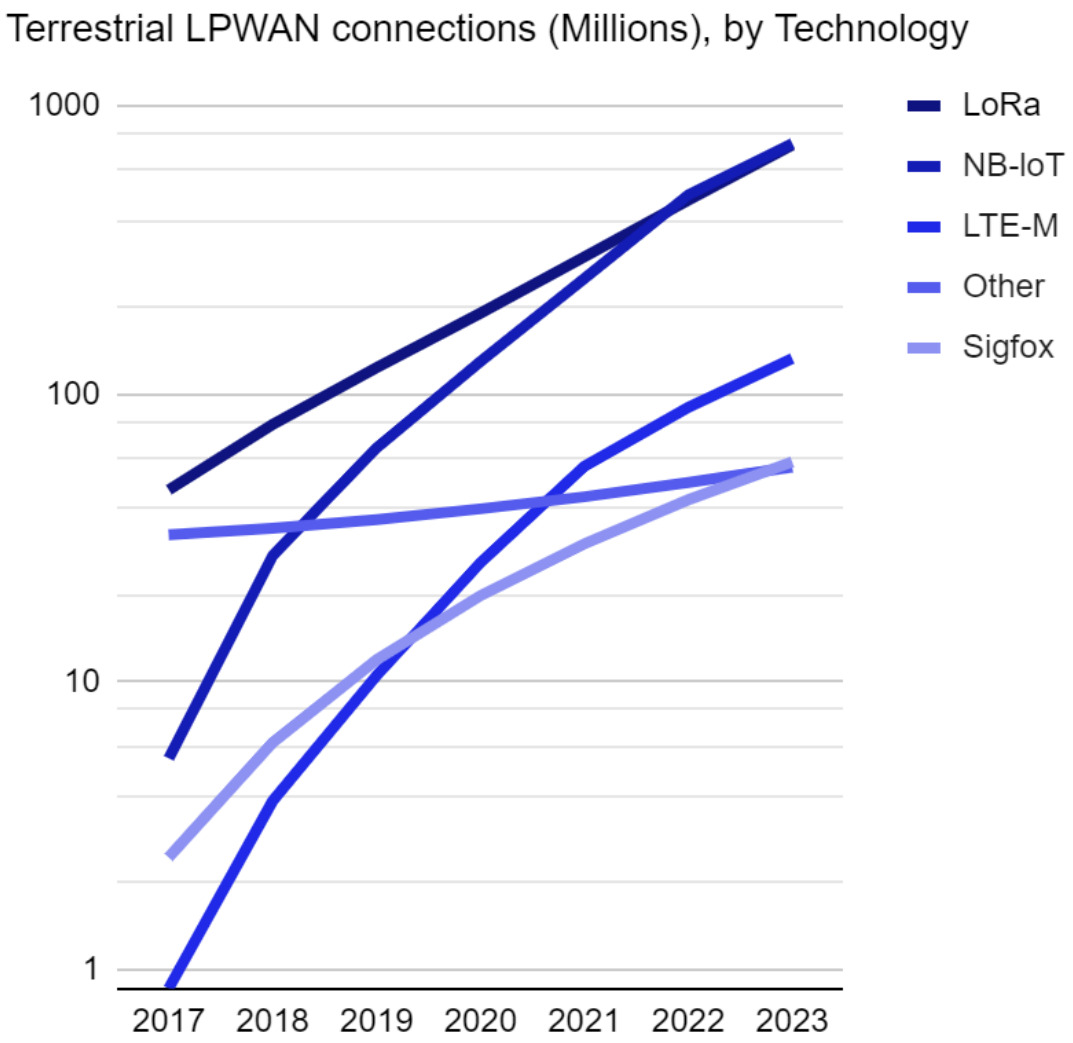
A common standard is necessary to fulfill the promise of Satellite IoT and realize the potential of terrestrial IoT

	Traditional Satellite M2M/IoT	Terrestrial M2M/IoT	Potential for hybrid satellite/terrestrial, 2025
Examples	SBD, IDP, Simplex	NB-IoT, LoRa Sigfox	NTN-IoT, LoRa-FHSS, Sigfox/ELO
UE cost (USD)	$80 - 250	<$20	All LPWA chipsets to have 'global option' with no hardware cost increase—roaming model used for devices that move between terrestrial and satellite coverage. Cost of satellite coverage to fall to <$3 / month
Cost/Month (USD)	10-30	<1	
Network coverage	Global	City block - National	
Major technology iterations, 1997 - 2020	1-2	4	Terrestrial technologies can be made 'satellite compatible' with relatively low effort. Satellites upgraded on ~5 year life cycles to capitalize on explosive growth in satellite capability/cost
CAGR, # of connections, 2017-2019	15%	90%	Terrestrial ecosystem can tap into traditionally satellite applications. Satellite ecosystem benefits from growth due to lower costs, faster technology evolution.

- A convergence between satellite and terrestrial LPWA standards will be a disruptive development for IoT applications moving in and out of cellular coverage.
- Cost of satellite IoT to dramatically decrease in next 5 years but satellite connectivity will always be a 'last resort' option
- Hybrid satellite/terrestrial will replace the majority of traditional satellite-only connections if available
- Hybrid satellite/terrestrial along with falling price for satellite connectivity unlocks previously untapped applications

SOURCES: Kepler, IoT Analytics, NSR

Hybrid satellite/terrestrial is a 2.5 horse race between NTN IoT, LoRa, and others



- NB-IoT and LoRa have a significant head start to capture the satellite market because of existing terrestrial ecosystem
- LoRa is making significant progress towards a satellite solution
  - April 2019- March 2021 – Lacuna, Swarm launch first satellites with LoRa, offer early commercial service
  - November 2020 –Semtech releases LoRa-FHSS to improve spectral efficiency for satellite deployments, no hardware changes to chipsets
- 3GPP must make progress in release 17 to maintain feature parity with LoRa
- If both 3GPP and LoRa are unsuccessful, Sigfox may capitalize on a hybrid satellite/terrestrial approach with Admiral LEO or proprietary satellite solutions will continue to dominate the satellite IoT applications

SOURCES: IHS Markit 2019, Kepler

Satellite Operators relying on NTN IoT cannot wait and remain competitive

Satellite Operators by IoT technology selection

Satellite Only	Non 3GPP Terrestrial	Waiting for 3GPP?
astrocast	eutelsat	ECHOSTAR
FLEET	KEPLER	eutelsat
Globalstar		inmarsat
hiber	Lacuna space	INTELSAT
inmarsat	SWARM	KEPLER
iridium		ligado NETWORKS
Myriota		OQ TECHNOLOGY
ORBCOMM		SATELIOT
TOTUM		

- Satellite operators waiting on NTN IoT cannot sit idle indefinitely while competitors who have selected Lora, Sigfox or Satellite only solutions capitalize on the Satellite IoT opportunity
- Some operators (Inmarsat, Eutelsat, Kepler) have already hedged directly by investing in multiple technologies
- Some operators have indirectly hedged through partnerships or selling bandwidth
- Slow progress in release 17 will push satellite operators to delay or abandon NTN IoT deployment in favor of other solutions
- Slow progress in release 17 will materially hinder the ability of satellite operators to plan satellite/constellation sizes, further develop use cases, and make financial commitments

SOURCES: Kepler

A minimal NTN IoT feature set for delay tolerant applications is sufficient to show commercial progress and further develop applications

- Kepler has seen strong engagement with Fortune 500 companies across a broad range of use cases even with a limited, delay tolerant, satellite IoT solution
- Applications include livestock monitoring, center pivots, weather stations, personal safety devices, asset tracking of railcars
- Feedback has been ‘yes, but when’

SOURCES: N/A

Kepler has 11 Satellites in orbit today ready to deploy NTN-IoT

Kepler 2021 Satellites		
Satellite	**Status**	**Launch**
KEPLER 3 (TARS)	Operational	September 2020
KEPLER 4–5	Operational	September 2020
KEPLER 6–7	Planned	March 2021
KEPLER 8–15	Operational	January 2021
KEPLER 16+	Planned	Mid/Late 2021

IoT service link

- Transparent / fully air interface agnostic (i.e. compatible with NTN IoT small satellite LEO scenario[1], LoRa, custom waveforms)

- Link budget better than small satellite IoT NTN scenario[1]:
  - peak EIRP > 21.45 dBW / MHz
  - peak G/T > -17.9 dB / K

2021 ground segment

- 4 feeder gateways in 3 countries (Norway, New Zealand, Canada)
- 1 service link calibration station in New Zealand
- New feeder gateways are portable, rapidly deployable (<30 days to deploy)

SOURCES:

1. R1-2102272 – "Study on Narrow-Band Internet of Things (NB-IoT) / enhanced Machine Type Communication (eMTC) support for Non-Terrestrial Networks (NTN)", March 2021

Kepler will rapidly deploy a LEO communications constellation through 2023+, can rapidly iterate on space segment as NTN IoT and use cases evolve, cannot include NTN IoT if progress is slow or with further delays

Kepler Constellation Rollout, 2019 – 2023	
Year end	**Cumulative satellites on Orbit**
2019	2
2020	5
2021	25
2022	80
2023	140

- >140 satellites by 2023
- Revisit time, link budget, capacity, and addressable use cases will continue to improve year over year once a minimal working solution is established. Rapid iteration enabled by full vertical integration of satellite design, satellite build, network, and ground operations.
- Aggressive timeline and commitment needs to be supported by clarity and appropriate scope of 3GPP commitment towards NTN IoT

SOURCES: N/A

Summary and proposed way forward

Recognizing that

1. The market for IoT via satellite is on the verge of explosive growth
2. A common standard between terrestrial and satellite IoT will benefit both ecosystems
3. LoRa and others have taken significant steps to capture this market already: risk of NTN IoT falling behind
4. A delay to Rel-18 will cause loss of interest in NTN IoT by many satellite operators
5. Many satellite operators have identified significant use cases that can be progressed even with a minimal set of NTN IoT features
6. Satellites are on orbit today that can implement NTN IoT, the launch of future satellites with NTN IoT will be contingent on early success and traction

RAN should

1. Specify a working solution for NTN IoT in Rel-17, down scope if necessary to avoid delays
2. Prioritize features that are required to support early commercial deployments with immediately available satellites over those that can wait for Rel-18

SOURCES: N/A