M2M/IoT via satellite

www.esa.int
What do we do?

1. We fund research and development in satcom via a program called **ARTES** (Advanced Research in Telecommunications Systems)

2. We issue tenders for **long-term developments** – we fund 100%

3. **Industry** can always submit a proposal for a mid-term development you see a market opportunity for – we **co-fund 75 to 50%, you bring 25 to 50%**

4. We fund developments or studies in **ground segment, space segment, payload and system** – including **in-orbit validation**

5. We build partnerships with operators to validate **innovative technology, equipment and services** in-orbit and on-ground
Satellite communications...

..is that not with these very big dishes?

> 10000 kg
Satellite node for worldwide tracking with ARGOS system

5 grams
Why use satellite for M2M/IoT applications?

1. For **remote, highly mobile, highly dispersed** of wide geographical areas (maritime, aero, railway, vehicular)

2. Address a **massive number** of devices simultaneously – e.g. for software updates or activities from deep-sleep mode, alarms

3. **Stable and controlled QoS** – not necessarily low latency

4. **Increased control** over the network and not dependent on MVNO/MNO’s

5. **Backup** to terrestrial connectivity

6. Very **predictable power-usage** of the end-nodes

7. Very **low-power transmissions required** due to regulatory constraints – i.e. less than some terrestrial solutions

8. Benefit from the **integration with GNSS** data transmission applications

9. Benefit from **already satellite connected** platforms (e.g. maritime)
IoT via satellite topologies

Direct access

- Antenna
- Terminal
- Sensor

Backhaul of aggregate sensors

- Antenna
- Terminal

Gateway

App. Server

System
Lora over satellite testbed

Triggered a number of projects in Europe

Showed feasibility of using LoRa from satellites circling the Earth

Will also be used over geostationary satellites!
Recent advances in re-using terrestrial low power standards.....from satellite

1. ESA initiated payload on-board NORSAT-2 satellite, fully software programmable
2. Transmitting LoRa signal from space to off-the-shelf LoRa < $5 devices
3. Reaching millions of devices simultaneously
4. Community effort
NB-IoT over satellite

Satellite channel emulator

- Doppler shift
- Doppler rate
- Delay
- Attenuation

UE

Satellite channel emulator

RF 200kHz (possibly using specific satellite frequency)

eNB

RF 200kHz (possibly using specific satellite frequency)

EPC

UE

RF 200kHz

UE

RF 200kHz (possibly using specific satellite frequency)
1. Low Power nodes (< 25 mW or 7dBm)

2. If you have an “eNB” or LPWAN Gateway with only 50 kHz bandwidth
   - **100,000 UE/nodes** could send 20 bytes every hour
   - **1,000,000** (one million) UE could send a 2 bytes measurement, 4 times a day.
   - **100,000 UE** could send a 140 bytes SMS every 4 hours

3. ETSI TS 102 721, ESA patents
4. With existing satellites in orbit
Antennas for M2M/IoT comms

**Body-worn antennas** – embedded into body-worn equipment enabling personal wireless functionalities

**Prototype shelter antenna system** – with interface to some M2M system

*Example usage:*

*This Jacket Designed For Refugees Transforms Into A Tent*
1. No immediate work on new 3GPP air interface defined for IoT - only starting in Release 17, i.e. after 2020

2. \( \rightarrow \) NB-IoT will be with us a long time

3. Satellite is now an integrated part of 5G architecture – 3GPP future standards will include satellite also for IoT

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From RAN chairman’s report after RAN#79: IoT – interim conclusions for Rel-16

- No NR based solution will be studied or specified for the LPWA use cases
- LPWA use cases will continue to be addressed by evolving LTE-M(eMTC) and NB-IoT
The future.....

Future satellite IoT node -

Example

E32(868T20D) Satellite IoT node
ETSI 103 456 Compliant
5G Release 17-ready terrestrial-satellite
100mW SMA antenna IOT transceiver (transmitter/receiver) module

US $5.20/piece

Some kind of standard in ETSI or 3GPP

5G ready..2020+
Makerspace for satellite M2M/IoT

1. A half-million € activity which is meant to scout (together with ESA) a large number small tasks to implement quick and dirty proof of concepts in the field of satellite M2M/IoT

2. Implemented with a minimum amount of paperwork

3. Small tasks could be e.g. prototyping new concepts, organise a mini-challenge for most wearable satellite M2M/IoT device, best energy harvesting M2M/IoT terminal, complement an Kickstarter campaign, experiment with an in-orbit payload.... LTE-NB1 over satellite

4. All ideas related to satellite communication prototyping welcome!

5. For ham radio amateurs/hobbyists/academia/garage-companies/individuals/hackers/inventors/....
Upcoming activities – talk to us if interested

1. Tests of other terrestrial technologies over satellite! Weightless, Telegram,....

2. Tests with NB-IoT backhaul over satellite

3. Satellite M2M technologies **live** demonstration – **500 k€**
   - a. Evaluate M2M protocols using in-orbit satellites
   - b. Modify/adapt terminals
   - c. Test campaign with background traffic

4. Pre-5G test of upcoming NR-IoT protocols

5. Messaging to millions of people – paging demo from satellite

6. 5G MakerSpace – for hackers/academia/inventors/individuals
2018... the summer of low-cost satellite IoT launches

.....and Myriota and others....all this year

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European Space Agency
1. We can support **developments** for satellite M2M/IoT:

   - **Not-so-poor entrepreneur with ideas**: 25-50% + **esa**: 50-75%
   - **Poor entrepreneur but with ideas**: 25-50% + **esa**: 50-75%

2. Detail services, prototype system and products, business case, simulations... → **results confidential, IPR with industry** + support by **esa experts**
What is still left to do...

1. A lot of satellite IoT initiatives – but **a lack of radio spectrum** – need for more innovative spectrum approaches

2. There is a **lack of standardisation for low power satellite M2M** – something for ETSI now and later in 3GPP in Release 17?

3. Integration of satellite and terrestrial may **still need some work** – need for larger trials

4. Electronics become smaller and smaller, but **antennas** are limited by physics – innovative concepts required.
Conclusions

1. New developments allow M2M/IoT services over satellite for **massive amounts of uncoordinated** UE’s using **very low** power end nodes

2. The summer of satellite IoT – many launches coming months 🚀🚀🚀

3. Integration of satellite and terrestrial may **still need some work** – **need for larger trials**

4. Many new activities upcoming for satellite IoT – **talk to us** to get involved!

5. ESA is prepared to **fund and co-fund** any developments in the satellite M2M domain

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