

Satellite IoT: a Game Changer?

"Connected World Series" - Space + Terrestrial - the IoT Connection

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Knowledge for Tomorrow



One Step back with few definitions

(or better said definition attempts)

- **“Internet of Things”**: a network of devices capable of gather, measuring, storing and processing data such as e.g. sensors, machines, computers, etc... which are connected via Internet and exchange data across different domains and using different transmission protocols without human interaction



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- **“Machine to Machine”**: direct communication between sensors, machines, computers, etc... which exchange data without human interaction
 - Typically communication between a population of devices using the same transmission protocol and one central entity not necessarily over the Internet
→ could be an isolated network often with limited scalability and integration options



One Step back with few definitions

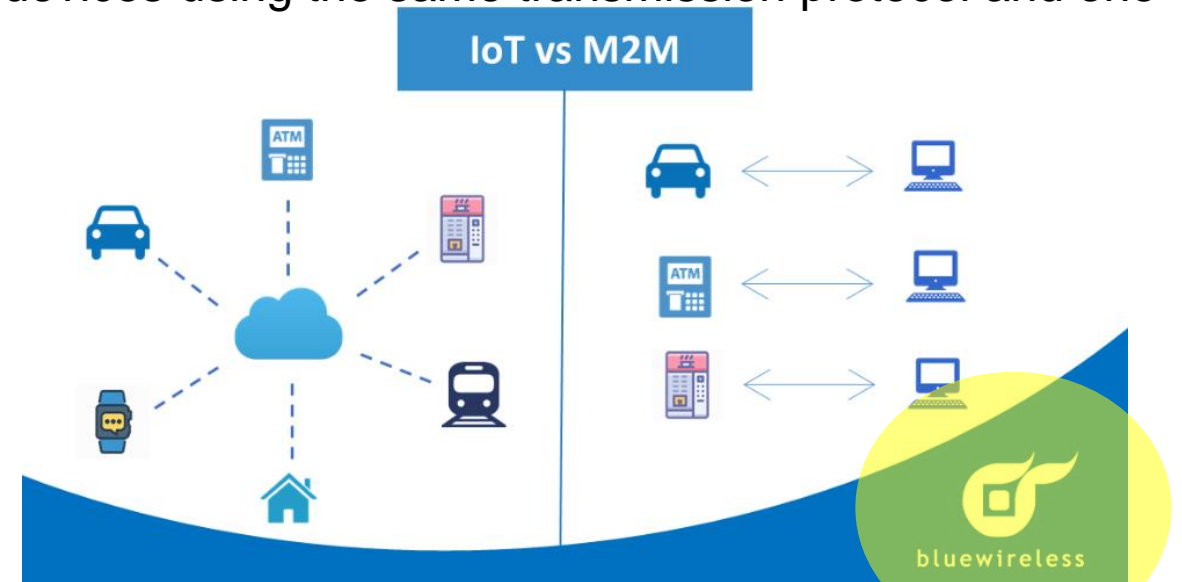
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→ M2M via Satellite is NOT new, Satellite IoT is!



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Satellite IoT: Main Connectivity Options

1. Satellite Backhauling via Gateway

2. Satellite Direct Access



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- One GW-Station collects traffic from a population of IoT nodes
- Aggregated traffic is „backhauled“ via satellite
- Conceptually similar to what happens on board aircraft or cruise vessels, with the additional difference that different IoT nodes may use different transmission protocols...

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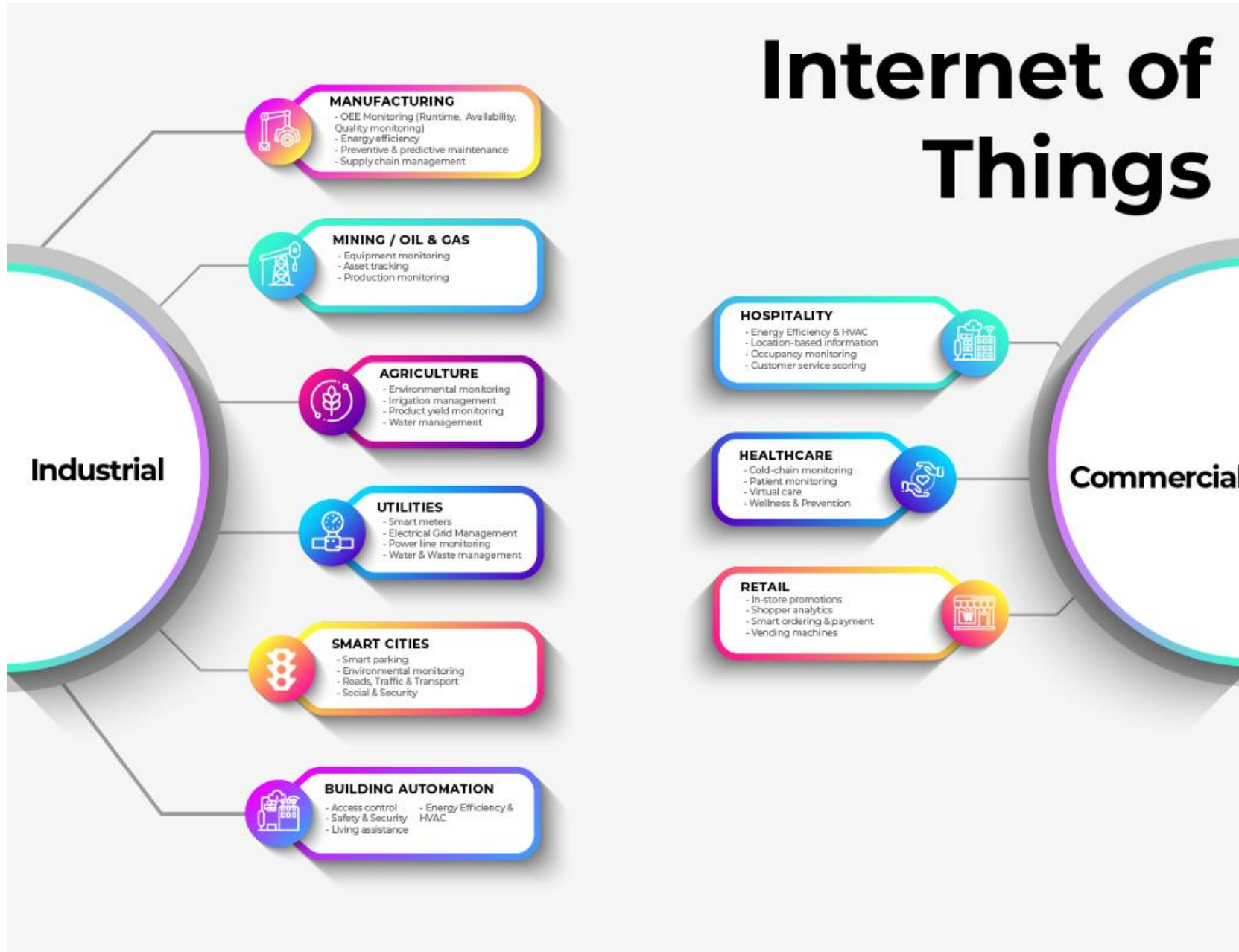
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2. Satellite Direct Access

- The IoT node is directly connected to the satellite
 - a. Transparent satellite
 - all traffic is sent back to ground
 - b. Regenerative satellite
 - Sampling, storing and forward (almost transparent...)
 - Full or partial data demodulation & decoding (and re-encoding & re-modulation)
 - ...
 - Capability to process data **content-wise (MEC in space)**



Internet of Things



Satellite IoT: Main Technical Challenges

Focus on Connectivity Option #2

	LEO	GEO
Coverage	Small beams (ca. 200km)	Large (nationwide) to very large (continental) beams
Population / density	High / Low	Very high / Low to very low
Link budget	Tight	Very tight, large COC-EOC variation
IoT nodes activity	Typically burtsy can be random or periodic / predictable „Energy saving mode,, required for battery-powered nodes	
Amount of data	From few bytes up to several MB	
Delay requirements	From almost realtime / interactive to several minutes (or even few hours)	
FWD Link	In special cases not required at all Either only control channel or both control and data	



Satellite IoT: Main Technical Challenges... and possible Solutions

Focus on Connectivity Option #2

- Flexible and adaptable communication protocols especially designed and optimised for satellite
 - Communication protocols developed for terrestrial IoT might work, but performance will be very suboptimal when the system is fully loaded!
 - „One-size-fits-all“ might still not be feasible / optimal



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 - GEO might still be used in specific case and for connectivity option #1 (IoT backhauling)
- ISLs are needed in order to cope with the most stringent delay requirements
- Smart payloads capable of processing IoT data will open up very innovative paradigms
 - **the satellite becomes itself an intelligent IoT node**



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