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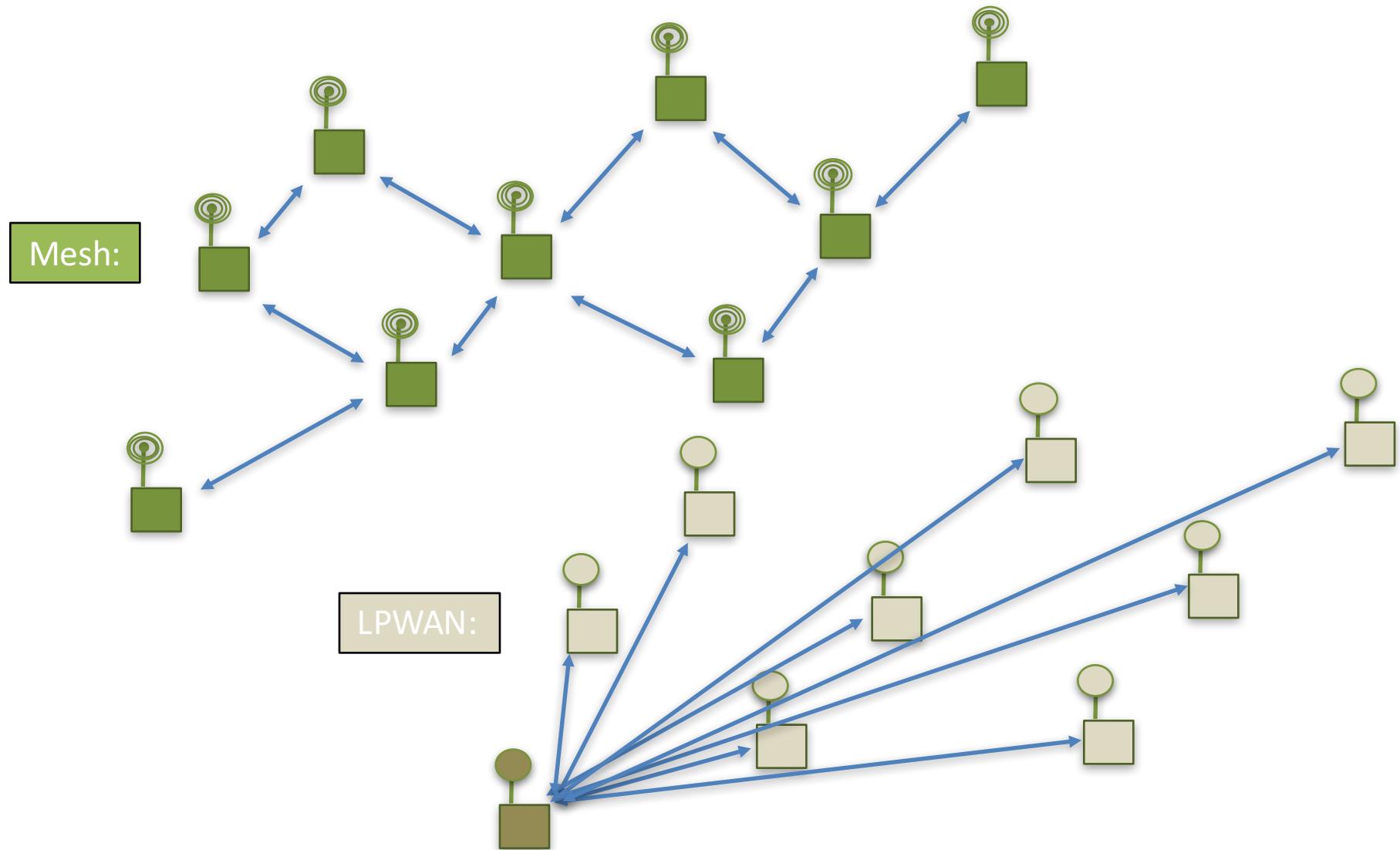
Wireless Mesh Network - A well proven alternative to LPWAN

EoT 2017

Introductions

- Thomas Steen Halkier
 - CEO NeoCortec
- NeoCortec
 - Innovator within Wireless Mesh Network technology
- This presentation will...
 - focus on NeoMesh compared to LPWAN
 - focus on Power Consumption and Total Cost of ownership

Wireless Topologies



Robustness in Wireless Communication

- Raw radio performance is defined by Signal to Noise Ratio (SnR)
- Radio receivers can employ error correction to improve robustness
- In general terms, radio links with low signal levels, are more impacted by noise, than those with high signal levels

Typical Link Budgets

- LPWAN: >150dB
- MESH: <100dB
- LPWAN is relying on receivers with high sensitivity detecting low signal levels
- MESH has receivers which are less sensitive and thereby relies on higher signal levels

Wireless medium

- Both Mesh and LPWAN operate in un-licensed frequency bands
- The noise floor is elevated due to many different systems operating

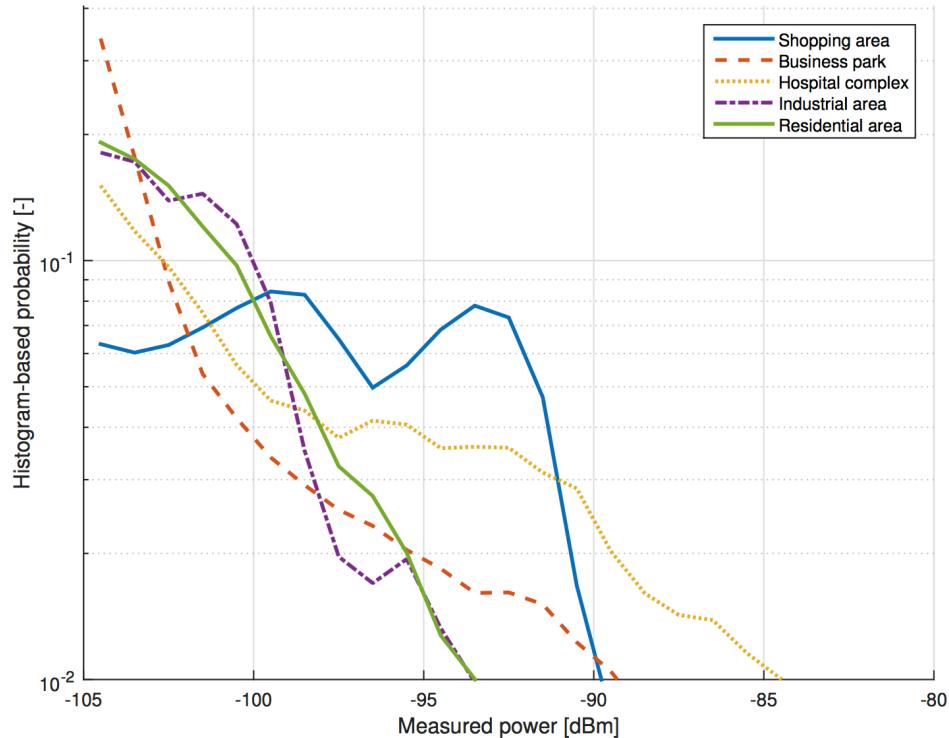


Fig. 7. Received power level probability density function based on a normalized histogram of the measurements in the 868.0-868.6 MHz band.

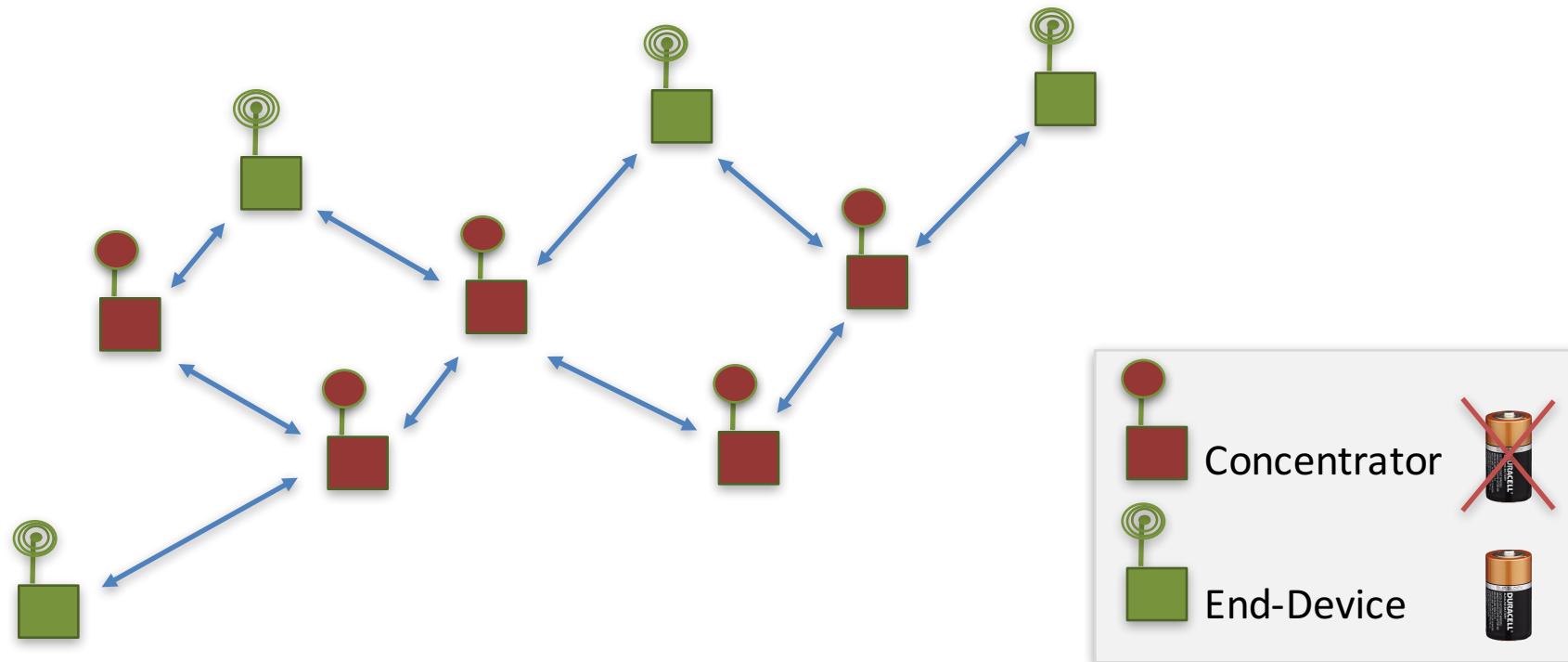
Figure from study done by University of Aalborg.

"Interference Measurements in the European 868 MHz ISM Band with Focus on LoRa and SigFox"

LEGACY MESH NETWORKS

Power consumption

- Asynchronous operation
 - Devices are not synchronized to each other timing-wise, and as such ultra low power is only achieved in “end-nodes” who is not capable of routing



Scalability

- Network Management
 - Centralized network management
 - Single point of failure
 - Slow process when network grows in size
- Payload transmission
 - Payload packages are either routed, or flooded into the network.
 - When routed, algorithms from IP networks are being used, which are not suitable for dynamic topologies, nor for deep network structures with many hop counts.
 - Flooded messaging is inefficient and not a good approach for battery powered devices.

Legacy Mesh Examples



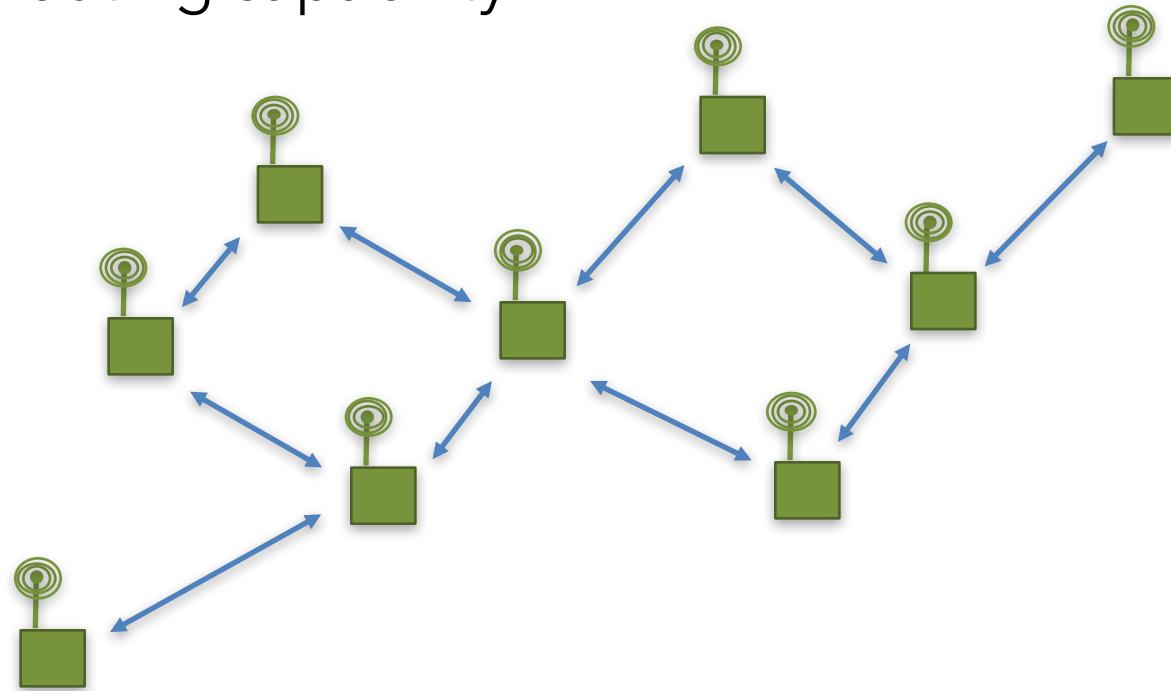
ZigBee®



NEOMESH - NEXT GEN MESH NETWORK

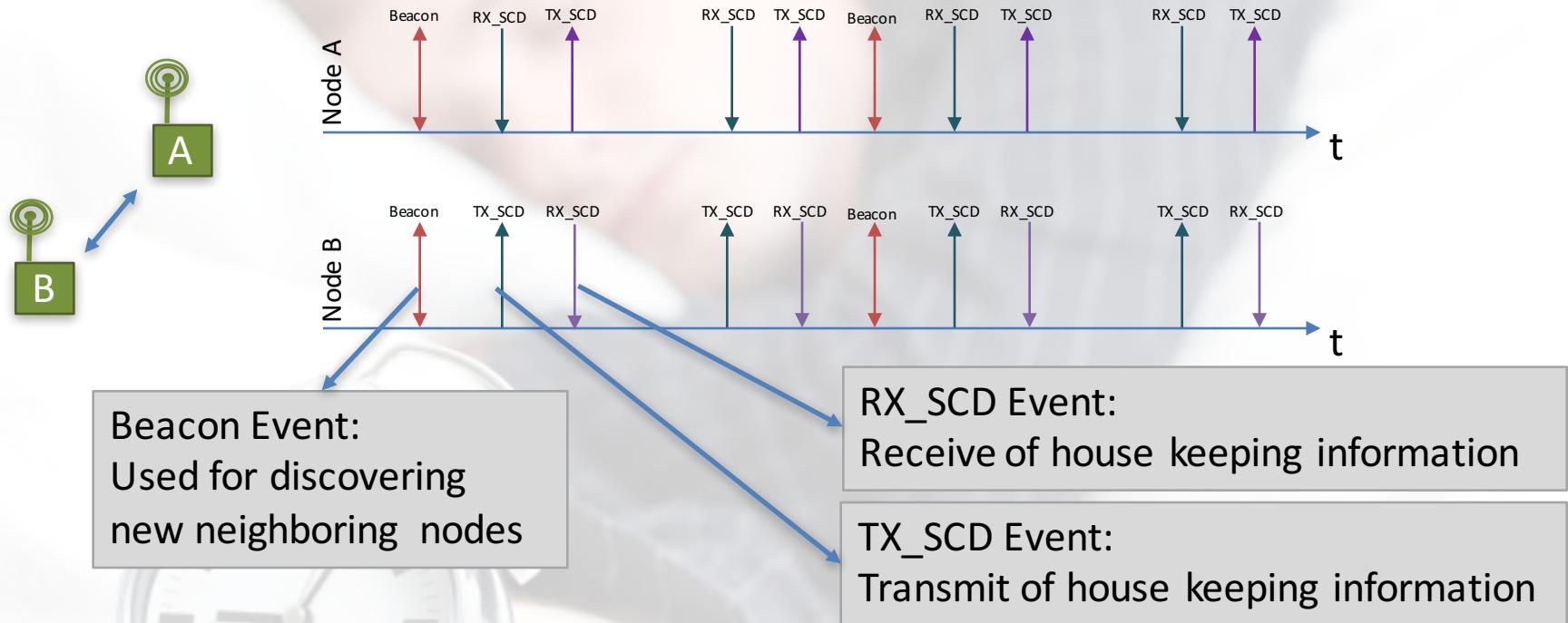
Power consumption

- Synchronous operation
 - All devices sleep autonomously resulting in ultra low power capabilities for all nodes, while maintaining full routing capability



Ultra Low Power - HOW?

Time Synchronized sleep!



DUTY CYCLE DECIDES CURRENT CONSUMPTION:
FROM <20 μ A AVERAGE CURRENT

Scalability

- Autonomous nodes for scalability
 - De-centralized network management
 - No single entity responsible for network creation / management
 - Neighbor relations are created and maintained locally
- Patented Routing Protocol
 - Optimized for MESH structures
 - Energy efficient
 - Real time handling of dynamic network topologies

NeoMesh Limitations

- NeoMesh is optimized for low-power
 -and is not well suited for low latency (sub seconds) or high data rate (100s+ of bytes applications)

LPWAN

Low Power Wide Area Network

- A number of technologies are referred to as "LPWAN"
- There are two which are being marketed heavily:
 -  **sigfox**
 - Subscription based, with a cost structure similar to GSM/2G/3G/LTE
 - "cellular" type network operating in the ISM bands
 - Relying on long range, with very sensitive receivers
 - Claims 10+ years battery life time
 -  **LoRa**
 - Private or Public network architecture
 - Star or Star-of-stars network topology
 - Relying on long range, with very sensitive receivers
 - Claims 10+ years battery life time

Claiming 10+ years of battery life is easy...



Comparing Average Current

- Sigfox:
 - Example from <https://radiocrafts.com/kb/battery-lifetime-sigfox-device/>
 - AA 3,6V Lithium cell
 - 10 msgs/day => **34uA average current**
- LoRa:
 - Based on "LoRa Modem Calculator Tool" from Semtech
 - Assumptions :
 - 12 bytes payload (same as SigFox)
 - SF12, 20dBm TX power, Unacknowledged
 - 10 msgs/day => **8uA Average** (!! ALOHA type transmission - no guarantee for delivery)
- NeoMesh
 - Based on Current Calculator in Config Tool
 - Assumptions:
 - 12 bytes payload (same as above examples)
 - NC2400 module in 2.4GHz band
 - Avg 3 neighbours, 30s SCD & Beacon rate, 5000 Full beacon interval
 - 10* msgs/day => **18uA average current** (Acknowledged messaging)

*) Can easily transmit more than 100 msgs/day at same level



Total Cost of Ownership

TCO between different technologies

	NeoMesh	SigFox	LoRaWAN Private	LoraWAN Public	NB-IoT
Module price	Par	Par	Par	Par	Low
Gateway price	Low	None	High	None	None
Subscription fee	None	High	None	?	?
TCO	LOW	HIGH	MED	??	??

	NeoMesh	SigFox	LoRaWAN Private	LoraWAN Public	NB-IoT
Coverage	Global	Scattered	Global	Local	Global

DEPLOYING A WIRELESS SOLUTION - THINGS TO CONSIDER

Important parameters to consider

- Payload data characteristics
 - Size?
 - How often?
 - One way - or bi-directional?
- Power supply
 - Battery?
 - Energy harvesting?
 - Mains powered?
- Total cost of ownership
 - BOM cost
 - Maintenance cost
 - Subscription
 - License

Every application is special

- There is no technology which is ideal for all applications
- NeoMesh is ideal when:
 - Payload size is small
 - Battery operation is required for all devices
 - You want to control your network and cost
 - The environment is dynamic

NeoMesh Application Examples

- Asset tracking - value boxes
- Emergency rescue system
- Agriculture - hilly landscape
- Outdoor parking sensor solution
- Utility meters with pre-payment authentication
- Communication system for rescue workers
- Wireless Sensor Network for wires legacy sensors

Thanks for listening!

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