

3GPP LPWA Standards LTE-M, NB-IoT & EC-GSM

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Nicolas Damour
Senior Manager, Business and Innovation
CTO Office, Sierra Wireless

The Internet of Things
#StartswithSierra



Sierra Wireless – The IoT Company

Founded in 1993

1,100 employees worldwide

2015 revenue: \$608 million

#1 IoT module supplier worldwide

25 years of steady innovation



Connected Machines

IoT Hardware

AirPrime[®]



AirLink[™]



IoT Connectivity



IoT Platform

AirVantage[™]
IoT Platform



Enterprise Services

Sierra Wireless – Open Source



www.mangoh.io



open source hardware



www.legato.io



open source

MangOH Green

- 120mm x 100mm
- ATmega32U4 MCU
- Arduino connector
- 2x CF3 cellular sockets
- MicroSD + 2xSIM
- Accelero, Gyro
- 2x USB, RJ45, 1 RS232
- 3x IoT Connectors

MangOH Red

- 69mm x 61mm
- ARM Cortex M4 MCU
- Raspberry Pi connector
- 1x CF3 cellular socket
- MicroSD + 1xSIM
- Accelero, Gyro, Altimeter
- 2x USB
- 1x IoT Connector



- Yocto-built Linux distrib
- Application Framework
- Development Tools
- Multi-Language Support



Available now



Low Power Wide Area – A Revolution for the IoT



Low Consumption



Extended Coverage



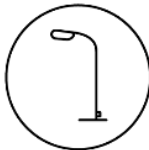
Low Complexity



Smart Meter



Wearables



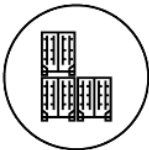
Street Lighting



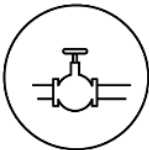
Home Automation



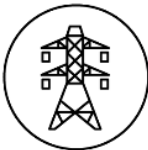
Toll Collection



Container Tracking



Pipeline Management



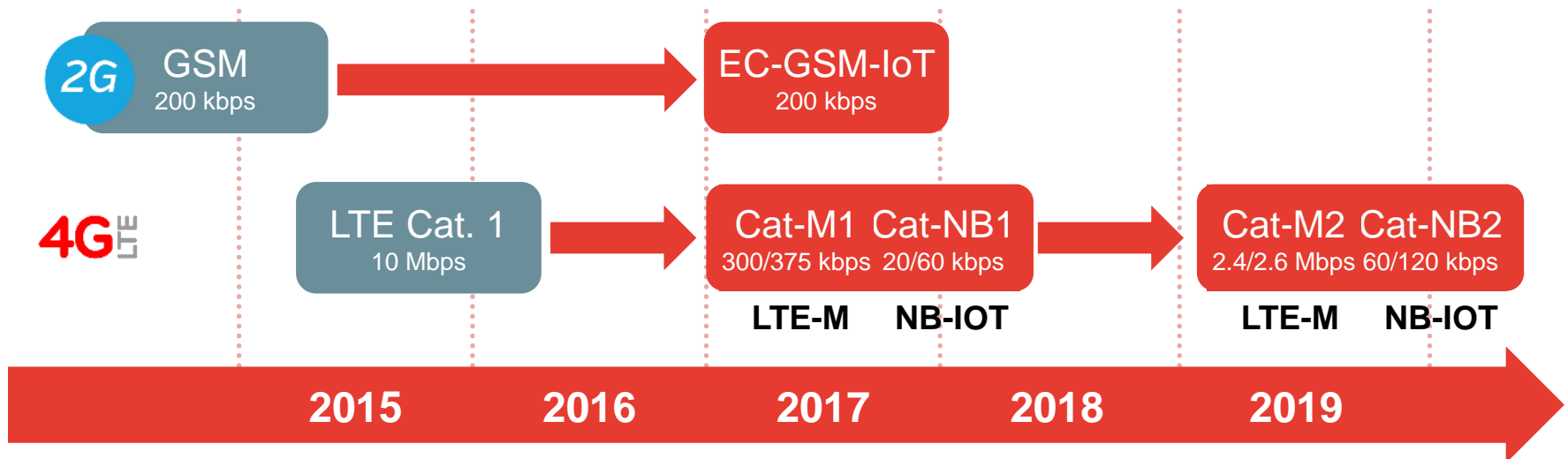
Smart Grid

Low Power Wide Area – Technology Panorama

Ad-hoc Networks - Proprietary - Unlicensed Bands



Cellular Networks - Standardized - Licensed Bands



Cellular LPWA – The Promise of the 3 C's



Consumption



Coverage



Complexity

Low Consumption



Consumption

10-20 years lifetime
On AA batteries
(2500 mAh)

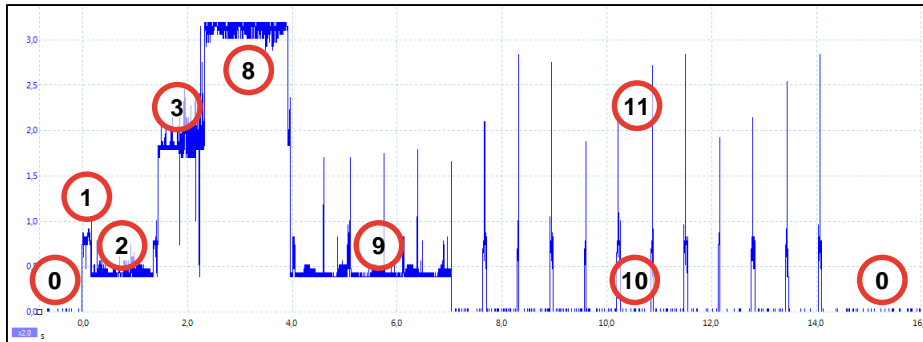


Coverage



Complexity

Low Consumption with PSM and eDRX



Power consumption for 1 data transmission - With PSM

PSM - Power Saving Mode

Lets the device “hibernate” between data transmissions while remembering its network state (no need to re-register)

Power consumption in hibernation: 4 μ A

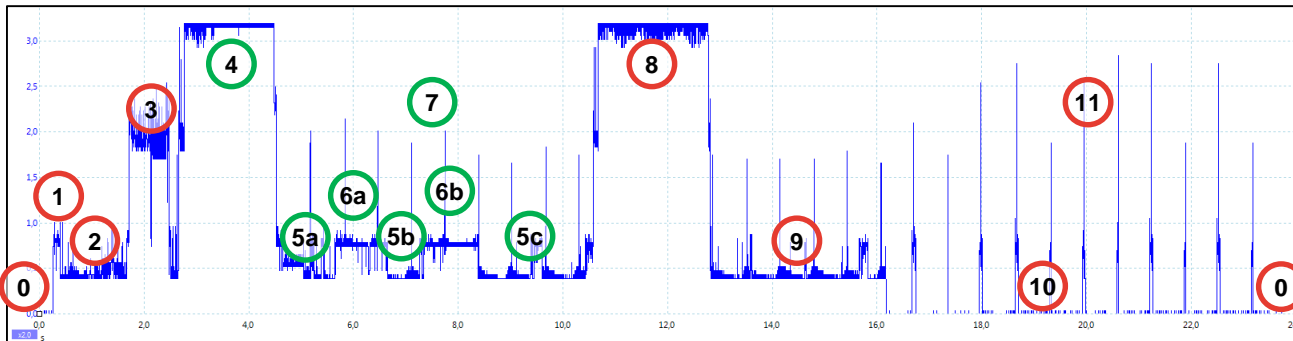
Gain on battery lifetime: x2 (compared to shutting modem off)

Ex: Tx 670 bytes / Rx 350 bytes on 2500mAh AA battery

- 1 transmission every 1 hour** => **1 year battery life**
- 1 transmission every 6 hours** => **5 years battery life**
- 1 transmission every 24 hours** => **19 years battery life**

eDRX – Extended Discontinuous Reception

Lets the device listen more infrequently to incoming messages



Power consumption for 1 data transmission - Without PSM (coming from “OFF” state)

0	Power Saving Mode or Off	4 μ A or 0 μ A	---	---
1	Wake-up or Boot	80 mA	0,185 s	14,80 mAs
2	Processing	45 mA	0,430 s	19,35 mAs
3	Look up cells	190 mA	0,915 s	173,85 mAs
4	Register onto network	320 mA	1,6 s	512,00 mAs
5	Processing	45 mA	4,09 s	184,05 mAs
6	Processing	80 mA	2,13 s	170,40 mAs
7	Listen to network pages	8 mAs each	x 16	128,00 mAs
8	Actual data transmission	320 mA	1,6 s	512,00 mAs
9	Processing	45 mA	3,1 s	139,50 mAs
10	Idle mode	300 μ A	7,07 s	2,12 mAs
11	Listen to network pages	8 mAs each	X 16	128,00 mAs
TOTAL RED				989,62 mAs
TOTAL GREEN				994,45 mAs
TOTAL RED + GREEN				1984,07 mAs

Extended Coverage



Consumption

10-20 years lifetime
On AA batteries
(2500 mAh)



Coverage

+18-22dB sensitivity
Open Range x 7
Basement Coverage



Complexity

Extended Coverage through repetitions

LTE-M Channel	Maximum Coupling Loss	Performance	Nb of Repeats
PSS/SSS	164dB	Acquisition Time=850 ms	-
PBCH	164dB	Acquisition Time=240 ms	5
MDPCCH	164dB	99% detection using 128 repeats	256
PDSCH	164dB	1400 bps using 512 repeats	2048
PUSCH	164dB	250 bps using 1536 repeats	2048
PRACH	164dB	90% detection using 64-128 Repeats	128
PUCCH	164dB	90% detection using 16-32 Repeats	32

HARQ: Hybrid Automatic Repeat Request

Detailed coverage study available online

http://hub.sierrawireless.com/coverage_analysis_lte_m

PSS/SSS Primary/Secondary Synchronization Signals
 PBCH Physical Broadcast Channel
 MDPCCH MTC Physical Downlink Control Channel
 PDSCH Physical Downlink Shared Channel
 PUSCH Physical Uplink Shared Channel
 PRACH Physical Random Access Channel
 PUCCH Physical Uplink Control Channel

Low Complexity



Consumption

10-20 years lifetime
On AA batteries
(2500 mAh)



Coverage

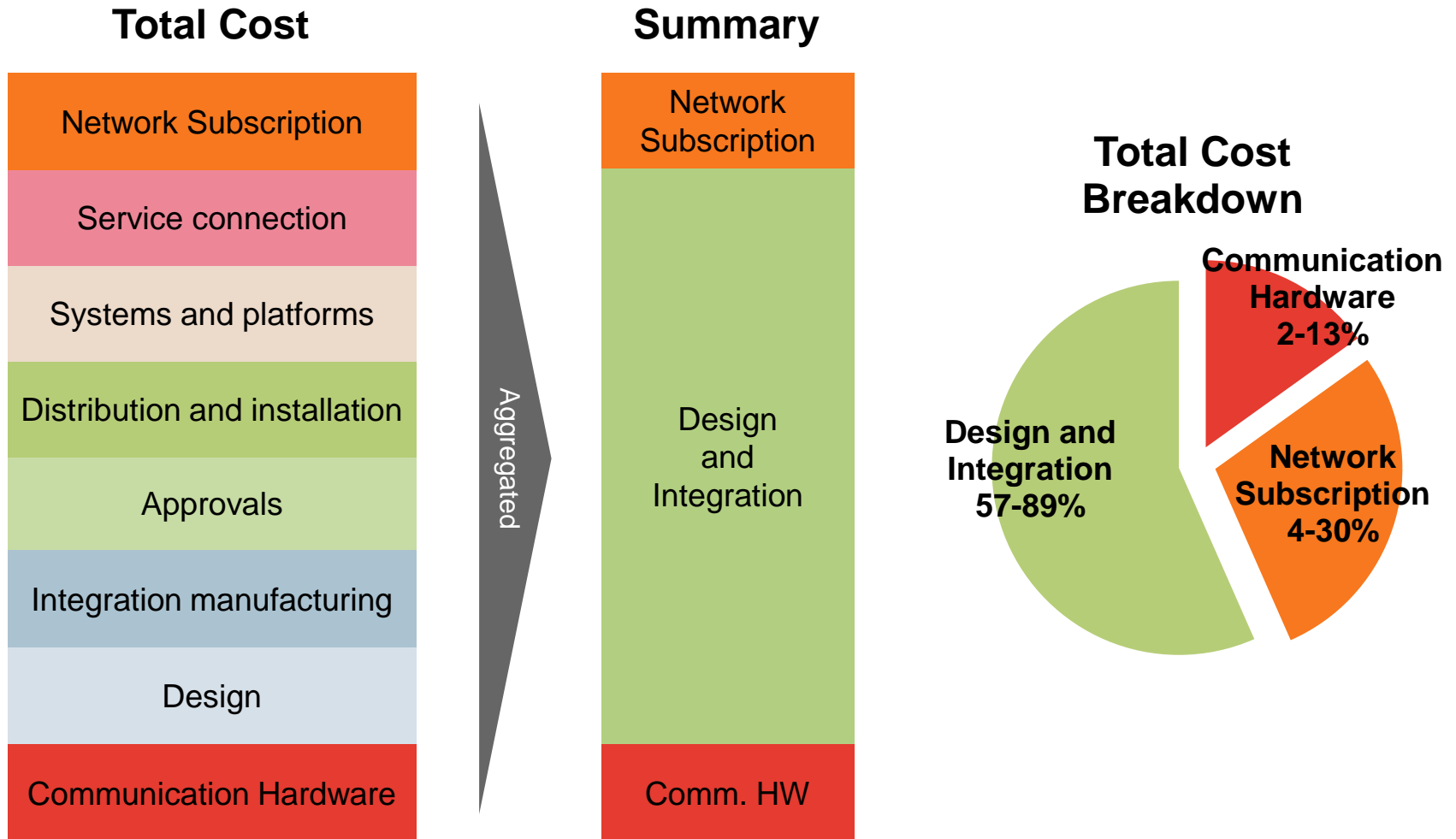
+18-22dB sensitivity
Open Range x 7
Basement Coverage



Complexity

-75% (rel. Cat-1)
Target: 2G Price
Single WW Product

Low Complexity, Cost and Total Cost of Ownership



Source: Analysis Mason, Nov. 2010
"The total cost of ownership for embedded mobile devices"

Cellular LPWA – Additional Benefits



Immediate Service

2016 – 2017 – 2018
447 Networks
143 Countries

Cellular LPWA – Additional Benefits



Immediate Service

2016 – 2017 – 2018
447 Networks
143 Countries



Durable Investment

Long-term availability
Global Standard
Scalable and Flexible

Cellular LPWA – Additional Benefits



Immediate Service

2016 – 2017 – 2018
447 Networks
143 Countries



Durable Investment

Long-term availability
Global Standard
Scalable and Flexible



Trusted Ecosystem

QoS & Security
Operator roaming
Embedded SIM - OTA

Mobile World Congress 2017 – On Air Demos



Live networks already on (US, Europe, Asia)
Mass deployments in 2017 and 2018

Technology Comparison – Summary

Attribute	LoRa	Sigfox	M1	NB1
Spectrum	Unlicensed ISM Bands: 433/868/915 MHz		LTE Bands	LTE & 2G Bands
Network: - Availability - Lifetime 10 years+ - Roll out	In deployment Parts of EU + US Uncertain Greenfield		2017 and 2018 Global Yes SW upgrade	
Coverage	Partial No MNO Roaming	Partial	Highest and Global Roaming	
Communication	Mostly Uni-directional		Bi-directional	
Infrastructure Service Layer	Messaging		IP and Messaging	
Scalability	Poor radio performance especially in ISM band Limited Base Station density		Highest Base Station density	
SW upgrade	Barely possible + severely impacts battery lifetime		Supported natively in the standard	
Security	Ad-Hoc, Not Strong	Very weak	Strong channel encryption (3GPP) + SW upgrade for security patches	
MNO Contract Lock-in	Yes: if using an MNO No: if self-operating	Yes	No: GMA eUICC SIM - Remote SIM provisioning enable/change MNO over the air	

Thank You

ndamour@sierrawireless.com

