Challenges of M2M in 5G

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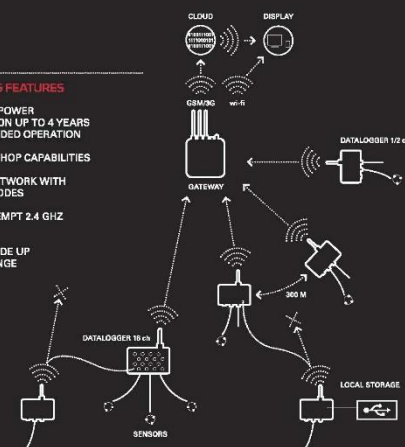KTH, Stockholm, Sweden

09/05/2014

1

M2M Usage Today

Industrial M2M Applications

© Worldsensing

M2M in Smart City Rollouts

Smart Parking

Smart Bins

© Worldsensing

Smart City Control Platform

Traffic Flow

Critical Infrastr.
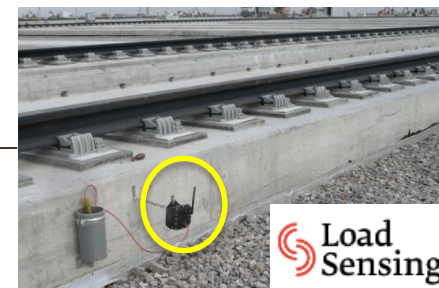
Travel Time

Historic Sites

**Proven Technologies
With Solid Deployment
Track-Record Today!**

2

Data Access Technologies

M2M Prime Business Criteria

Availability

Cellular 3GPP MTC

Low Power Wide Area

Low Power Wifi

Reliability

Bluetooth LE

Zigbee-like

Wired M2M
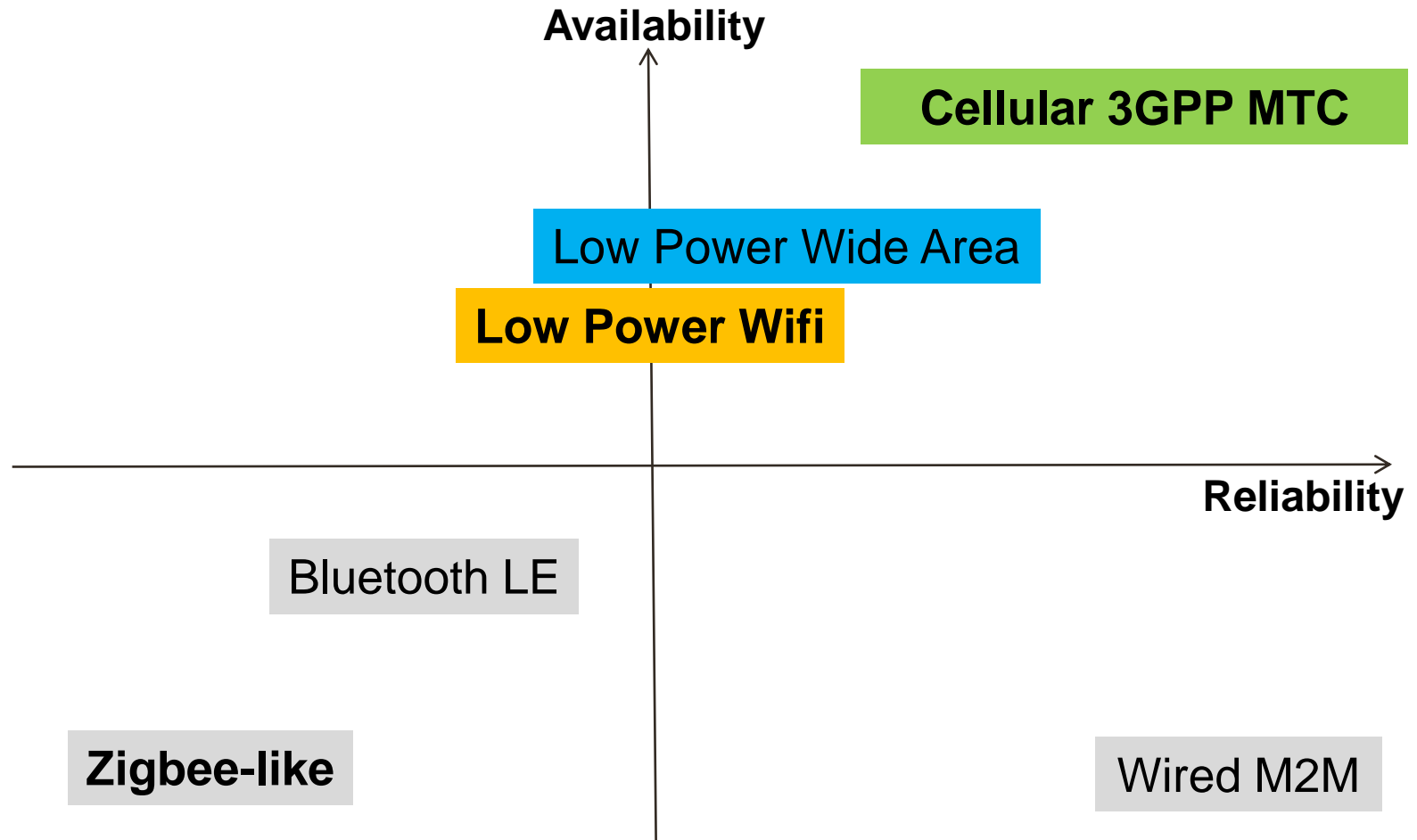
Availability = coverage, roaming, mobility, critical mass in rollout, etc.
Reliability = resilience to interference, throughput guarantees, low outages, etc.
(Total **Cost** of Ownership = CAPEX, OPEX.)

Standardized M2M Protocol Stacks

	Capillary M2M M2M Area Neworks		Cellular M2M
	Zigbee-Like	Low Power Wifi	LTE/LTE-A MTC
Application	IETF CORE	HTTP, etc.	
Transport	Lightweight TCP, UDP	TCP, UDP	LTE/LTE-A Networking Layer
Networking	IETF ROLL / 6LowPAN	IPv4, IPv6	
MAC	IETF 6TSCH / 802.15.4 /e Industrial Apps. / 802.15.4 /f RFID	802.11g/ac/ad/ah	LTE/LTE-A Link Layer
PHY	802.15.4-2006 /g Smart Grids /k Low-Energy Infrastructure Monitoring		

IETF (Application, Transport, Networking)

IEEE (MAC, PHY)

3GPP

Problems of ZigBee-like Solutions

Interference in ISM
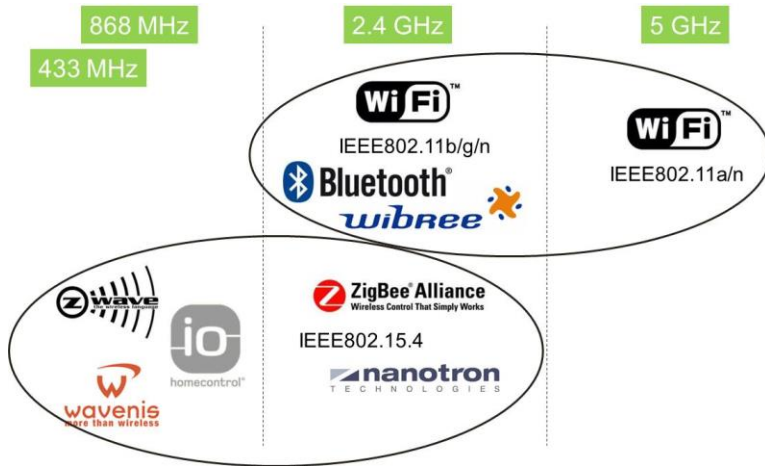
No Global Infrastructure

Lack of Interoperability

Higher Total Cost
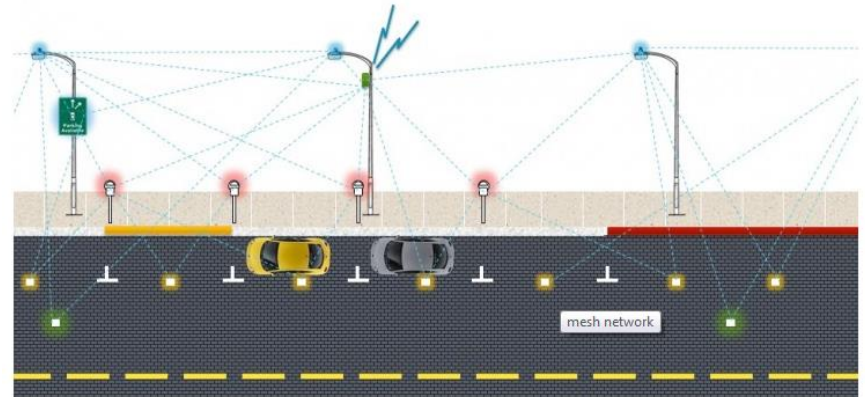
Industries start to understand!

bluetooth / internet of things / wi-fi

Zigbee and Z-wave are out. Broadcom's new chips bet on Bluetooth and Wi-Fi for IoT

by Stacey Higginbotham   MAY. 29, 2013 - 1:36 PM PDT

22 Comments

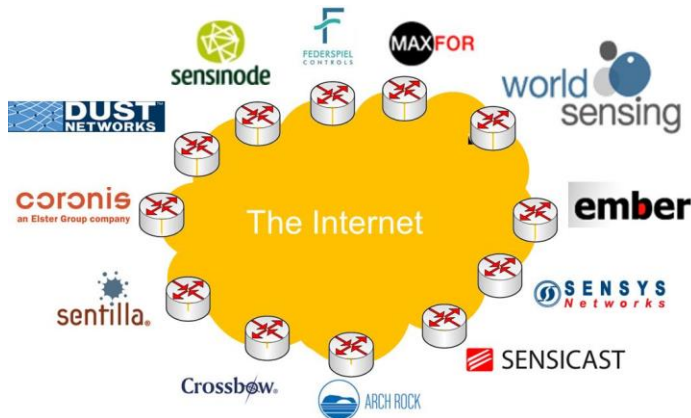SUMMARY: *The wide array of wireless radio technologies used to get devices online may soon shrink as major players in the chip world start choosing the standards they will support for the internet of things.*

tweet this

photo: Shutterstock / Jiri Hera

Advantages of Low-Power WiFi

Ubiquitous Infrastructure

Number of Wi-Fi Public Hotspots in the World
(in million), 2009-2015

350%

5.8
4.5
3.3
2.1
1.3
0.8
0.5

2009 2010 2011 2012 2013 2014 2015
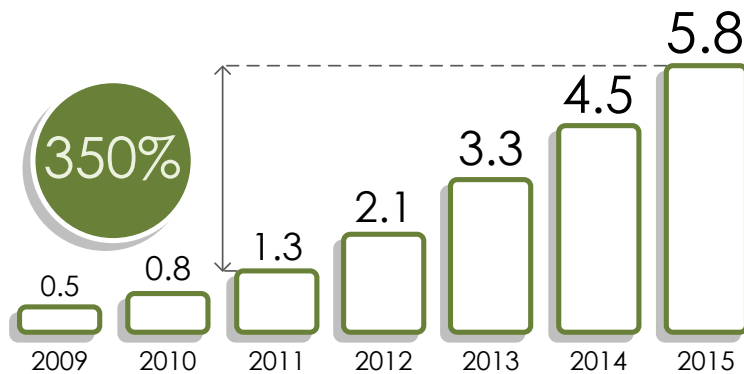
Source: Wireless Broadband Access (WBA), Informa, Nov. 2011

Vibrant Standard

IEEE 802.11™

WiFi

300 members

Interference Management

NAV Medium Reservation

Sound Security

WPA2/PSK/TLS/SSL

LP-Wifi vs ZigBee Capillary M2M

6LoWPAN vs. Low-power Wi-Fi at 54Mbps

	6LoWPAN		Low-power Wi-Fi	
Packet size	8 Bytes	1024 Bytes	8 Bytes	1024 Bytes
Time (ms)	6	23.61	11.3	16.58
Energy (mJ)	2.5	9.17	0.55	1.28

10x

"Low-power Wi-Fi provides a significant improvement over typical Wi-Fi on both latency and energy consumption counts."

"LP-Wifi consumes approx the same as 6LoWPAN for small packets but is much better for large packets."

[© IEEE, from "Feasibility of Wi-Fi Enabled Sensors for Internet of Things," by Serbulent Tozlu (2011)
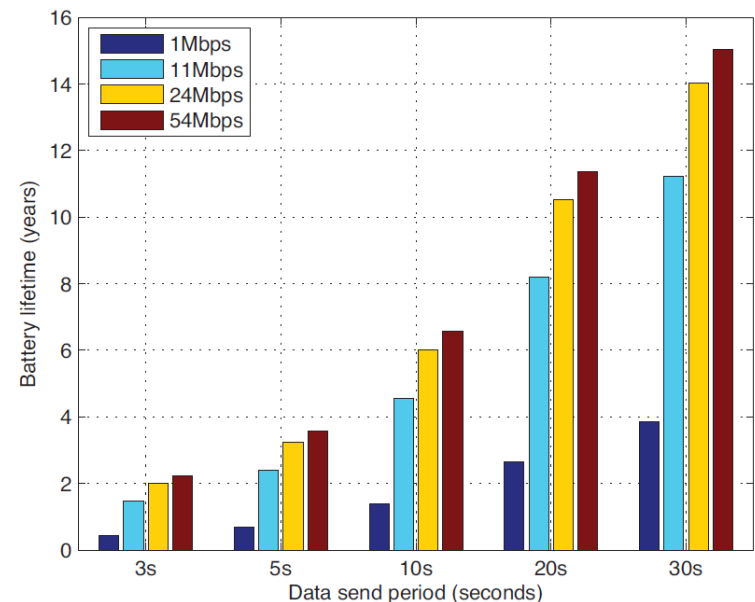
Advantages of LPWA M2M Networks

Large Coverage

Low Cost

Available Today

SigFox WIRELESS
REINVENT RADIO COMMUNICATION

SEMTECH

ONRAMP WIRELESS

neul

Operator Model

Service Level Agreement

Current Eco-System

- **Sigfox** (market leader in Q1 2014):
    - <u>technical</u>: sub-GHz, UNB, very long range, one-way
    - <u>business approach</u>: operator, yearly license fee; €20+ million VC

- On-Ramp:
    - <u>technical</u>: 2.4GHz ISM band; "Random Phase Multiple Access"; 170dB link budget
    - <u>business approach</u>: equipment provider mainly; Managed Service SLA possible

- Cycleo (now Semtech):
    - <u>technical</u>: sub-GHz, CDMA-based, long range
    - <u>business approach</u>: equipment provider

- Neul:
    - <u>technical</u>: initially TVWS only; now shift into other bands too (notably licensed!)
    - <u>business approach</u>: originally only equipment; now SLA possible

Performance Comparison

© Orange, excerpt from PhD Thesis of Dr Quentin Lampin:
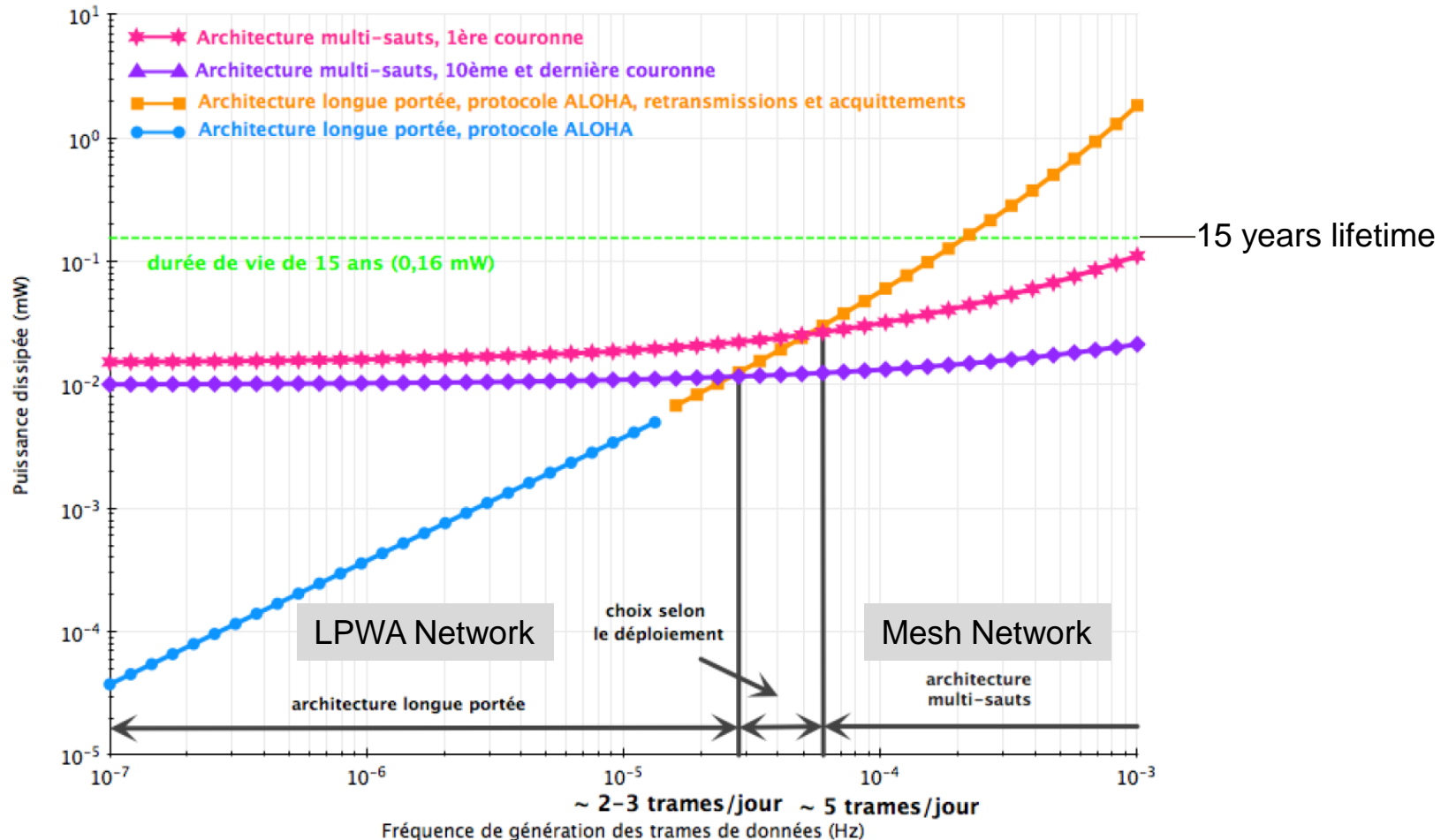
(a) $N = 100$ et $d = 10$

3

M2M (MTC) in 5G Cellular Systems
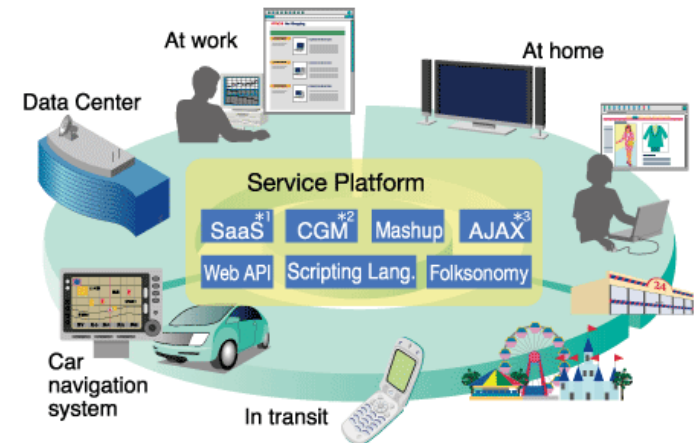
Advantages of Cellular M2M

Ubiquitous Coverage

Mobility & Roaming

Interference Control

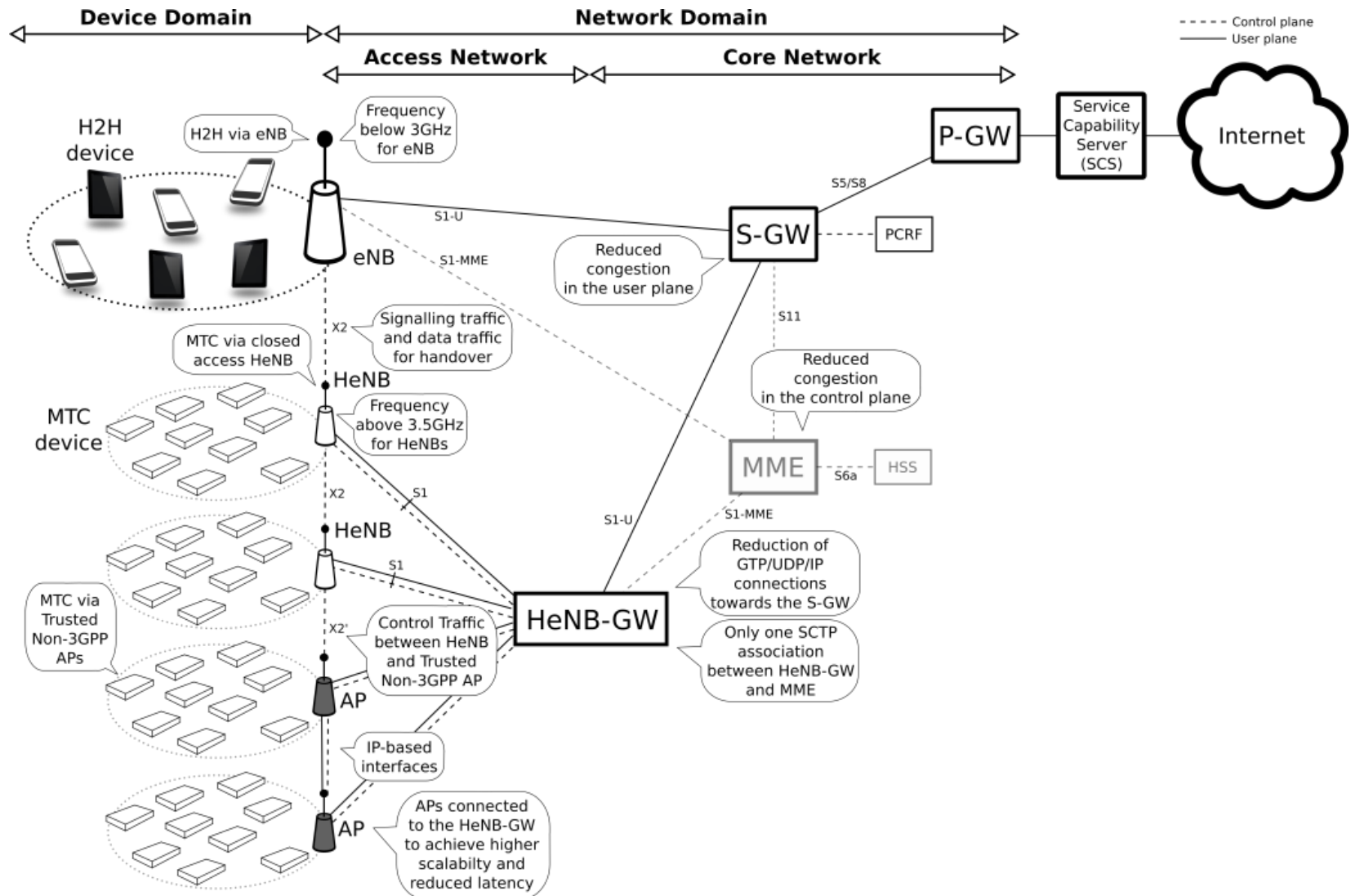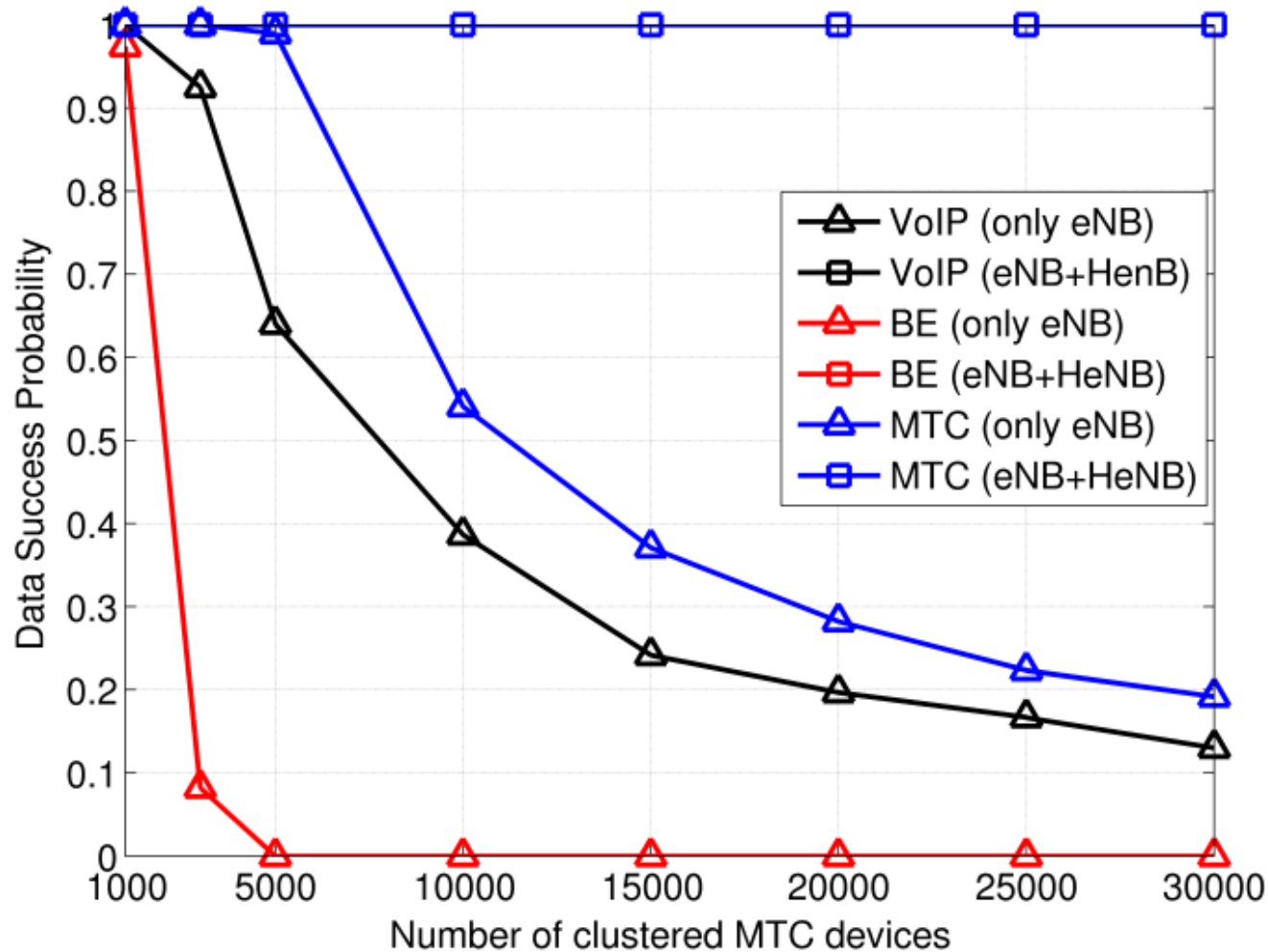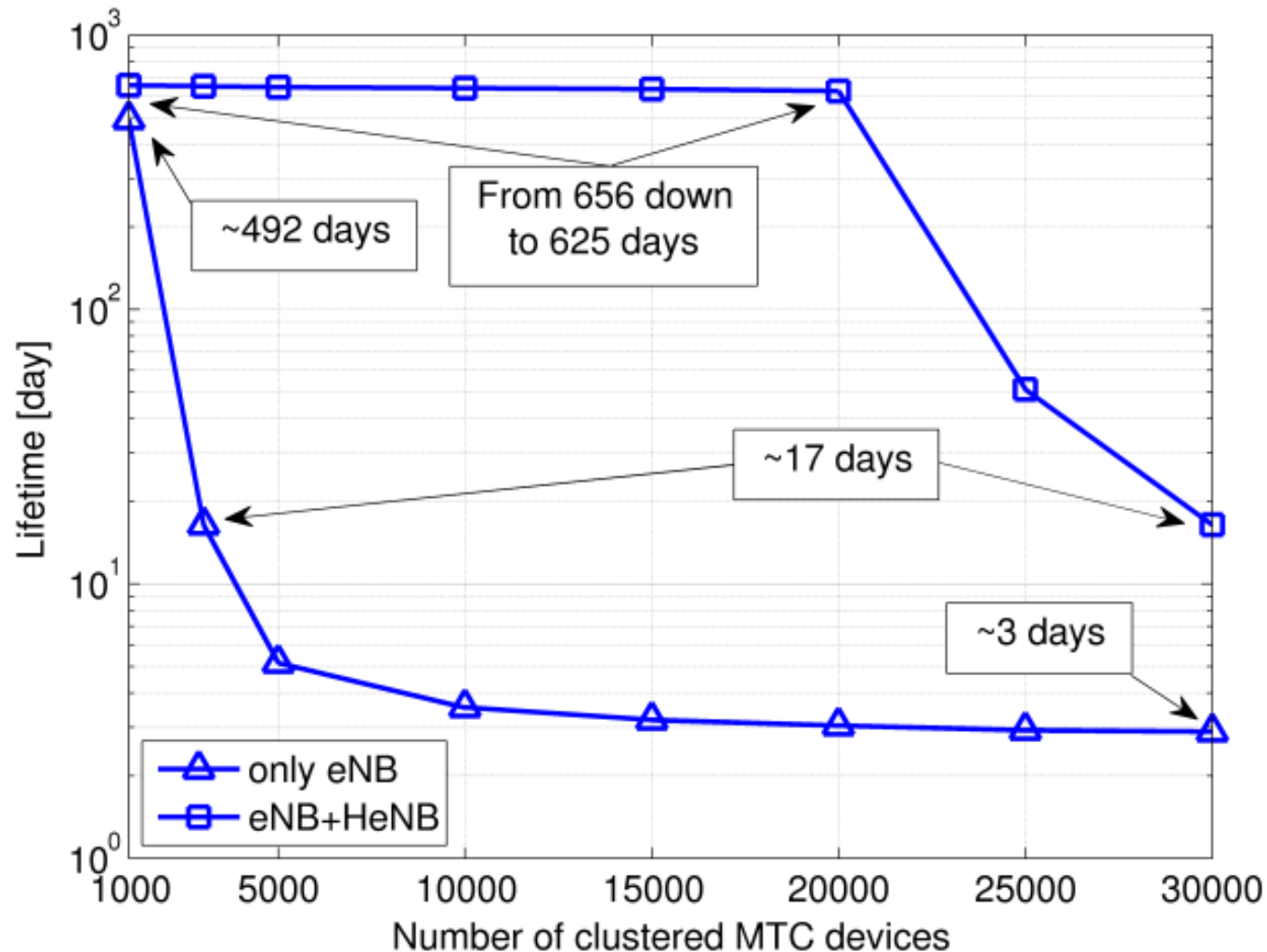## Service Platforms

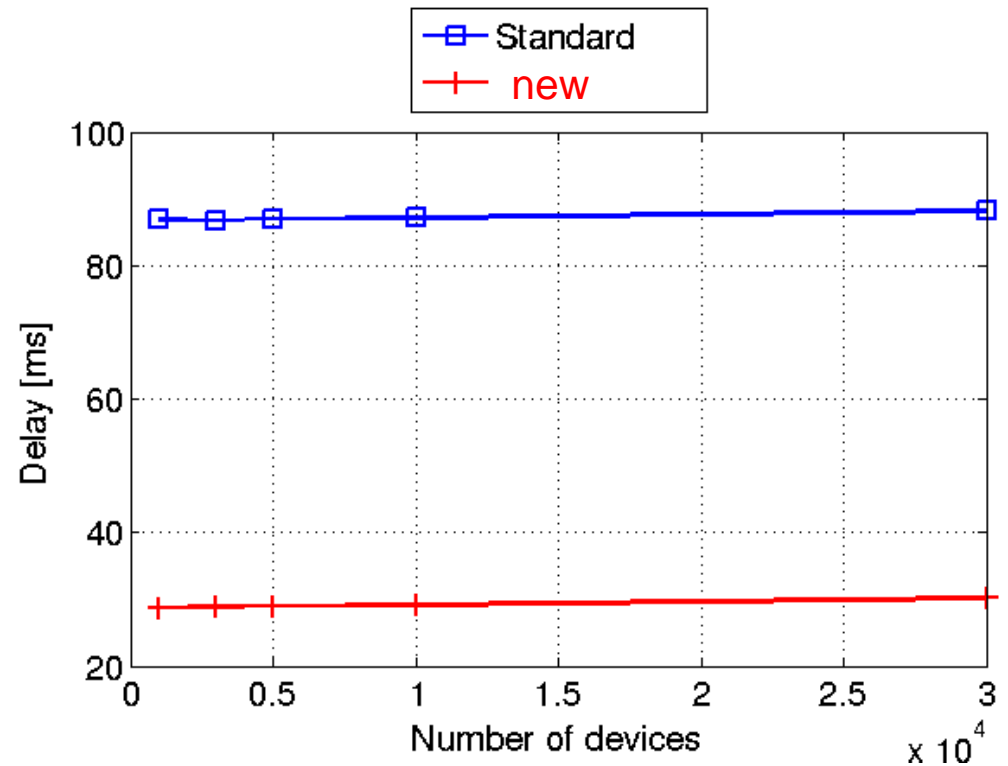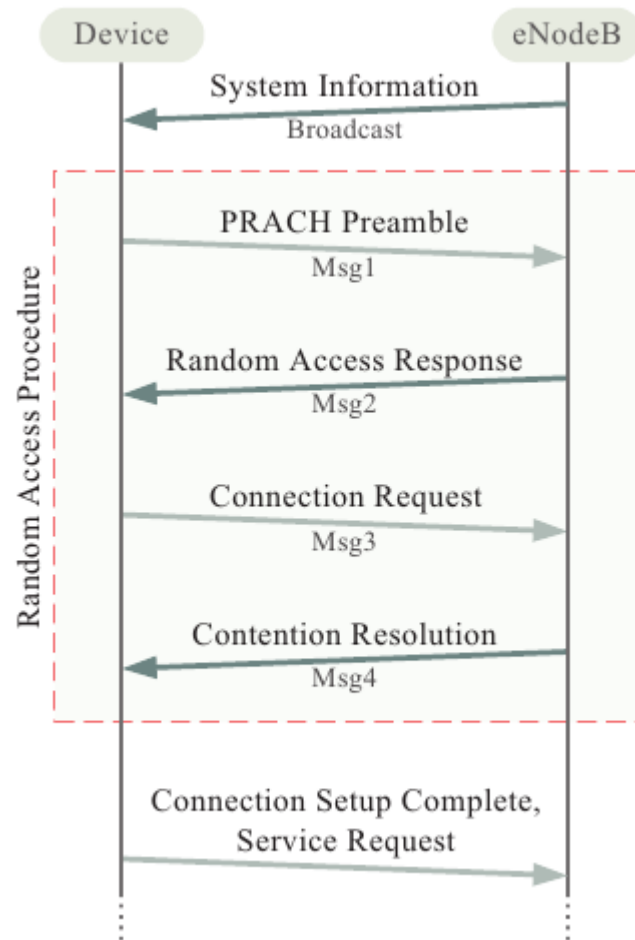# Creation of oneM2M Partnership project

5G HetNets M2M Architecture

© Massimo Condoluci, Mischa Dohler, Antonella Molinaro, Giuseppe Araniti

5G M2M: Dealing with Scalability

© Massimo Condoluci, Mischa Dohler, Antonella Molinaro, Giuseppe Araniti

5G M2M: Dealing with Lifetime

© Massimo Condoluci, Mischa Dohler, Antonella Molinaro, Giuseppe Araniti

5G M2M: Dealing with Delay

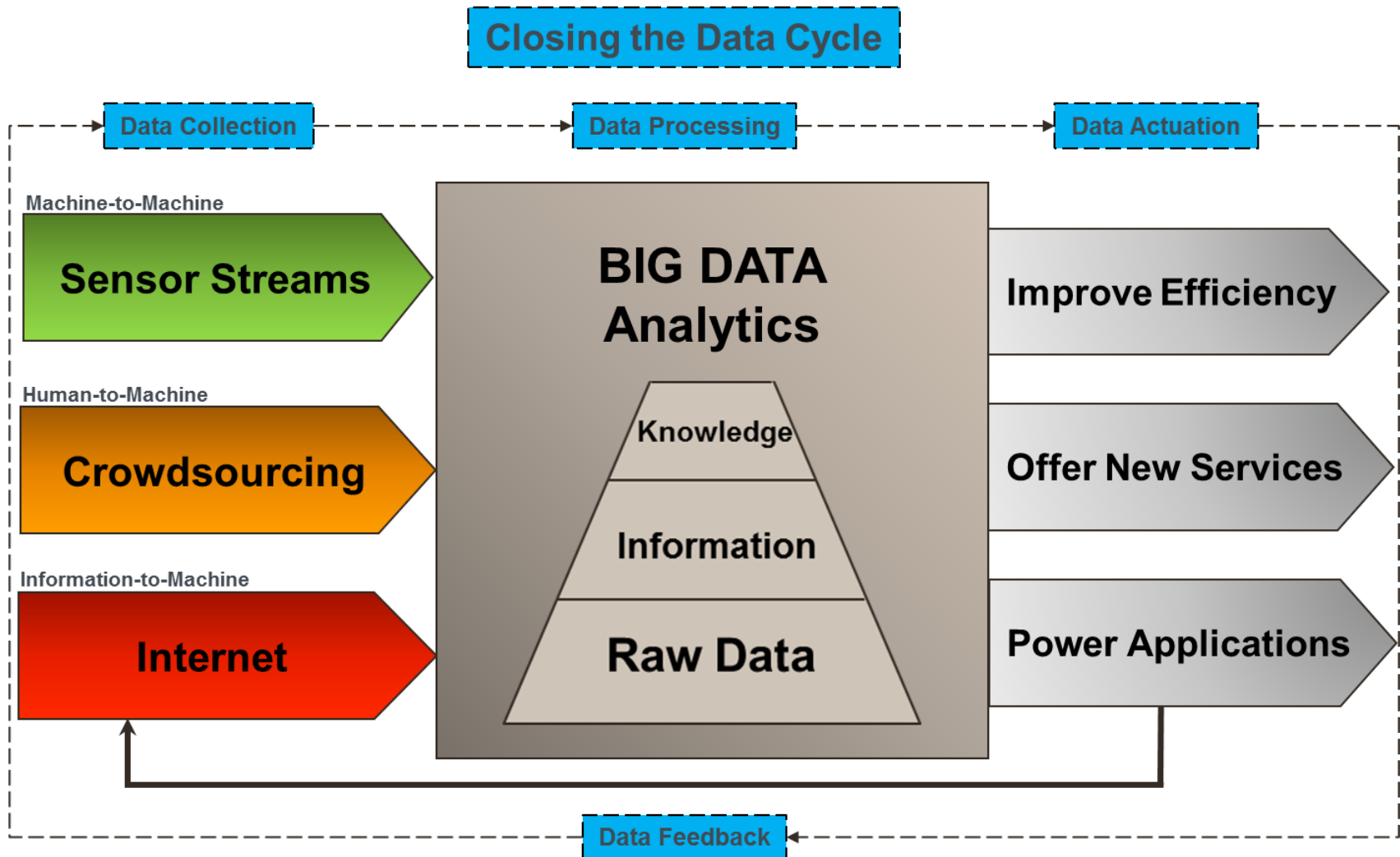© Massimo Condoluci, Mischa Dohler, Antonella Molinaro, Giuseppe Araniti

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Concluding Remarks

Closing the Data Cycle

M2M in 5G

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