Machine-to-Machine Technologies

Vision, Standards and Applications

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Introducing Machine-to-Machine

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Machines Do What Humans Don’t

Repetitive (Boring) Jobs

© http://japanesecanvas.blogspot.com/2010/07/bored-means-boring.html

(Time) Critical Jobs

© http://balancedlifeskills.com/home/tag/teen-stress

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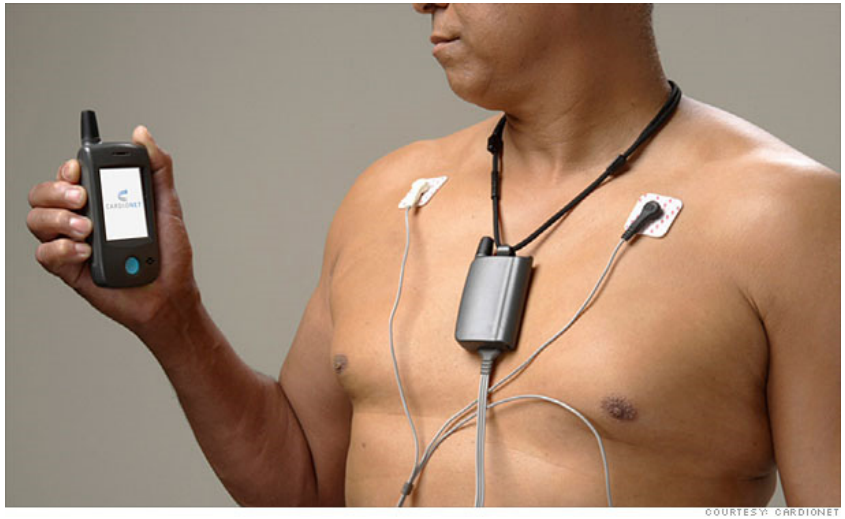
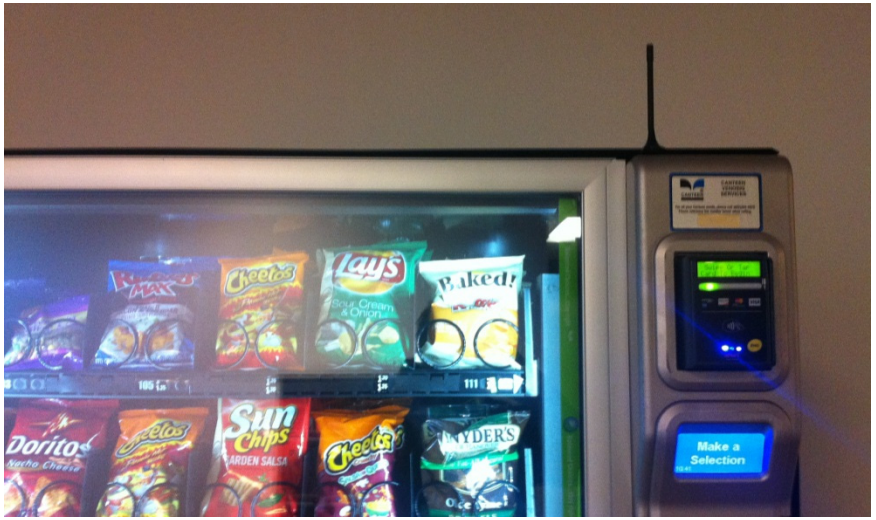
M2M Is All About Helping Humans





© CNN “When Machines Talk To Each Other”;
http://money.cnn.com/galleries/2011/technology/1104/gallery.machine_to_machine_communication.fortune/5.html

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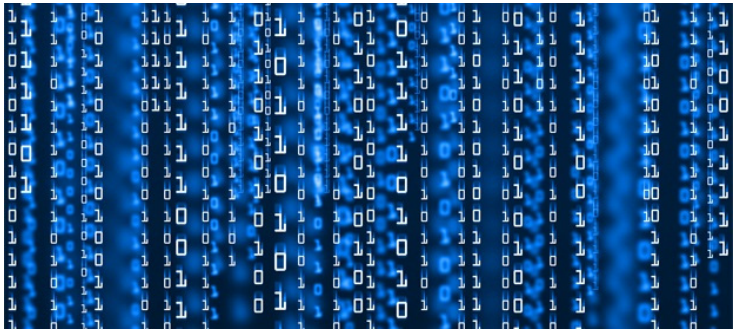
M2M Is All About Real-Time "Big" Data



© http://www.zdnet.com/big-data-all-you-need-to-know-1339335818/

http://strata.oreilly.com/2012/01/what-is-big-data.html

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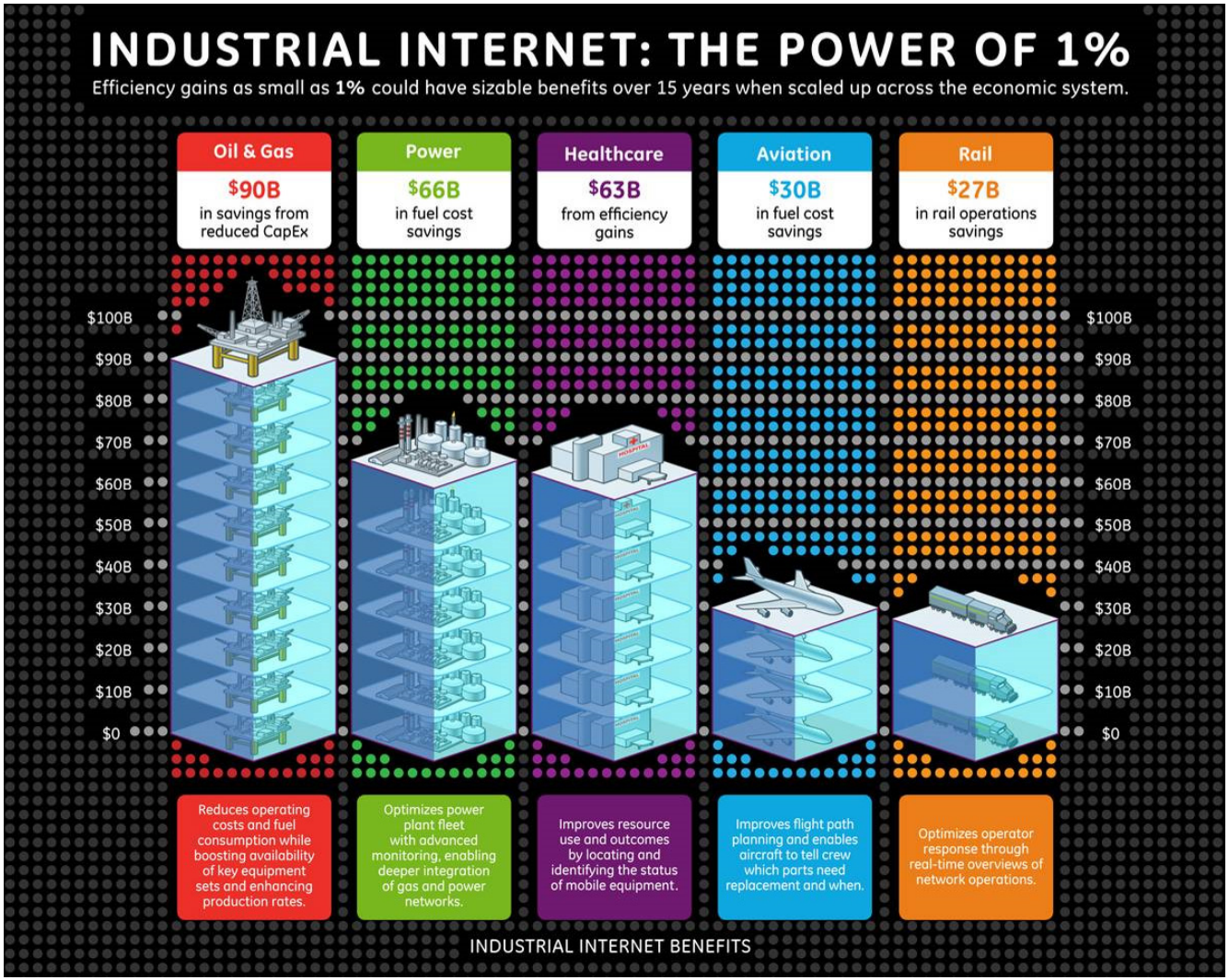
M2M Is All About Opportunities



http://www.gereports.com/new_industrial_internet_service_technologies_from_ge_could_eliminate_150_billion_in_waste/

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Data Mashup Platforms

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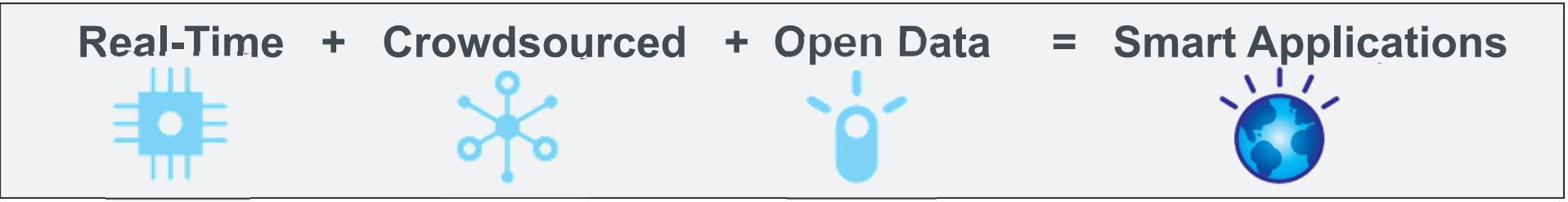

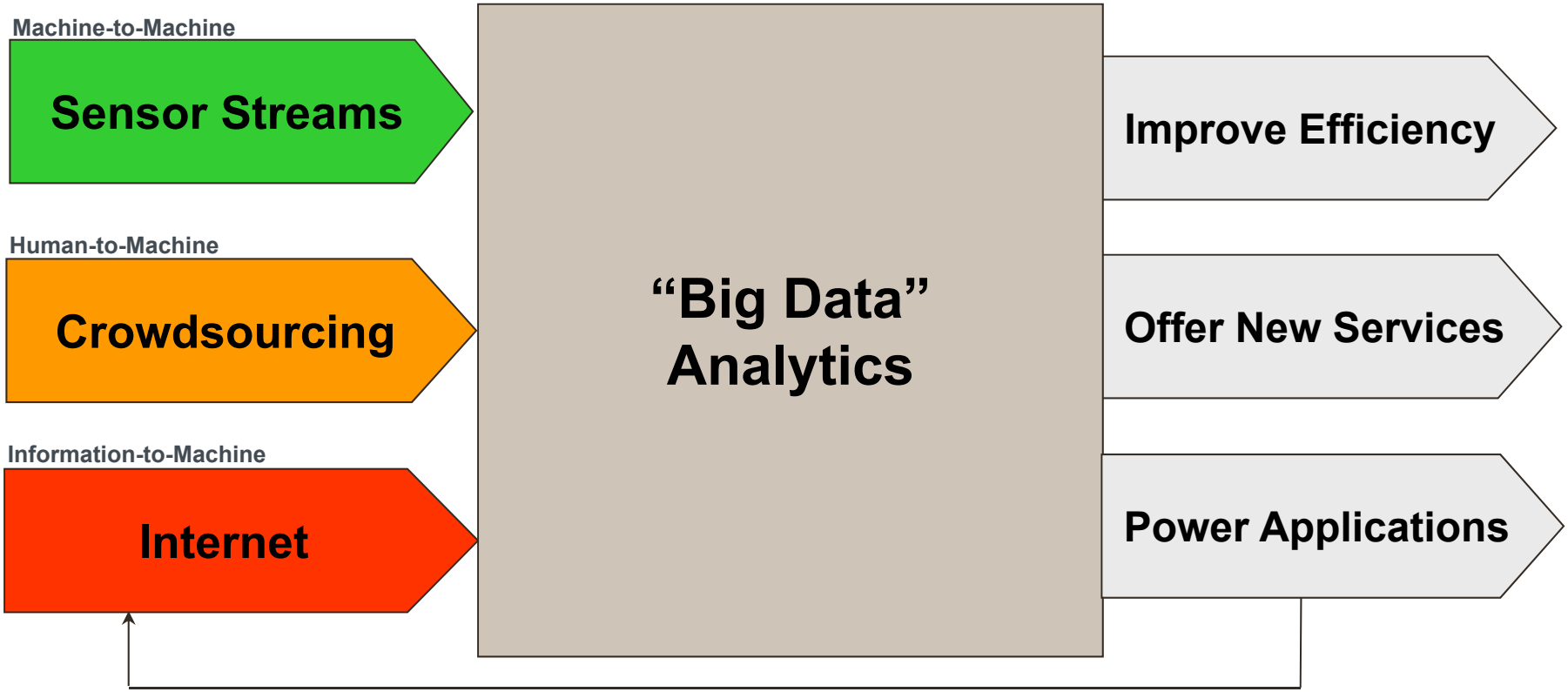

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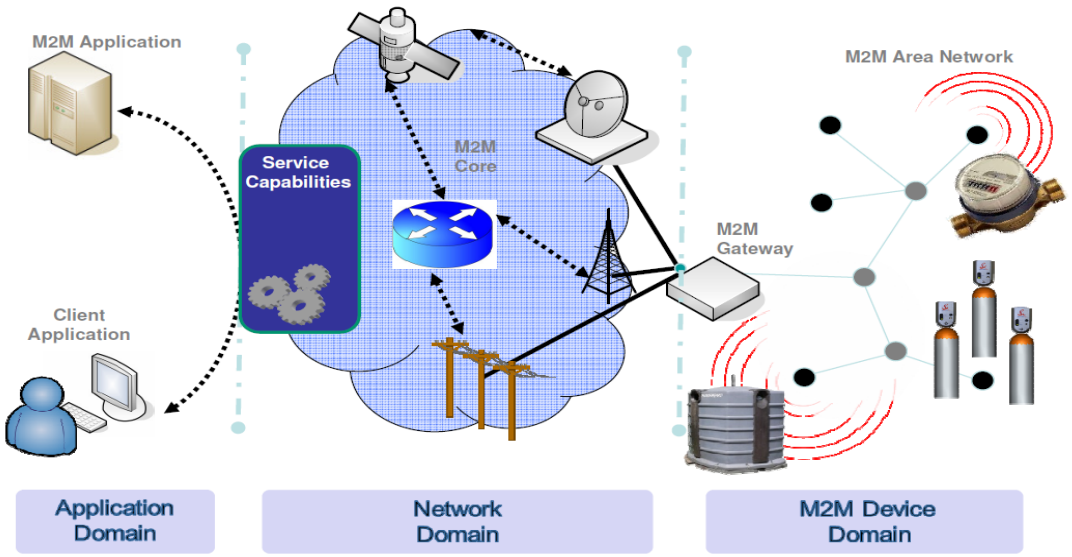
Tough Technical Implications

- **Machine-to-Machine (M2M) means no human intervention whilst devices are communicating end-to-end.**

- This assumes some fundamental M2M system characteristics:
  - support of a **huge amount** of nodes, sending **small data each**
  - **mission-critical** data provision
  - **autonomous** operation
  - self-organization
  - power efficiency
  - reliability
  - etc, etc



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Technical Overview of Machine-to-Machine

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Quick Intro

- **Machine** – To – Machine:
  - device (water meter) which is monitored by means of sensor [in “uplink”]
  - device (valve) which is instructed to actuate [in “downlink”]
  - keywords: physical sensors and actuators; cost
- Machine – **To** – Machine:
  - network which facilitates end-to-end connectivity between machines
  - composed of radio, access network, gateway, core network, backend server
  - keywords: hardware; protocols; end-to-end delay and reliability; cost
- Machine – To – **Machine**:
  - device (computer) which extracts, processes (and displays) gathered information
  - device (computer) which automatically controls and instructs other machines
  - keywords: middleware, software, application; cost

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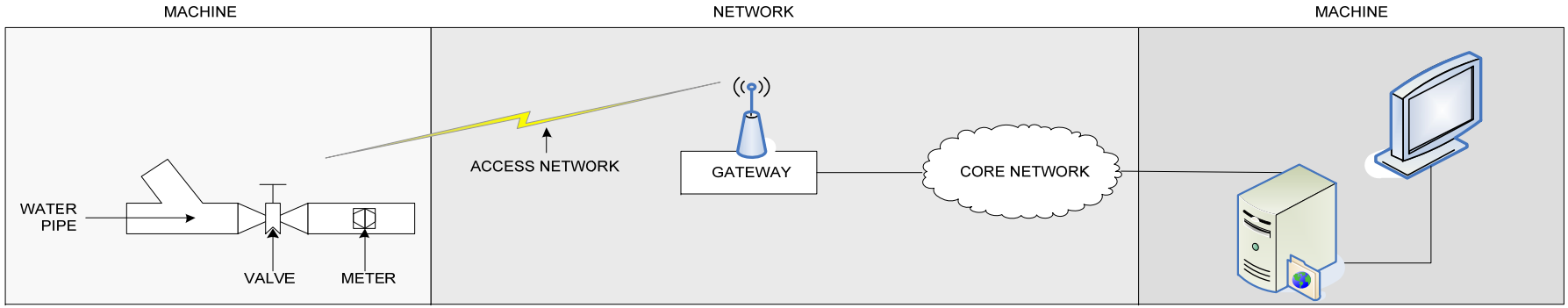
M2M End-to-End Network

- **Access Network** – connecting the sensors & actuators:
  - "wired" (cable, xDSL, PLC, optical, etc.)
  - wireless "capillary"/short-range (WLAN, ZigBee, IEEE 802.15.4x, etc.)
  - wireless cellular (GSM, GPRS, EDGE, 3G, LTE-M, WiMAX, etc.)
- **Gateway** – connecting access and backhaul/core networks:
  - network address translation
  - packet (de)fragmentation; etc.
- **Core/Backend/Internet Network** – connecting to computer system:
  - IPv6-enabled Internet



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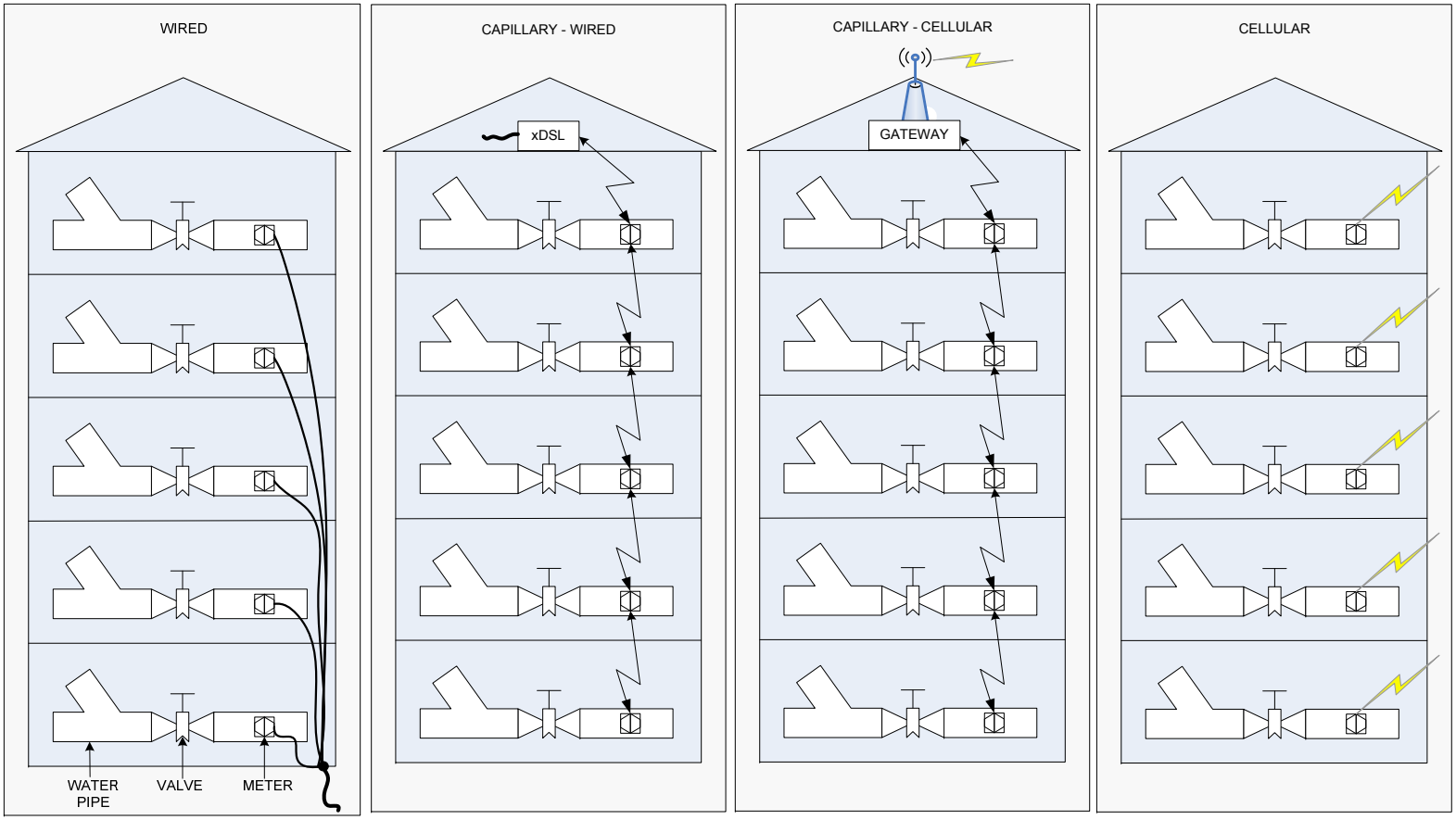
M2M Access Networks [1/2]

- Connecting your smart meters through 4 example access methods:



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M2M Access Networks [2/2]

- **Wired Solution** – dedicated cabling between sensor - gateway:
  - pros: very, very ***reliable***; very high rates, little delay, secure
  - cons: very ***expensive to roll out***, ***vandalism***, ***not scalable***, *no mobility*
- **Wireless Capillary Solution** – shared short-range link/network:
  - pros: ***cheap*** to roll out, generally scalable, ***low power***
  - cons: short range, ***multi-hop not a solution***, low rates, weaker security, ***interference***
- **Wireless Cellular Solution** – dedicated cellular link:
  - pros: ***excellent coverage***, mobility, ***roaming***, generally secure, infrastructure
  - cons: ***expensive operate***, not cheap to maintain, ***not power efficient***, delays

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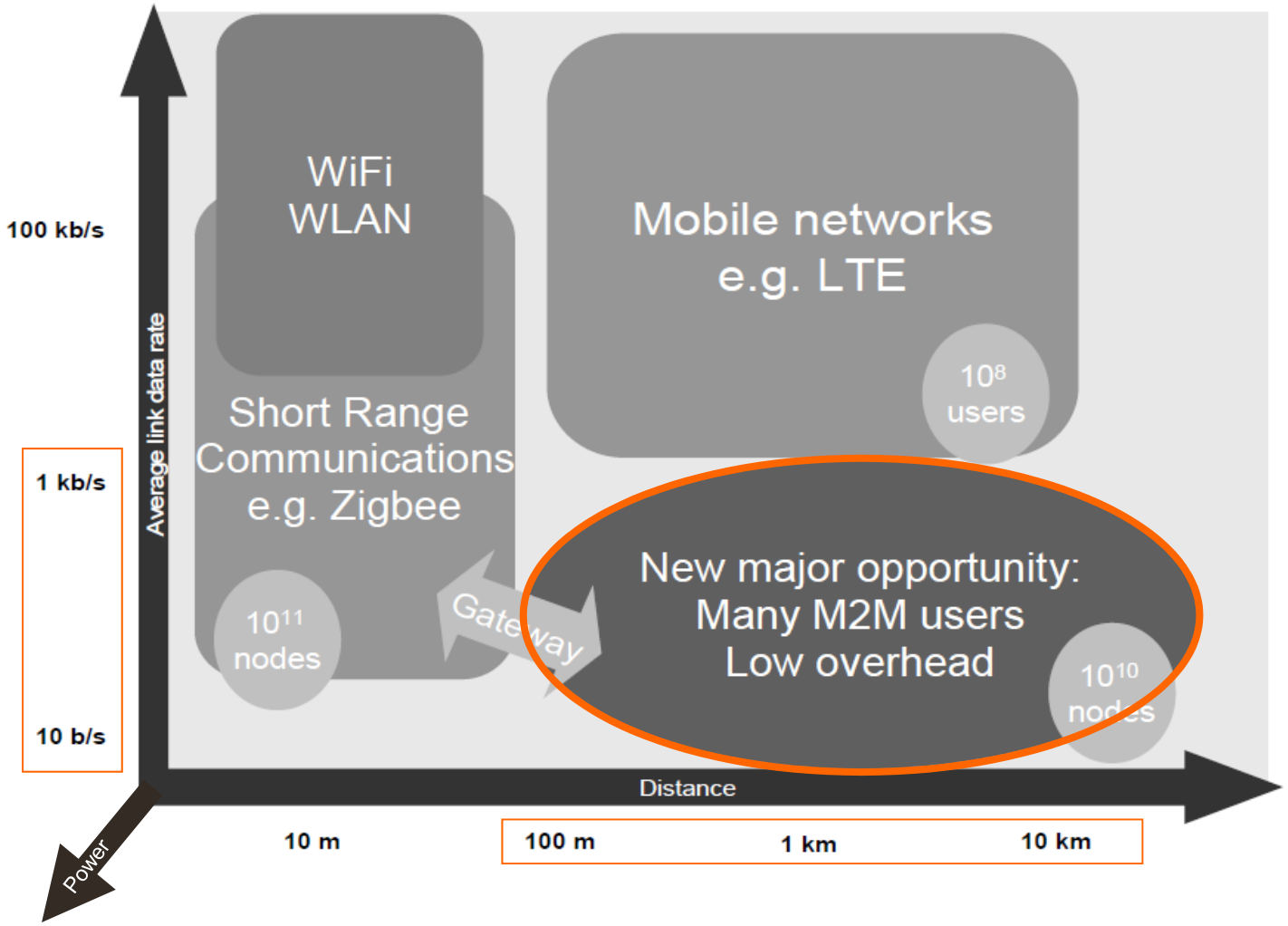
Novelty of Wireless M2M



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Capillary & Cellular M2M Technologies

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Standardized Capillary M2M Stack

IETF

IEEE

	Zigbee-like	Low-Power Wifi
Application	IETF CORE	HTTP, etc
Transport	(Lightweight TCP), UDP	TCP, UDP, etc
Networking	IETF ROLL (routing)	IPv4/6, etc
	IETF 6LoWPAN (adapt.)	
MAC	IEEE 802.15.4e	IEEE 802.11
PHY	IEEE 802.15.4-2006	

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Advantages of Low-Power WiFi

Ubiquitous Infrastructure

Vibrant Standard

IEEE 802.11™

300 members

Wi Fi

Interference Management

NAV Medium Reservation

Sound Security

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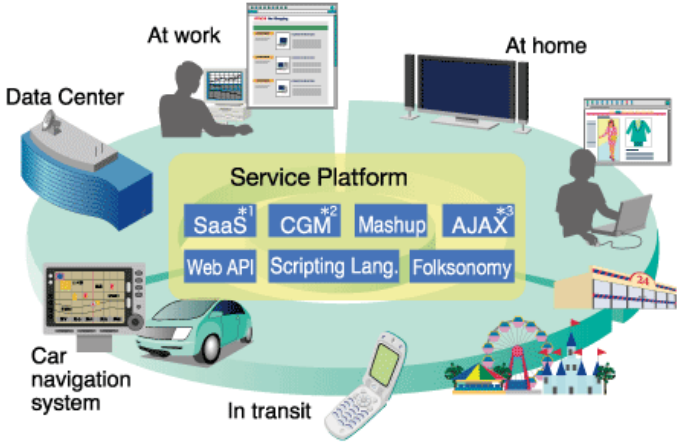
Advantages of Cellular M2M

Ubiquitous Coverage

Mobility & Roaming

Interference Control

Service Platforms



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Standardization Activities

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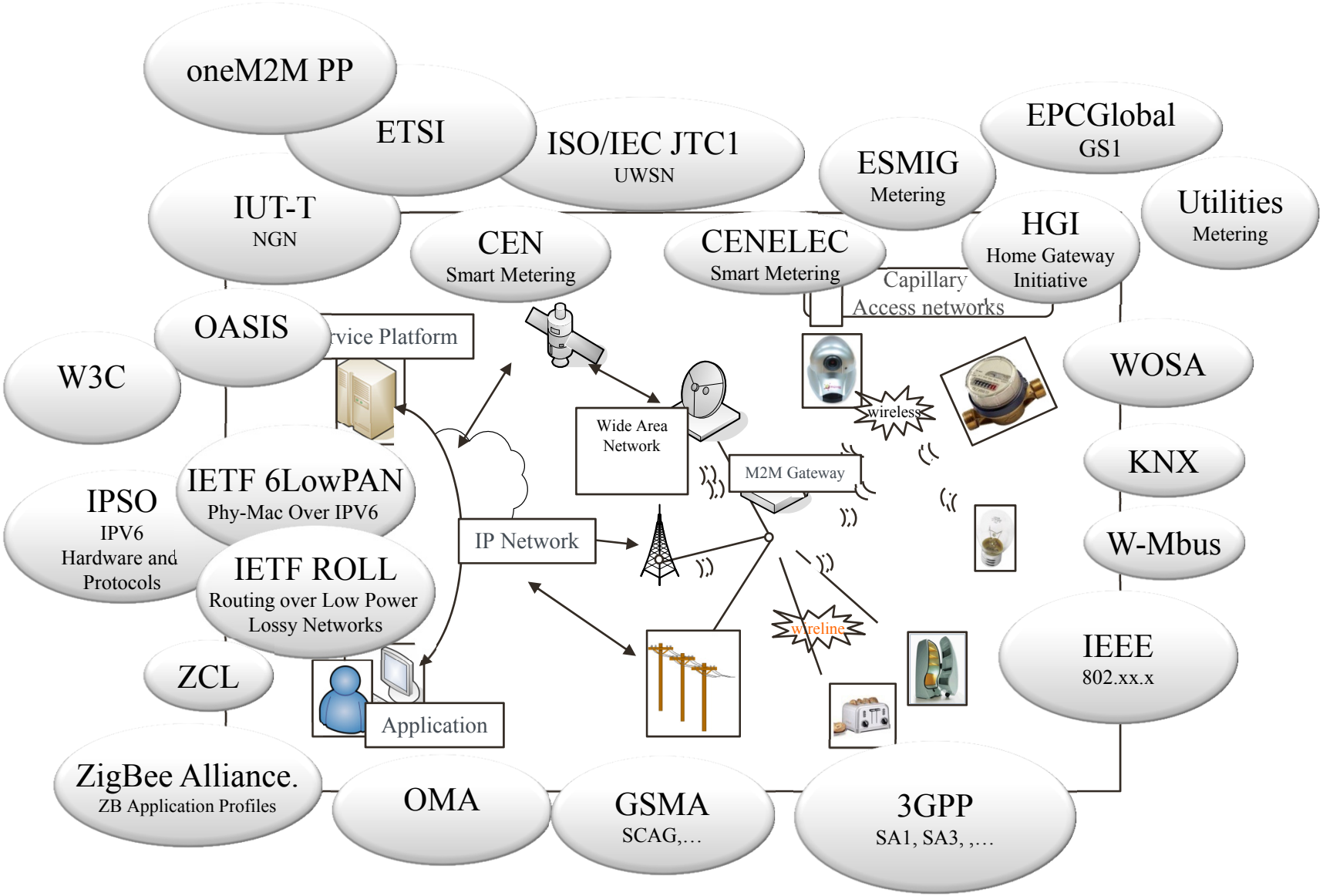
M2M-Related Standardization Bodies



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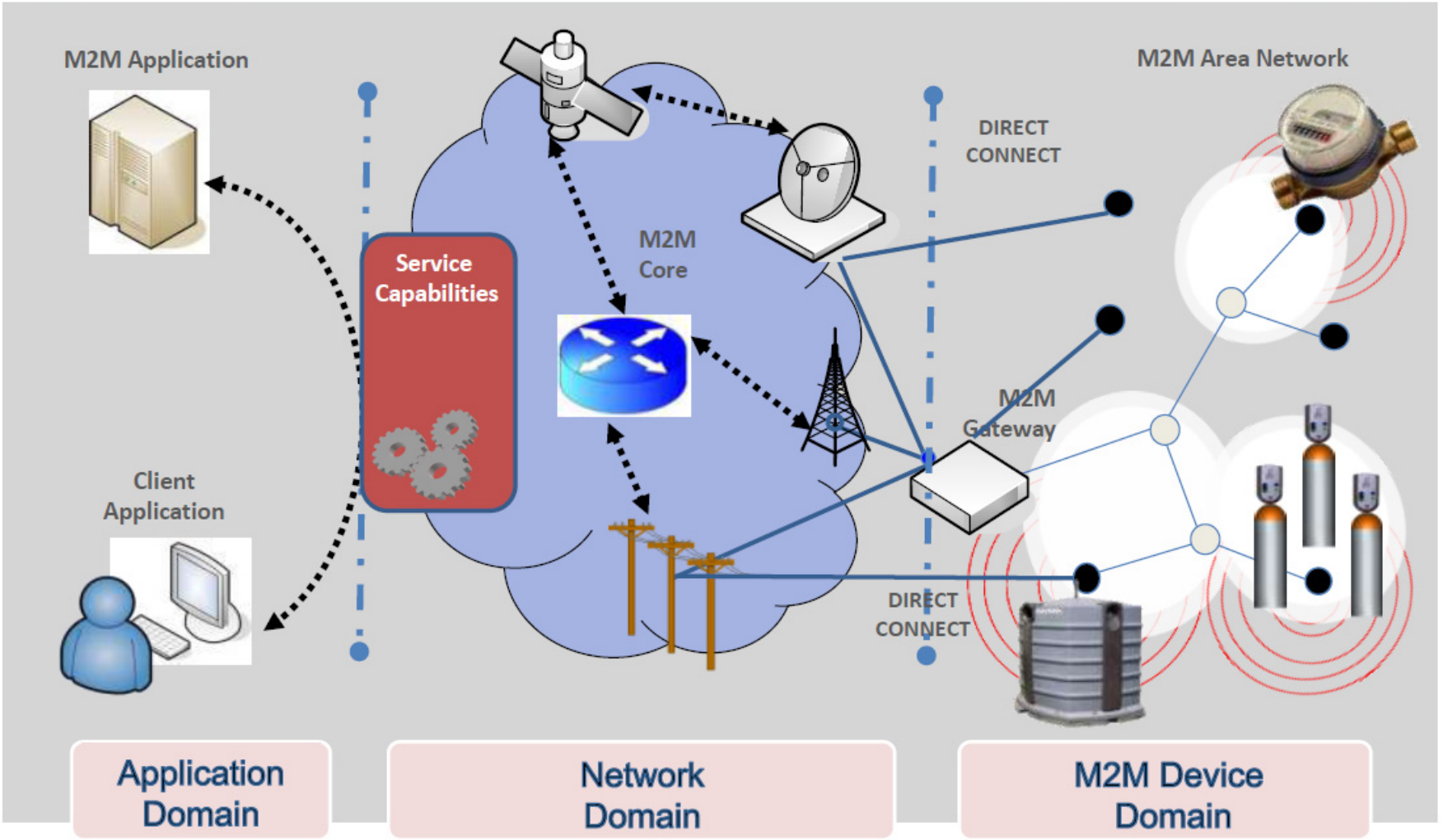
ETSI: TC M2M Simplified Architecture



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3GPP: MTC Feature List

- A ***feature*** is a system optimization possibility
- Different requirements → different optimizations
- Offered on a ***per subscription*** basis:
  - Low Mobility
  - Time Controlled
  - Time Tolerant
  - Small Data Transmissions
  - Mobile originated only
  - Infrequent Mobile Terminated
  - MTC Monitoring
  - Priority Alarm Message (PAM)
  - Secure Connection
  - Location Specific Trigger
  - Infrequent transmission
  - Group Based features
    - Policing
    - Addressing

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oneM2M Partnership Project

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Business & Markets

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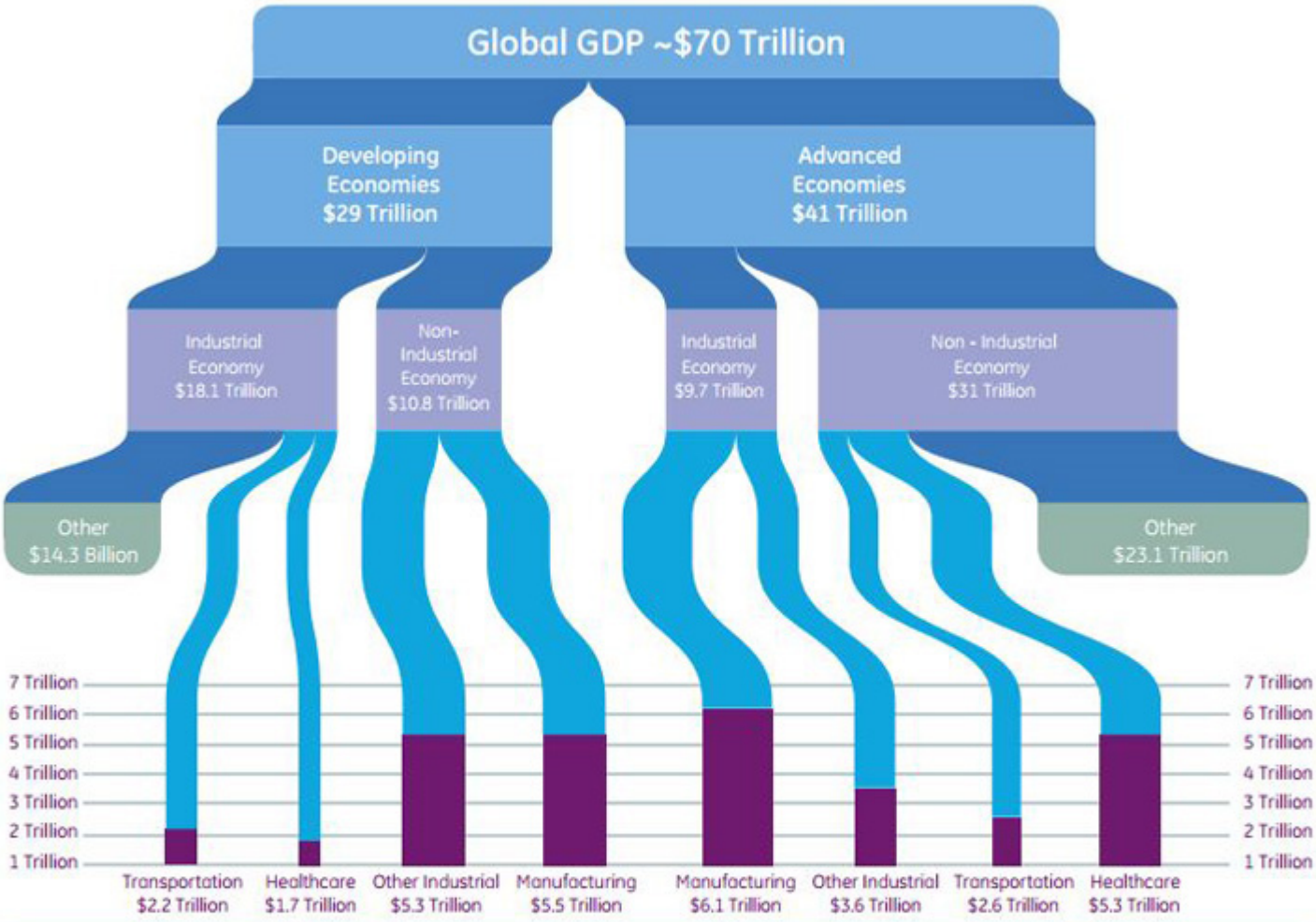
ROI #1 – Real-Time Instrumentation



Source: World Bank, 2011 and General Electric

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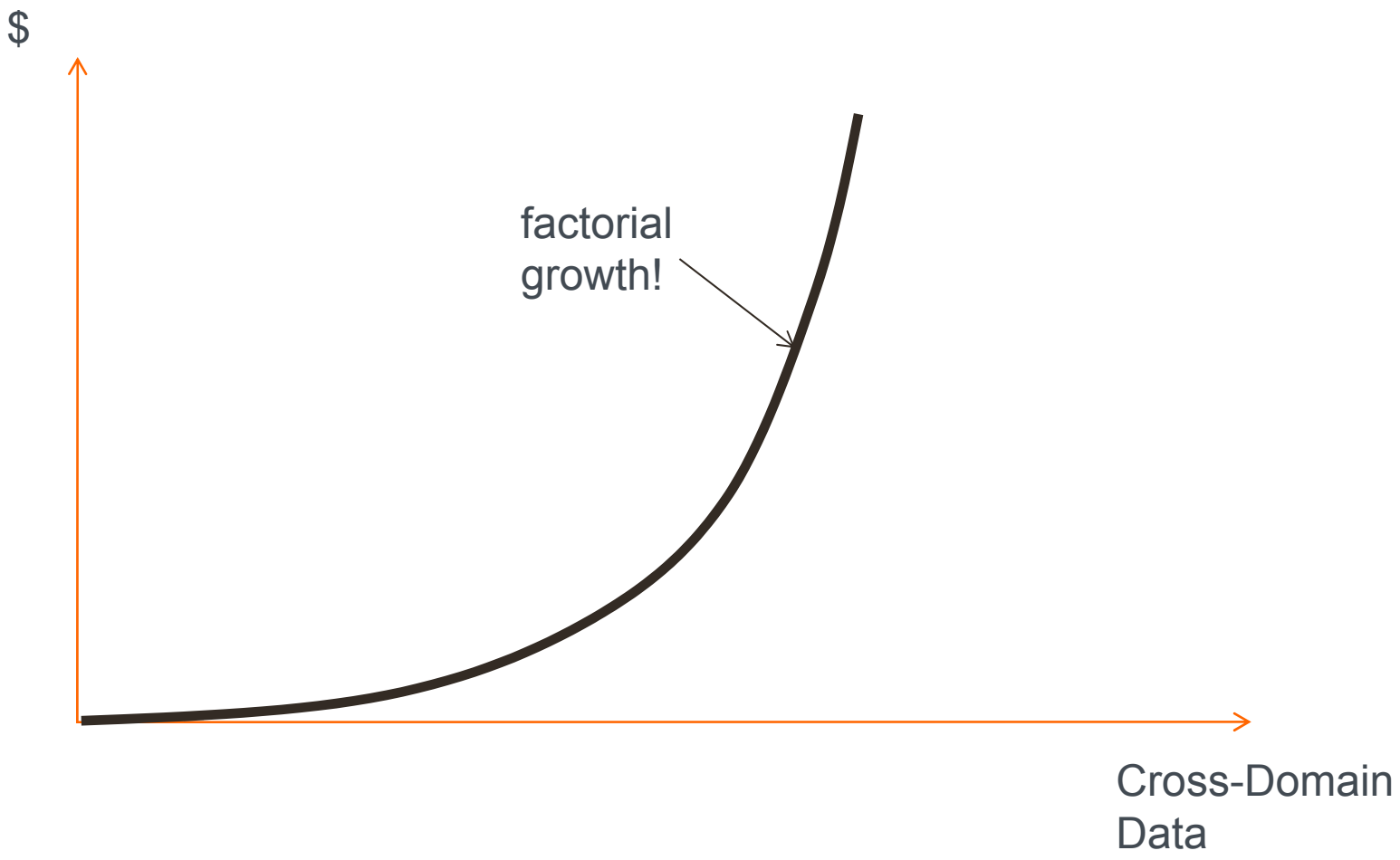
ROI #2 – "Big Data" Value



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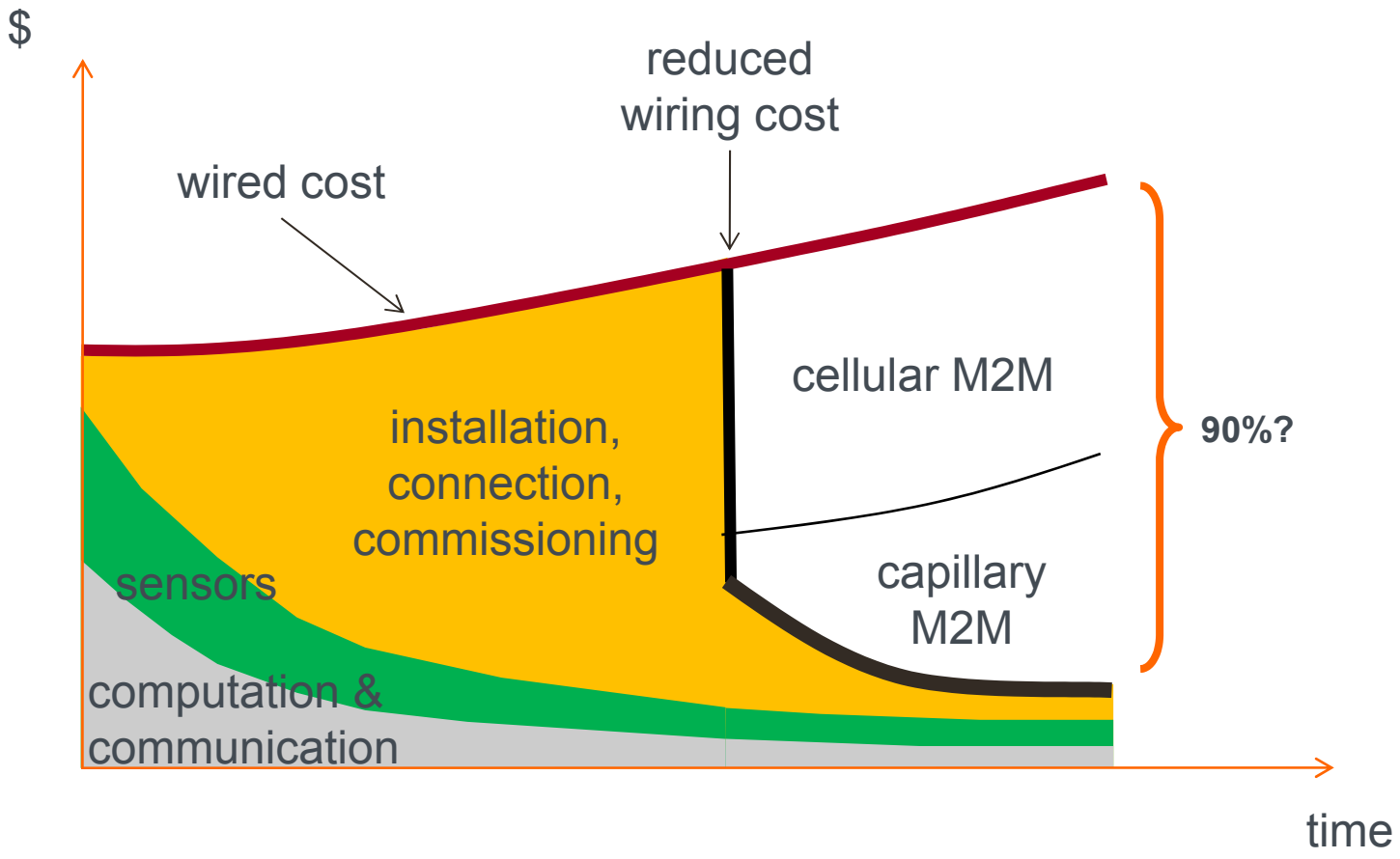
ROI #3 – Savings of Wireless M2M



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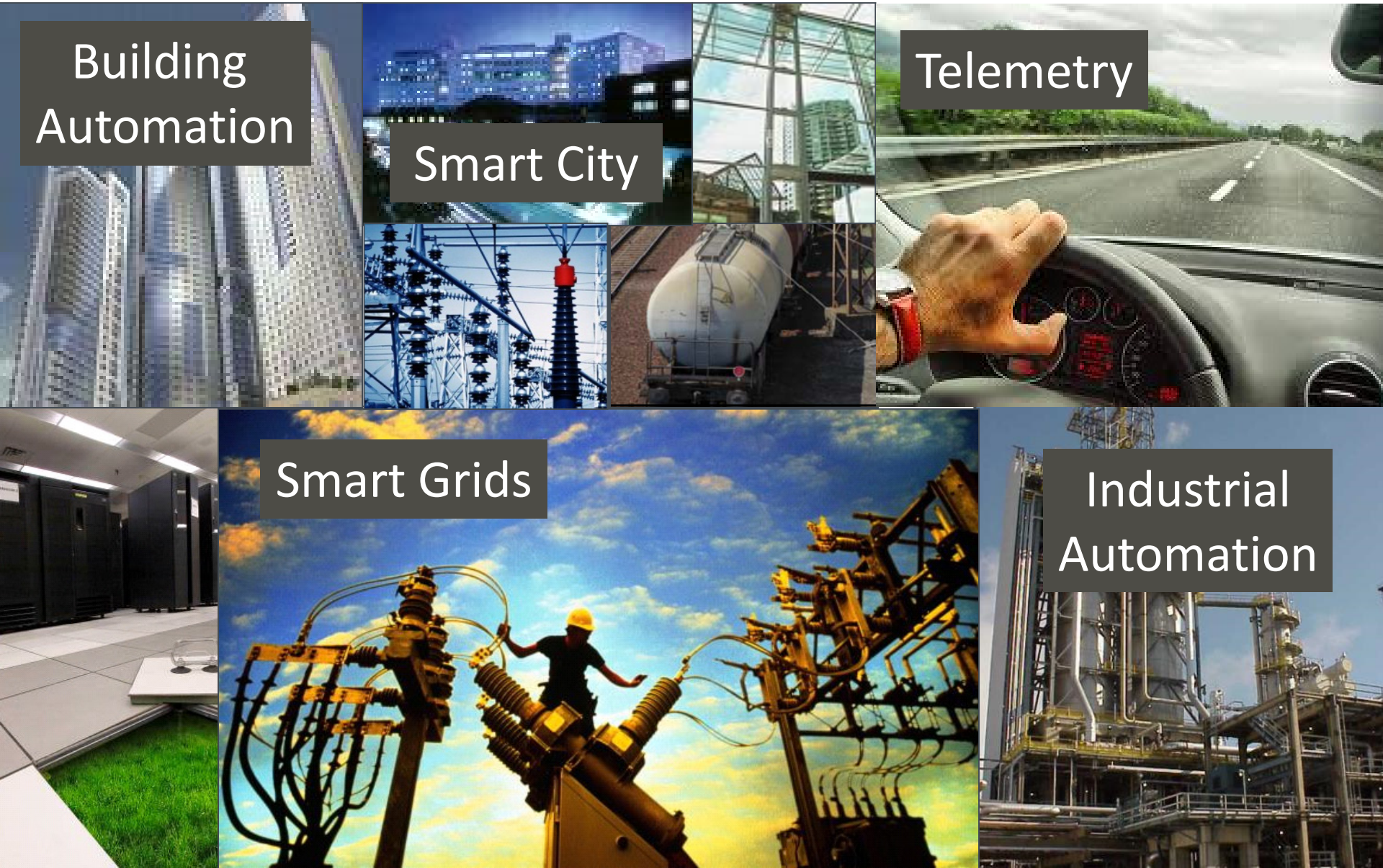
Popular M2M Markets



Today's M2M Smart City Reality

Smart Parking

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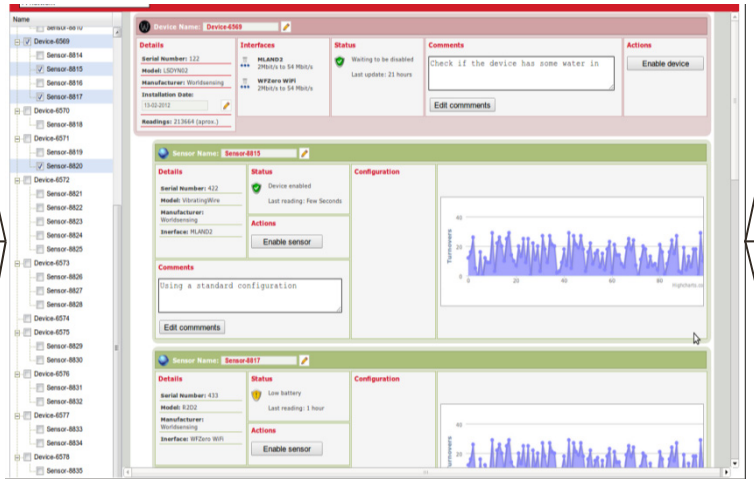
Smart Bins

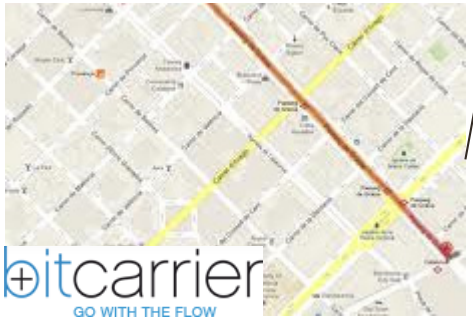
Smart City Control Platform



Traffic Flow

Critical Infrastr.

Travel Time



Historic Sites

Proven Technologies With Solid Deployment Track-Record Today!

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Concluding Remarks

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Machine-to-Machine Predictions

- **Prediction #1:** The capillary embodiment of M2M, Zigbee, will never reach critical mass due to lack of already deployed infrastructure; however, low-power Wifi will scale very quickly.

- **Prediction #2:** With some exceptions, operators will miss out again on the opportunity to become a true service provider, i.e. capitalize on the data content rather than on the data pipe.

- **Prediction #3:** Integrators of integrators & data analytics companies, such as IBM, Oracle, SAP, will capitalize on the true value of M2M; and thus make it an expensive "circle" to be in.

- **Prediction #4:** Uptake of M2M technologies will be much slower than anticipated since marginal business for very large corporations but too-long sales cycles for innovative startups.

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THANKS

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