Benefits of nanosatellite network for smart metering technological infrastructure in wide areas

P. Motta, A. Castiglione, E. Catania, E. Guardo, A. La Corte, S. Pagano*
University of Catania

University of Catania
Department of Electric, Electronic and Computer Engineering

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Contents

- Smart Metering
- Current and Proposed Architectures
- Characteristics of the Nanosatellite
- A case study
- Satellite vs Mobile

Smart Metering

Fig.1: Meter

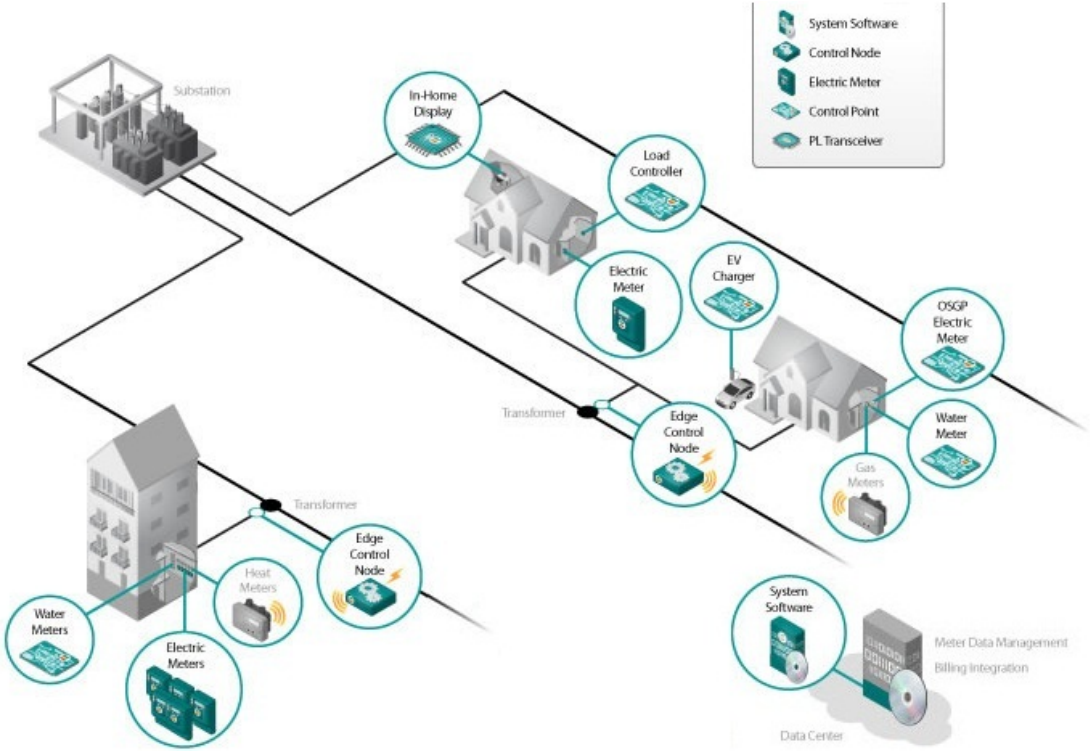
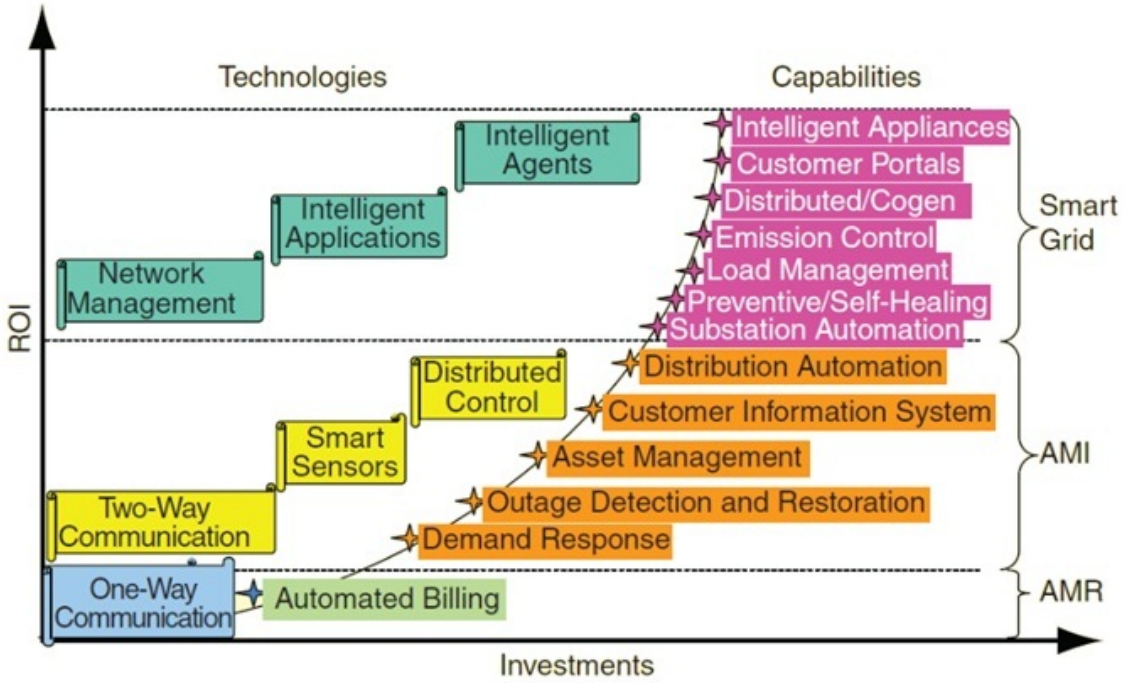


Fig.2: Metering network

Smart Metering

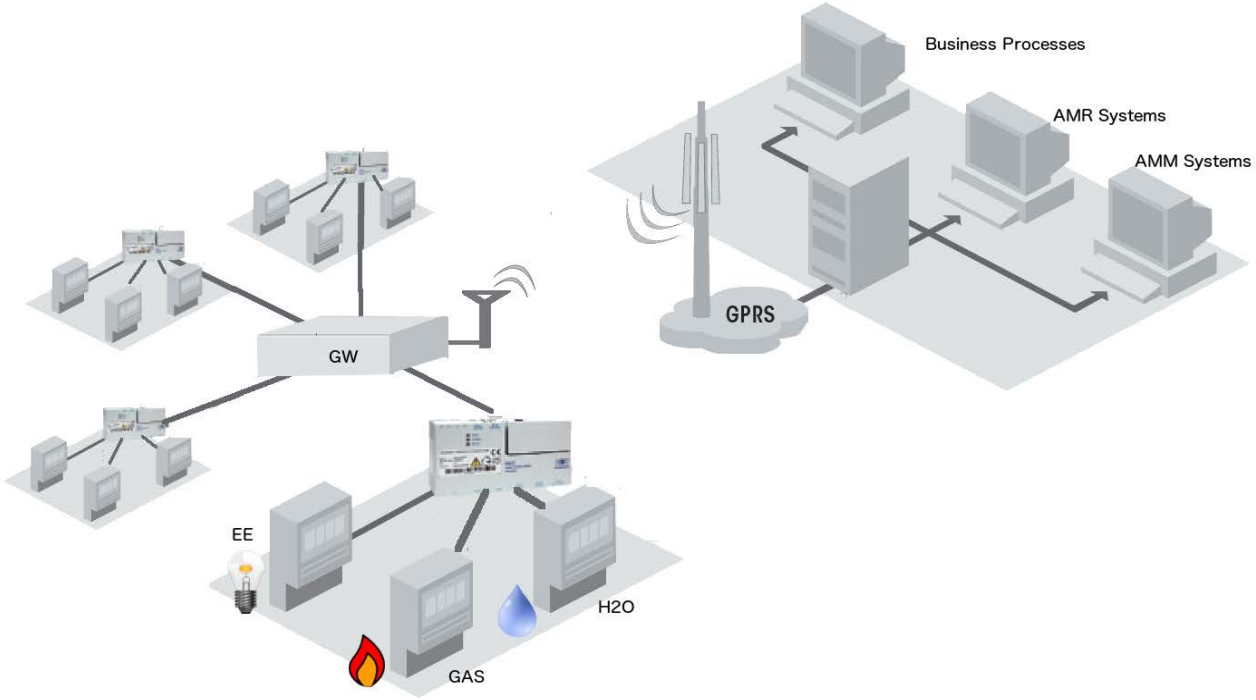


Smart Metering

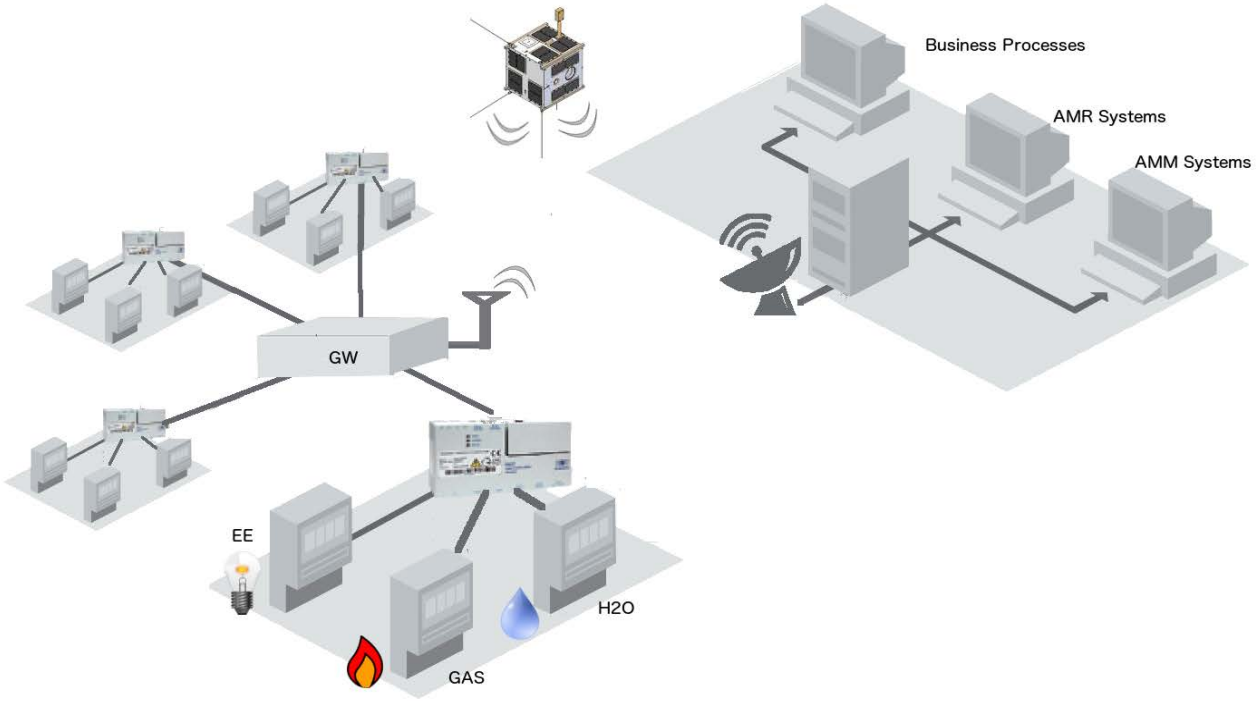
Directive 2012/27/EU of the European Parliament and of the Council on energy efficiency

Art 9: Member States shall ensure that, in so far as it is technically possible, financially reasonable and proportionate in relation to the potential energy savings, final customers for electricity, natural gas, district heating, district cooling and domestic hot water are provided with competitively priced individual meters that accurately reflect the final customer's actual energy consumption and that provide information on actual time of use.

Current Architecture: Mobile



Proposed Architecture: Satellite



Benefits

Economic

- It covers high density areas with less devices and structures
- Communication network management and implementation lower costs

Coverage

- Variable coverage area, from medium to extremely wide, depending on distance from Earth's surface

Infrastructure

- Coverage of rural or particular areas not covered by other systems
- Independence from ground facilities (get over digital divide)

Characteristics of the Nanosatellite

- **Orbit:** low levels of LEO
- **Coverage diameter:** variable, depending on users, rate and technology
- **Coverage time:** minutes
- **Transmission Frequency**: to be defined (from UHF to X-band are under consideration)
- **Power supply**: depending on previous choices (altitude, coverage diameter); batteries, photovoltaic panels
- **Cost:** **as low as possible!**

Constraints and other considerations

- **Data-rate:** more customers = more data-rate or more satellite; less customers = less data-rate = less saving money
- **Orbital decay:** propulsion, slow decay, maintenance of the orbit
- **Reliability:** longer satellite lifetime, less failures, instruments degradation
- **Redundancy**: backup devices and satellites avoid system collapse

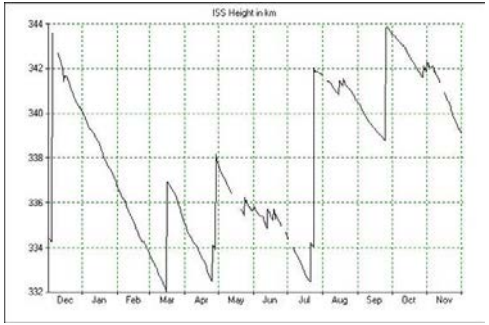


Image credits: BRITE Austria

A case study

Considering only Sicily Region:

No. Users Sicily = 5,000,000
- Electricity
- Water
- Gas

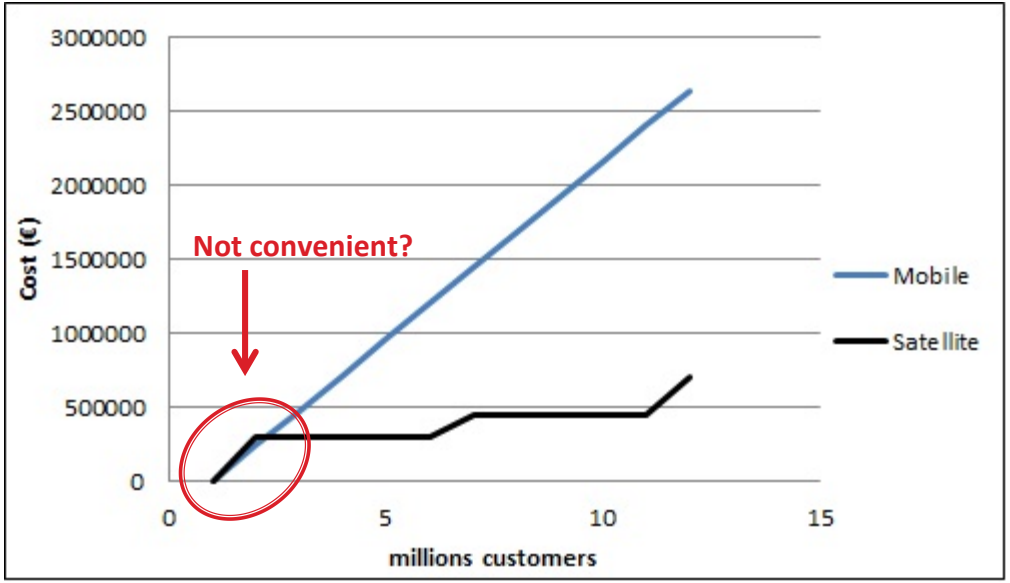
No. Gateway = 50,000 (1 gateway for 100 users)
Single customer data per day = 5 kbit/day all included
Satellite's altitude = 400 Km
Orbit period = ~92 min
Coverage diameter = ~500 km
No. of orbit = 15-16 → 14 orbit + 1-2 Backup orbit
Coverage period = ~65 sec

Throughput = ~28 Mbit/s (Uplink)

A case study

Costs per 1 year vs Customers

- 1 satellite covers 5 millions customers
- One Sim's Fee = 40 cent € per month for each gateway
- Supposed satellite costs: 150,000 €

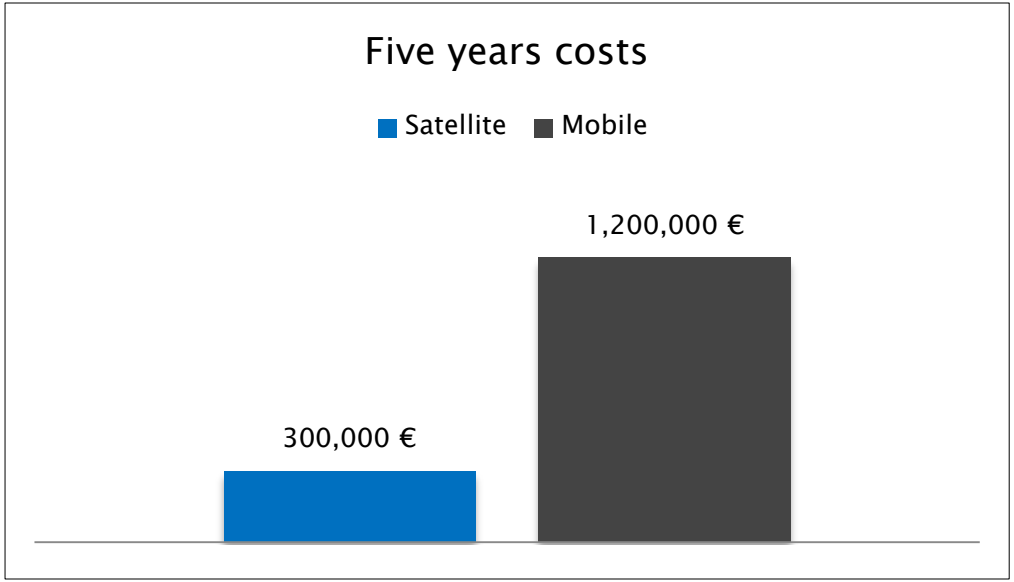


A case study

A case study

Costs vs Time (five years)

- No. Sims = No. Gateways = 50,000
- Month fee = 0,4 €
- Annual sim costs (ASC) = 4,80 €
- Total sims costs (TSC) = ASC · N.Gateways = 4,80 · 50,000 = 240,000 € per year
- 5 years total costs = TSC · years = 240,000 · 5 = 1,200,000 €
- Nanosatellite supposed cost = 150,000 € (x2)



Satellite vs Mobile

	Mobile	Satellite
Costs for connectivity	X	✓
Potential uptime	✓	X
Fixed network independency	X	✓
(Current) implementability	✓	X
Broadcasting/Multicasting	X	✓

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SINERGREEN
Smart Intelligent GREEN Energy

Smart & green energy
Cod.: PON04a2_E

Thank you