An evaluation of communication means for smart metering in Flanders

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Context & outline

- report for *Flemish Regulation Entity for the Electricity and Gas Market* (VREG)
  - G. Deconinck, D. Bekaert, P. Jacqmaer, T. Loix, T. Rigole, B. Verbruggen, "Studie communicatie-middelen voor slimme meters (VREG 2006/0192)," K.U.Leuven - ESAT, 2007, 84 pages
- outline
  - smart meter requirements
  - communication means
  - cost
  - conclusion

Smart meter: AMR + AMM

- (VREG): E / G meter, with 2-way communication
  - send measurement registers
    - on demand (1/yr) + periodically (monthly)
  - remotely (dis)connect & reduce E/G supply; budget meter
  - multiple measurement registers
  - remote modification of tariffs and tariff periods
  - remote upgrading of firmware for new functionality
  - send on demand PQ diagnosis + automatic fraud alarms
- in line with NTA 8130
  - also other utility functions (heat, water)
  - requires **simultaneous** dimming/disconnecting consumers

Smart meter requirements

transaction type	time critical	response min/typ/max	#times/yr	#data min/typ/max
command store measurement registers	yes	immediate 5 min 1 h	1	0,5 KiB 1 KiB 16 KiB
send **measurement registers** (periodically + on demand)	no	immediate 10 min 2 h	13 (12+1)	1 KiB 32 KiB 16 MiB
command reduce load	yes	immediate 5 min 1 h	1	0,5 KiB 1 KiB 16 KiB
adjust **parameters**	no	immediate 10 min 2 h	2	0,5 KiB 1 KiB 16 KiB
upgrade **firmware**	no	-	0,2	0,5 KiB 1 KiB 512 KiB
send **alarms**	no	immediate 10 min 2 h	0,2	0,5 KiB 1 KiB 16 KiB

Situation in Flanders

- 0.5 MiB / meter / yr for measurement registers
  - min. 15 KiB – max. 250 MiB
- 3.1 million E-meters + 1.6 million G-meters
  - (2.6 + 1.4 million residential)
  - approx 3 million smart meters
- results in 1.28 TB raw data / yr (4 - 654 TB)
  - negligible with respect to internet traffic

Need for hierarchical approach

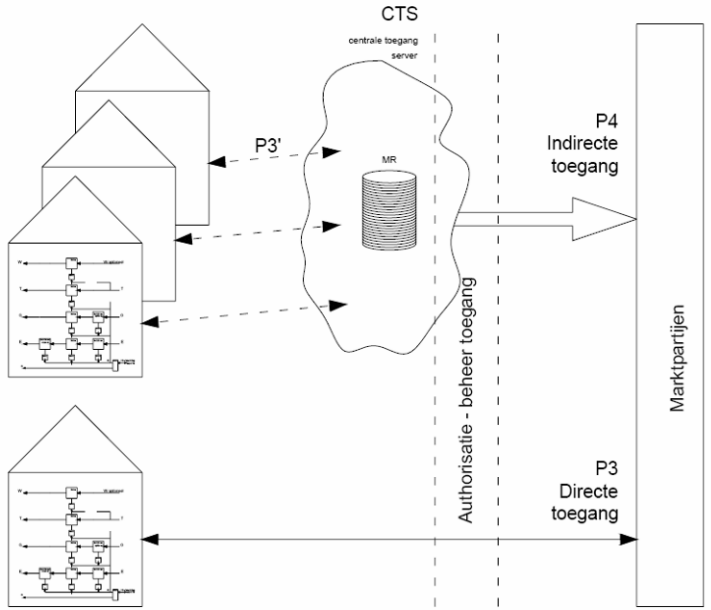
- need for hierarchical approach

Data \ Time	5 s (min.)	10 min (typ.)	2 h (max.)
1 KiB	1.6 kbps	14 bps	1.1 bps
32 KiB	52 kbps	437 bps	36 bps
16 MiB	27 Mbps	224 kbps	19 kbps

- small bandwidth sufficient for basic information
  - additional services require broadband
- real-time requirements
  - if no broadcasting, only 1.2 ms is available for addressing all meters in 1 hour

Communication architecture

- communication architecture
  - direct connection (PSTN/GSM/GPRS)
    - dial-in via modem or data connection
  - dedicated intermediate comm. infrastructure
    - with *concentrators* (PLC, RF)
  - existing intermediate comm.
    - ADSL or internet connection



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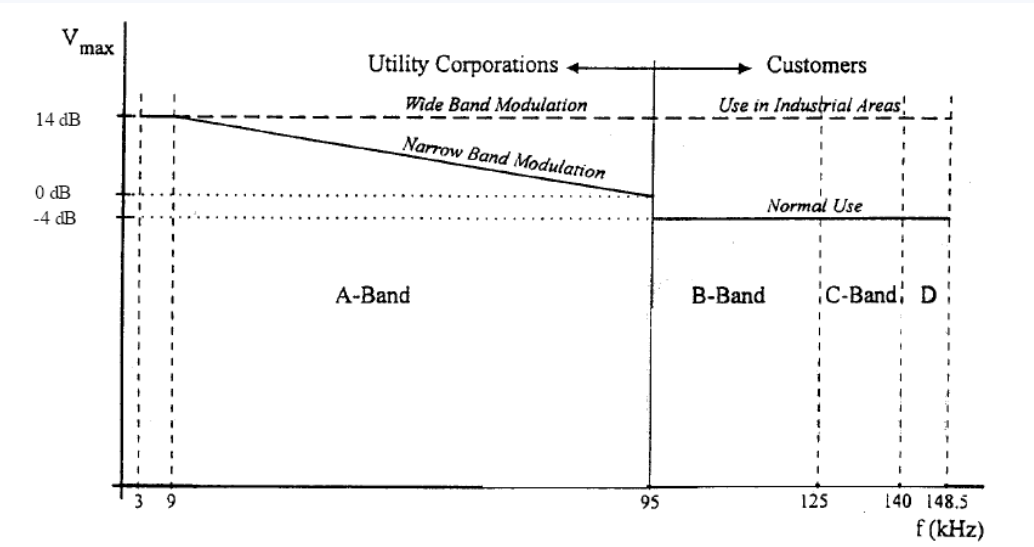
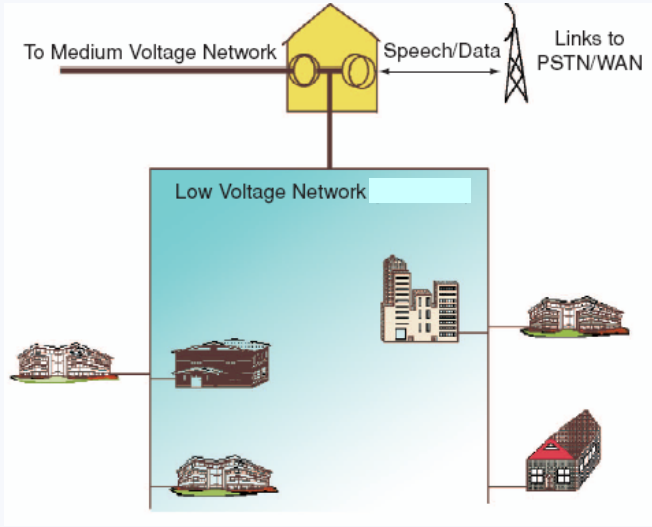
Overview of communication means

- categories studied
  - power line communication
  - comm. over telephone / cable infrastructure
  - wireless communication
- discussion
  - technical aspects
    - description, protocols
  - suitability for smart metering
    - bandwidth, responsiveness, reliability, accessibility, …
  - situation in Flanders

Power line communication

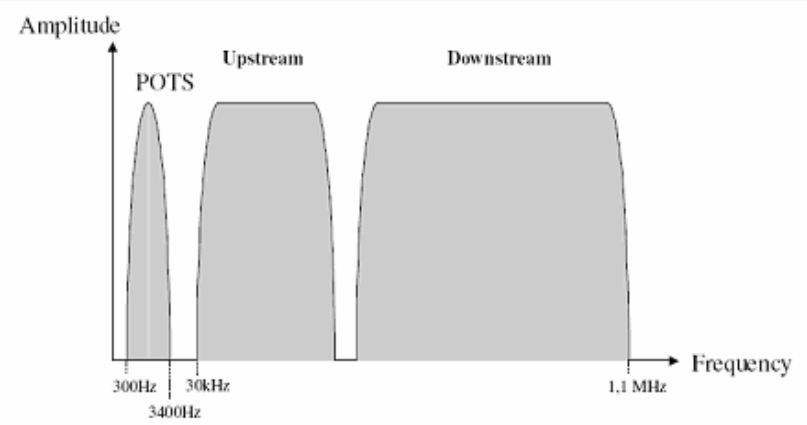
- Usage: between smart meters and concentrators
- + no extra cabling required
- - smallband, short distances to concentrators (< some km)
- - reliability less than other communication means, but still OK
- - not available when certain power problems occur

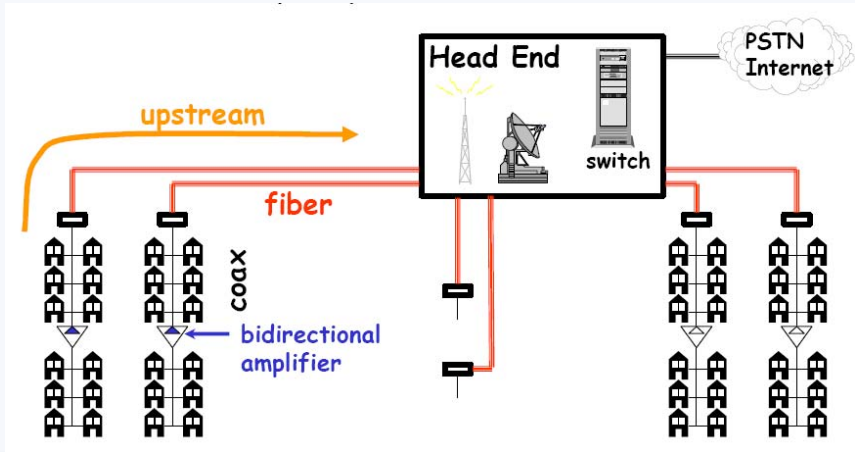




Communication over telephone and cable infrastructure

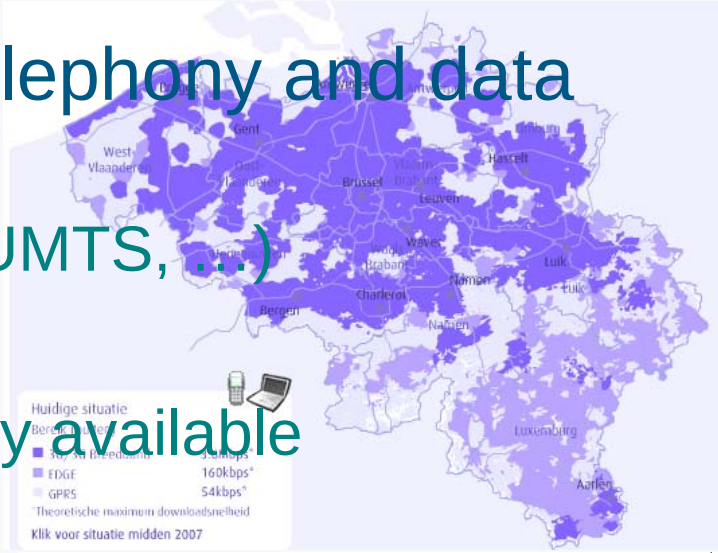
- smallband communication over analog / digital phone lines
  - + very reliable
  - - smallband
  - - requires connection to phone equipment & call centres
  - - slow communication setup
  - - smallband, no multicasting
- broadband connection over phone line or TV cable (dedicated / shared)
  - + broadband
  - - requires connection to phone or cable equipment & access points
  - - short distances (<3 km)
  - + multicasting on TV cable



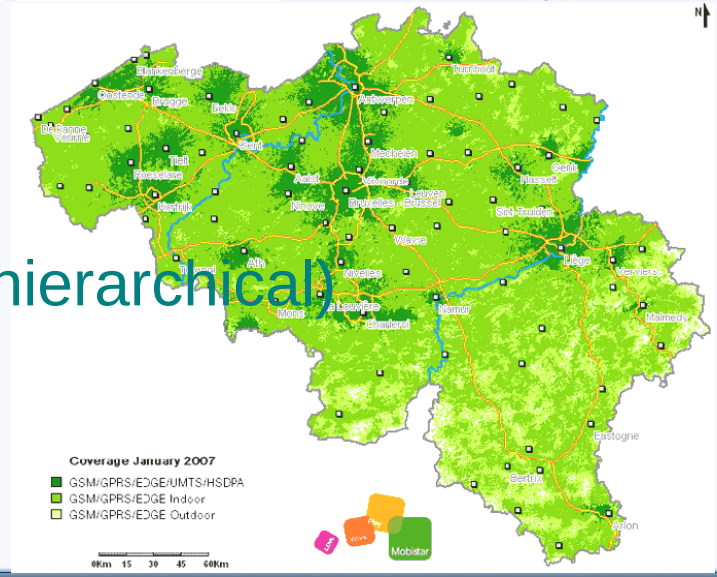


Wireless communication

- 2nd or 3rd generation mobile telephony and data
  - circuit-based: GSM, HSCSD
    packet-switched: GPRS, EDGE, UMTS, …)
  - - smallband (2G)
  - + broadband (3G), - not yet widely available
  - - not so good coverage in cellars

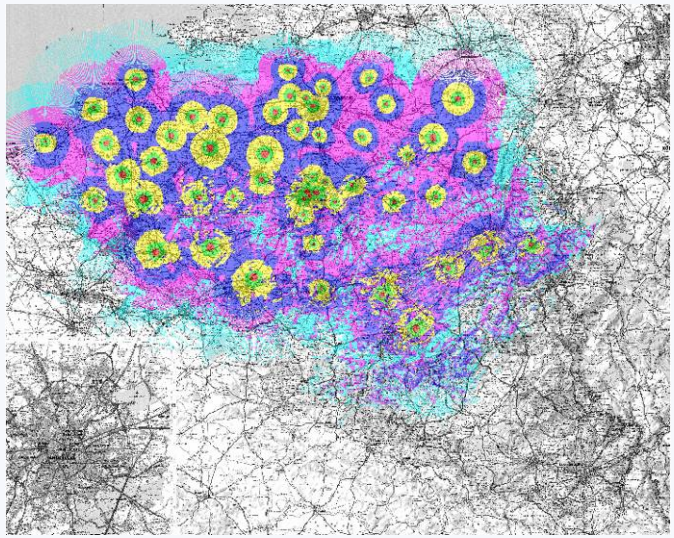


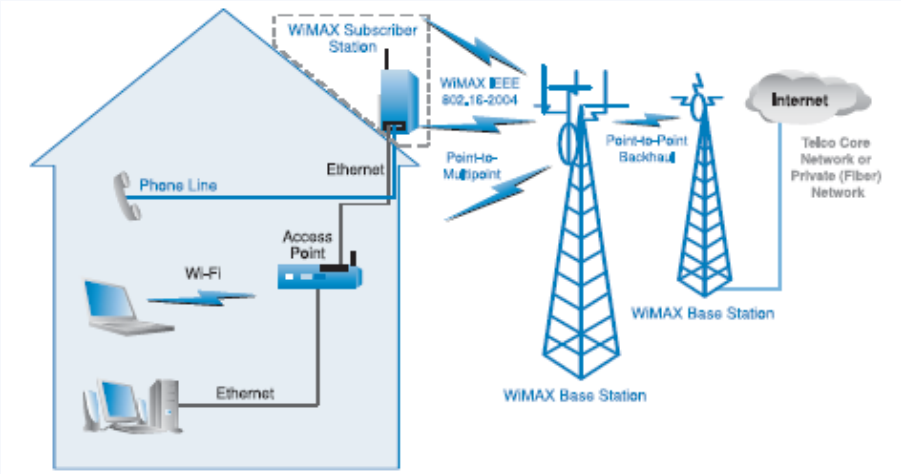
- non-licensed RF (ISM band)
  - - requires antenna infrastructure (hierarchical)
  - - typically smallband



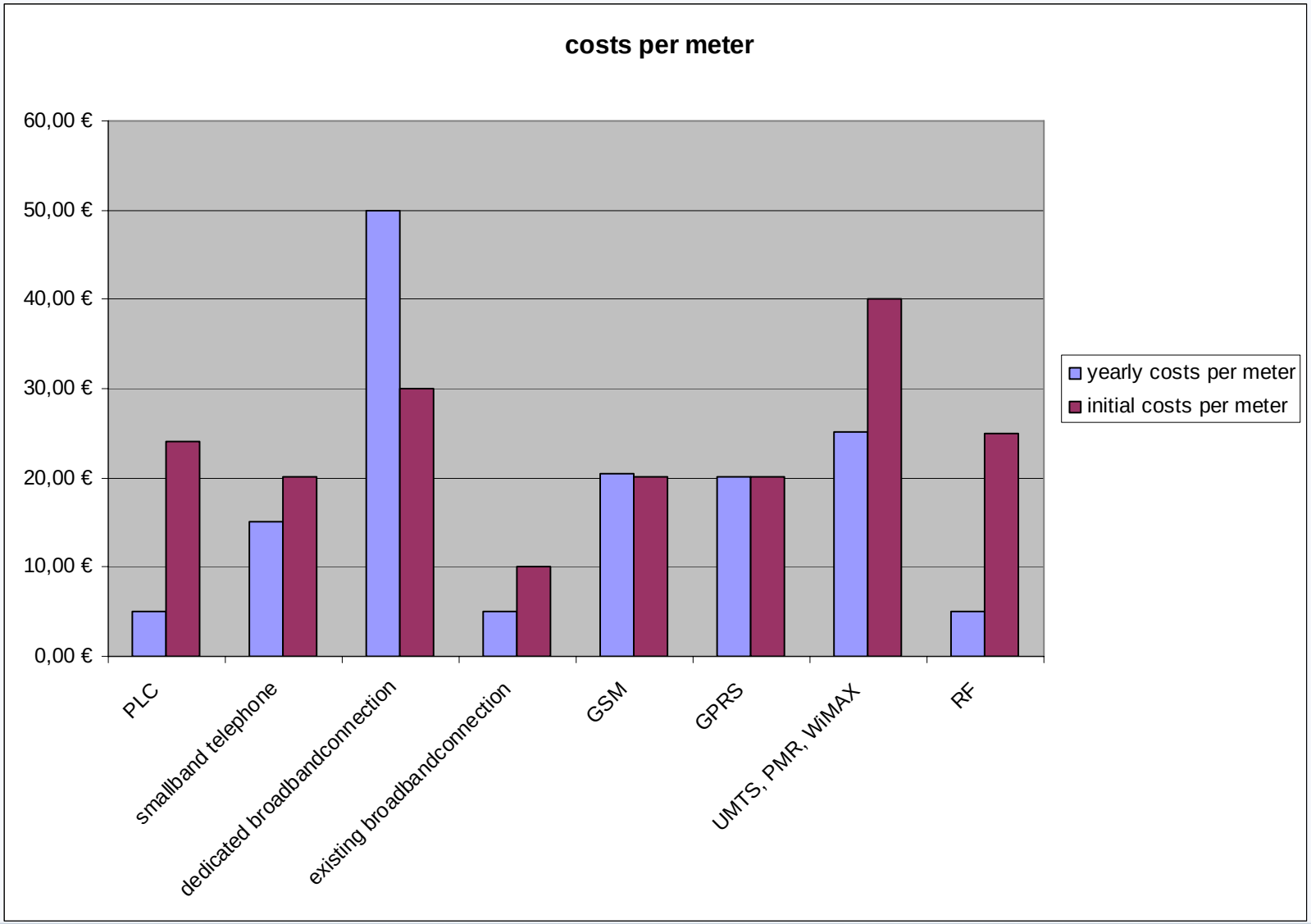
Wireless communication (ctd.)

- licensed RF (PMR, trunked radio)
  - + very reliable, broadcasting, fast, good coverage
  - - smallband
- others (WiMax, …)

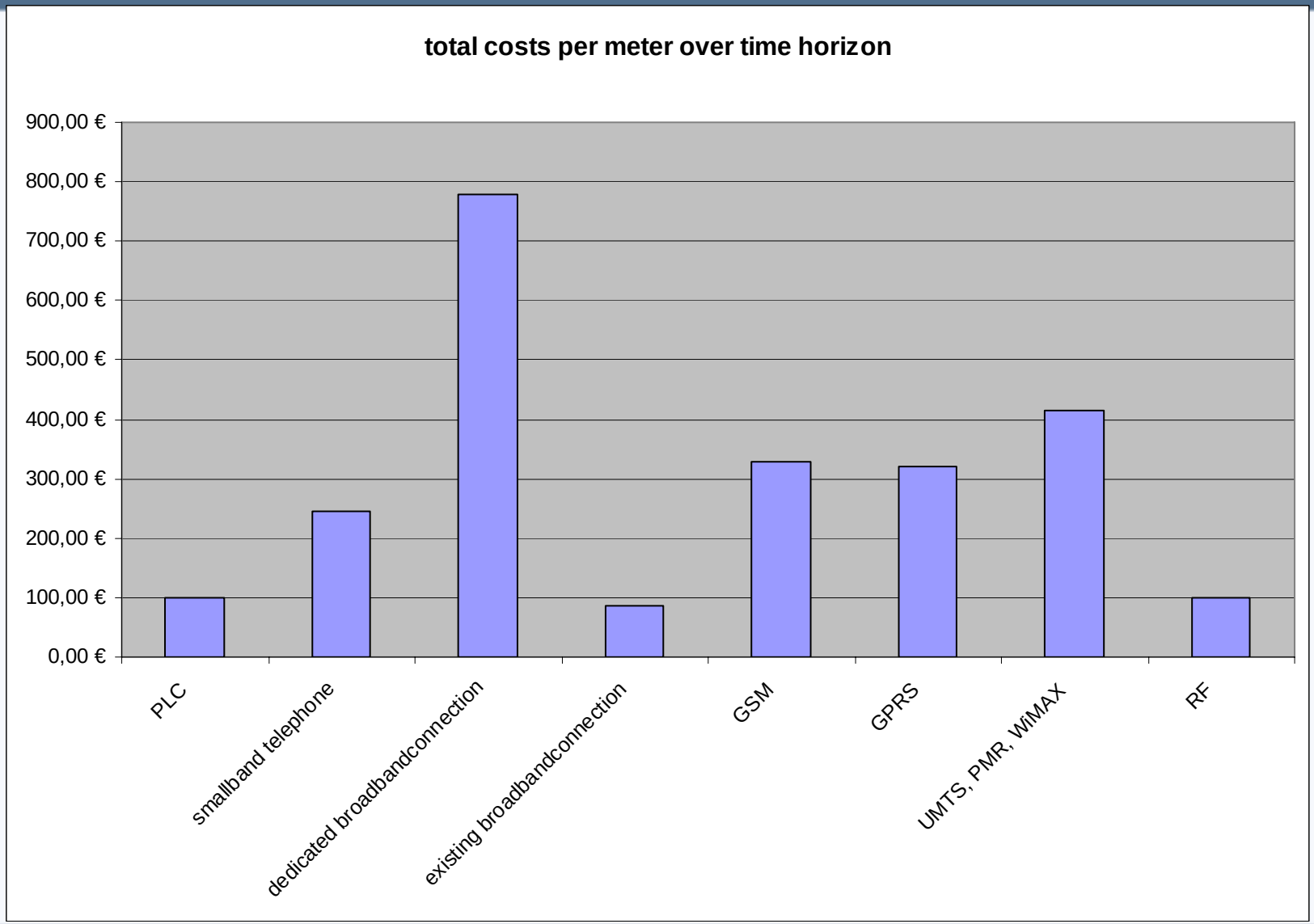




Cost analysis



Costs over 15 year time horizon



Conclusion

	PLC	cable		wireless			
		internet	telephone	GSM, GPRS	UMTS	RF	PMR
reachability	100%	S: 95% / B: 60%	98%	+ 99%	60%	100%	100%
costs	medium	S: very high B: medium	medium to high	high	high	medium	high
operation	own	S: telecom-provider B: ISP	telephone operator	mobile phone operator	mobile phone operator	own	own or PMR-operator
access	via comm. provider	directly	directly	directly	directly	via comm. provider	directly or via comm. provider
suitability (bandwidth, BW)	functions with low BW	functions with high BW	functions with medium BW	functions with medium BW	functions with high BW	functions with low BW	functions with medium BW
suitability (real-time, RT)	functions with RT req's	functions with (S) / without (B) RT req's	functions without RT req's	functions without RT req's	functions with RT req's	functions with RT req's	functions with RT req's
flexibility	medium	high	medium / high	medium / high	high	medium	medium / high
reliability	high	medium / high	very high	high /very high	medium / high	high	very high

Conclusion: technical & non-technical aspects

- all communication means fulfil minimal req's
- technical
  - much data → broadband
    - broadband internet-based solutions or 3G mobile
  - real-time → broadcasting
    - PLC or wireless solutions (RF, PMR, UMTS, …)
- non-technical aspects
  - costs
    - PLC/RF and existing internet solutions
  - (in)dependence
    - telecom infrastructure by third parties

Personal comments

- smart utility interface + measuring instruments
  - (E, G, heat, water, …)
- future-proof: broadband + real-time required
  - creative contracts with critical/non-critical apps
  - PQ-based services
  - decentralised control of DER