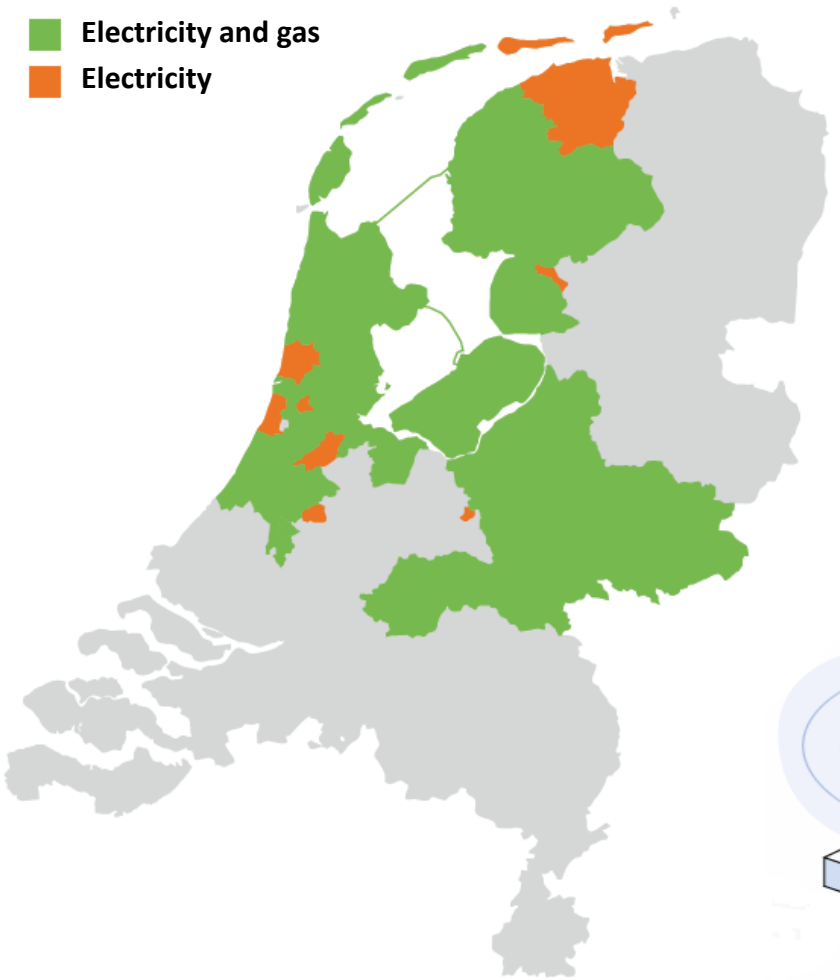
Optimizing wireless communication for WAN and IoT communications

Frank Visser l Alliander Telecom l Februari 2020

alliander Telecom

The energy transition increases the need for the digitalization and intelligent management of the electricity and gas distribution grids. With the digitalization the number of smart assets increases exponentially.



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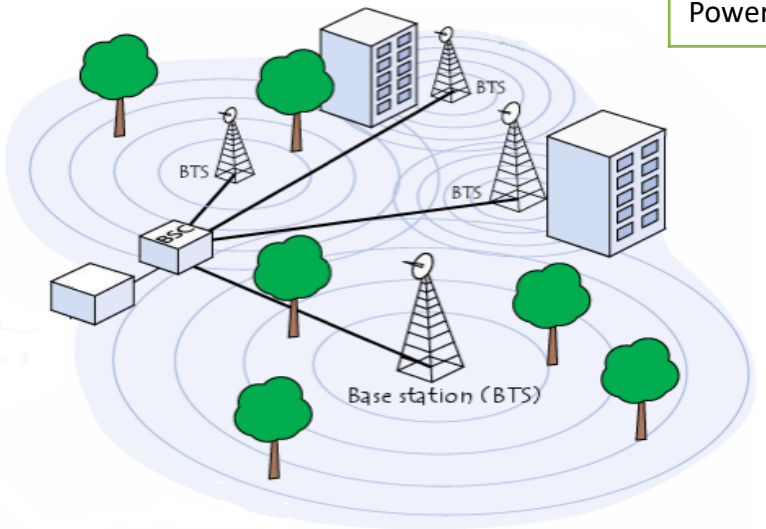

Wireless smart assets	In production	Goal
Smart meters	2.600.000	3.100.000
Street light switching	13.500	20.000
Short circuit indicators	5.600	
MV measurements	1.200	7.000
Distribution automation	575	2.000
Gas automation	300	
Alarm indicators	250	
Power quality meters	53	

The energy transition leads to trends and changes in the energy system which have an impact on current and new smart assets and the telecommunication needs.

Trends	Changes in Energy system	Developments	Requirements
Decentralization	Emergence of new local networks, which are not necessarily "open"	Continued development of smart meter.	High quality service
Sustainability	More local generation and use	Need more real-time insight into LV and MV.	Handle changing demands in the future
Electrification	New ways of heating	New type of measurements (Heat, changing gas composition)	Independent of market whims
Democratization	Emergence of storage and conversion systems	Real-time capacity control of our networks at all levels and system control.	Expected lifetime of smart asset is taken into account
Exponential technological growth (digital and energy)	Increase dependence on electricity and digitization	More need for scalability / modularity and suitable for more decentralized intelligence (edge computing)	
	New market models	Increase in number of sensors and greater diversity.	

How to optimize wireless connectivity

- Challenges & strategic requirements
- Solution toolkit
- Use case examples

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Challenges of wireless communication

- Commercial Wireless networks do not have a guaranteed performance and coverage.
- Effective lifetime of commercial wireless technology and networks is shorter than the lifetime of the smart assets of the utilities.
- Commercial and technical lock-in due to the long lifetime of smart assets without local interaction on the smart asset side.

Commercial Wireless networks do not have a guaranteed performance and coverage.

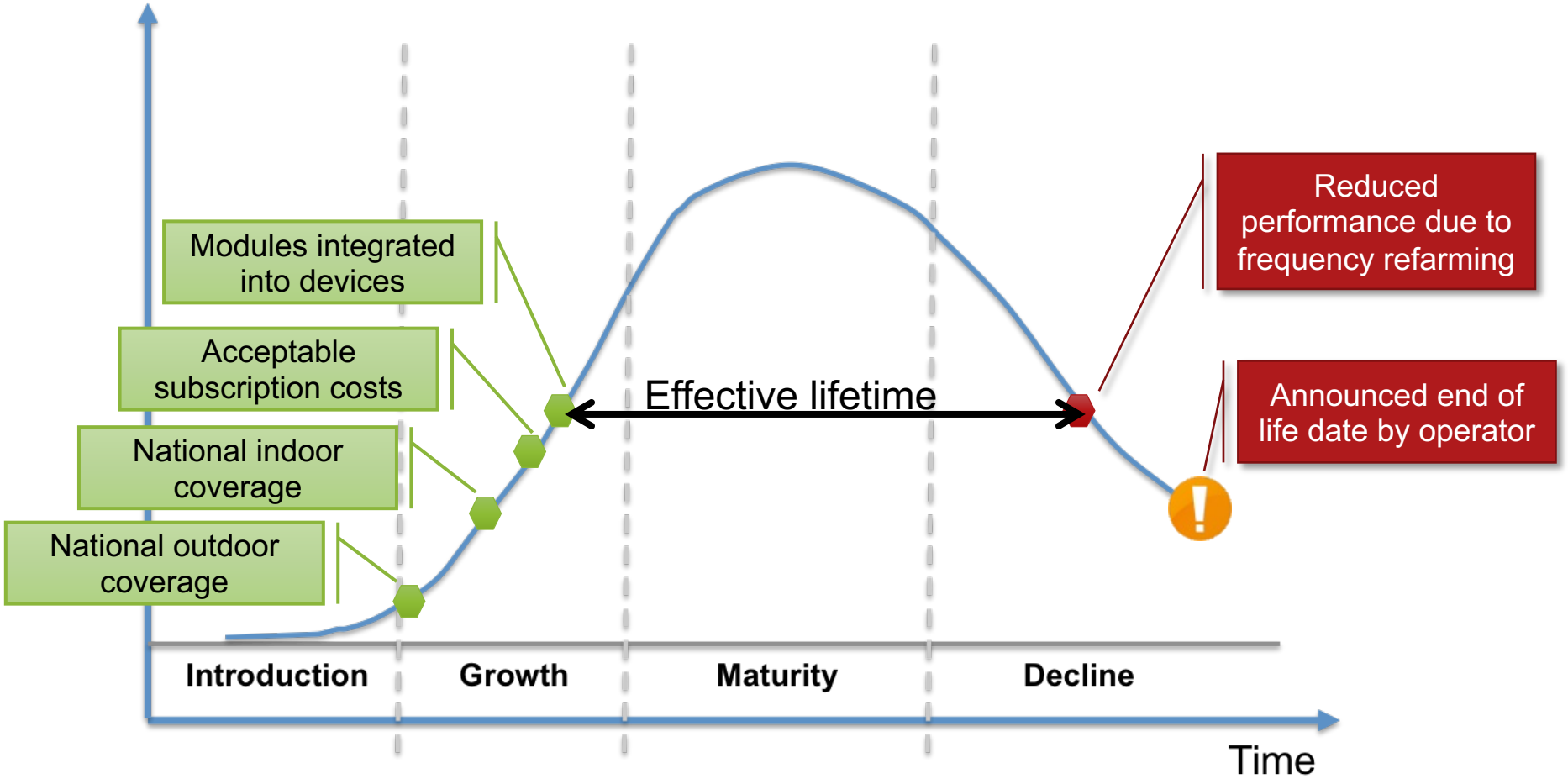
No Service Level Agreements on performance of the network.

No provider has 100% indoor coverage.
Smart assets can be in remote or difficult to reach locations like basements.

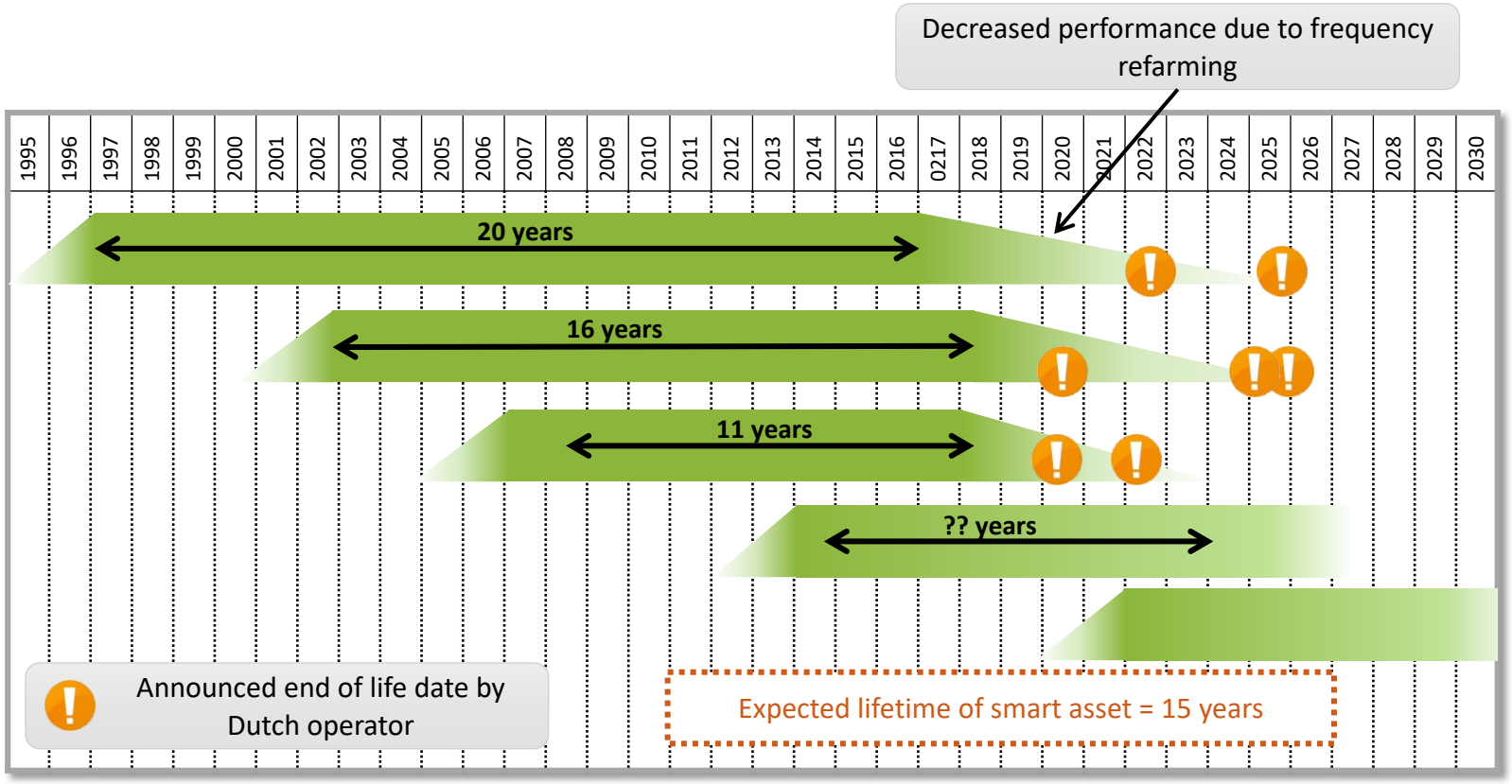
Network failures or planned outages occur. Base stations have frequent maintenance.

Commercial wireless networks don't have a guarantee on power autonomy in case of a power outage.

Effective lifetime of commercial wireless networks is shorter than total lifetime of the network.



Effective lifetime of commercial wireless technology and networks is shorter than the lifetime of the smart assets of the utilities.



- Every 7 years introduction of a new generation of cellular network technology.
- Demands for higher bandwidths and performance increases the pressure on the operators to phase out older technologies.
- Effective lifetime of technologies becomes shorter.

Commercial and technical lock-in due to the long lifetime of smart assets without local interaction on the smart asset side.

A standard commercial cellular solution does not match the strategic requirements of a utility.

Challenges

1. Commercial Wireless networks do not have a guaranteed performance and coverage.
2. Effective lifetime of commercial wireless technology and networks is shorter than the lifetime of the smart assets of the utilities.
3. Commercial and technical lock-in due to the long lifetime of smart assets without local interaction on the smart asset

Strategic requirements

- ☐ High quality service ✗
- ☐ Handle changing demands in the futur ✗
- ☐ Independent of market whims ✗
- ☐ Expected lifetime of smart asset is taken into account ✗

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Solution toolkit

- Modularity between telecommunication unit and smart asset
- Multiband and multi technology modems
- National roaming
- eSIM and remote sim provisioning
- Dedicated wireless network

Use modularity between telecommunication unit and smart asset.

- With modularity it is possible to change the communication technology without changing the smart asset.
- Exchangeability between telecommunication units is covered by standardizing on a standard interface, e.g. Ethernet, serial or PCI.
- Can be used in the following situations:
  - Changing telecommunication technology when there is no coverage of preferred technology.
  - Changing technology when end of life of telecommunication technology.
- Modularity should be taken into account at the design phase of your ecosystem.

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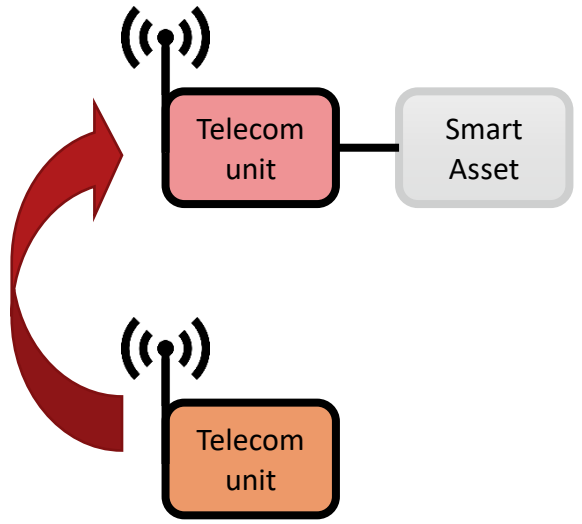

Use of multiband and multi technology modems into the telecommunication device.

- Multiband modems support multiple frequency bands on the same technology.
- Multi technology modems support multiple technologies on a frequency band.
- With the right network connectivity it is possible to use all frequencies and technologies in the same device.
- Possibilities to combine the commercial cellular bands together with a dedicated utility network on the 450 MHz band.
- Introduction of modems with LTE-M, NB-IoT on band 31 (450 MHz), band 5 and 20 (800 MHz) and have support for legacy GPRS.

Strategic requirements

- [x] High quality service
- [x] Handle changing demands in the future
- [ ] Independent of market whims
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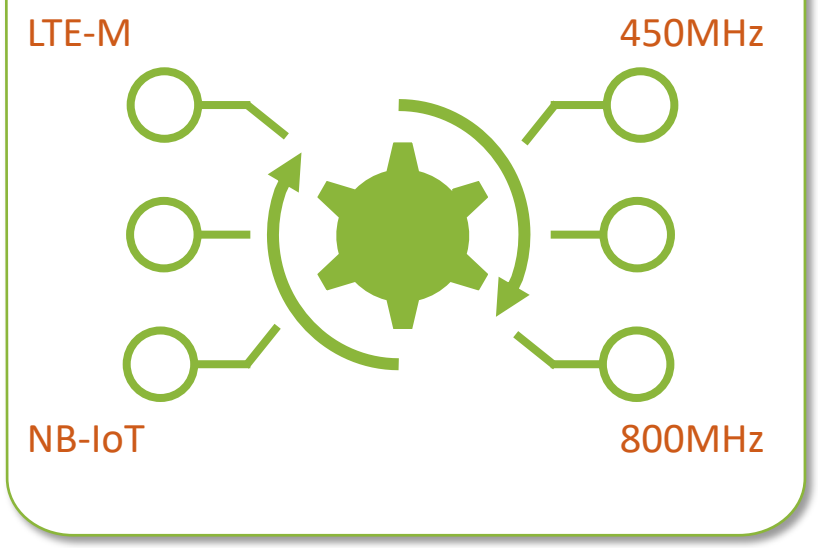

National roaming is a solution for increased performance and longer lifetimes.

- With national roaming you contract one party which has national roaming agreements with multiple MNOs.
- SIM card will select other operator if preferred operator doesn't have coverage in the area.
- Switching between MNOs is seamless, there is no effect on de wireless device.
- Can support a technology as long as it is supported by the roaming partners.
- Commercial lock-in by SIM card.
- No guarantee on power autonomy.

Strategic requirements

- [x] High quality service
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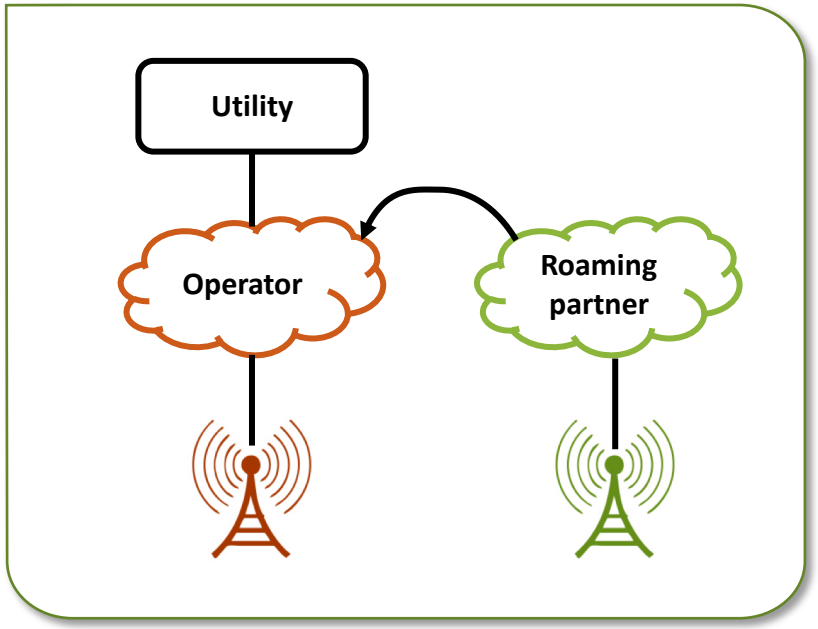

eSIM with over the air provisioning provides a solution for commercial lock-in.

- eSIM is a secure element designed to remotely manage multiple mobile network operator subscriptions.
- Can be implemented on any form factor SIM card, there is no need for an integrated or M2M form factor.
- Possible to change operators without replacing the SIM card.
- No extra performance than standard MNO contract.
- Possibility to change to other operator after contracts ends or for maximum lifetime of used technology.

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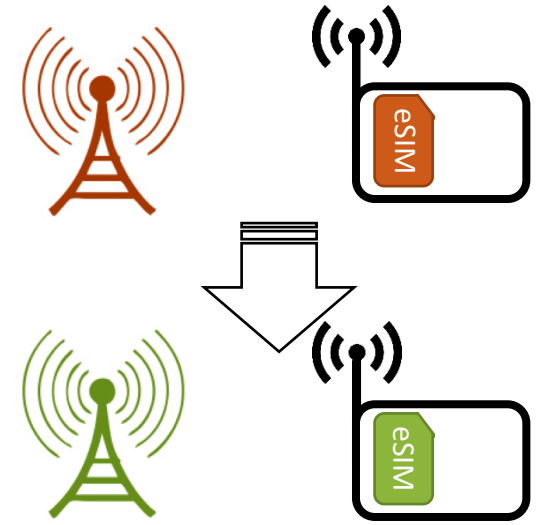

A dedicated wireless network lets the utility company be in control of the network.

- A dedicated wireless network special designed for the needs of the utility sector.
- Coverage can be adapted to the needs of the utility company.
- Deep-indoor frequency (450MHz) for the network.
- Lifetime of the network can be aligned with the lifetime of the wireless devices.
- Strict power autonomy possible.

Strategic requirements

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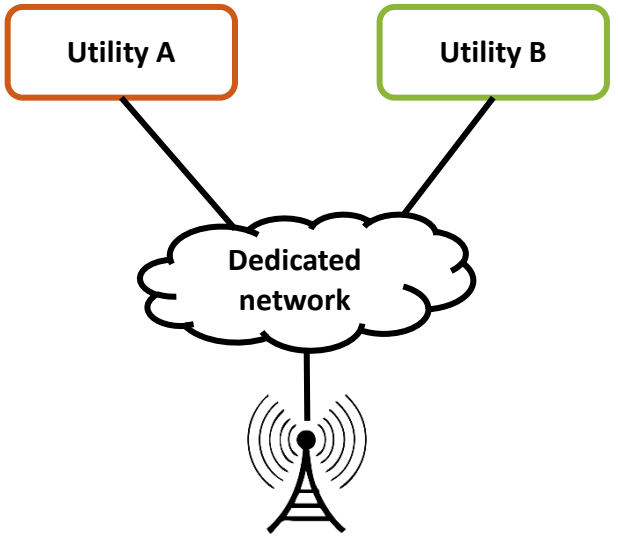

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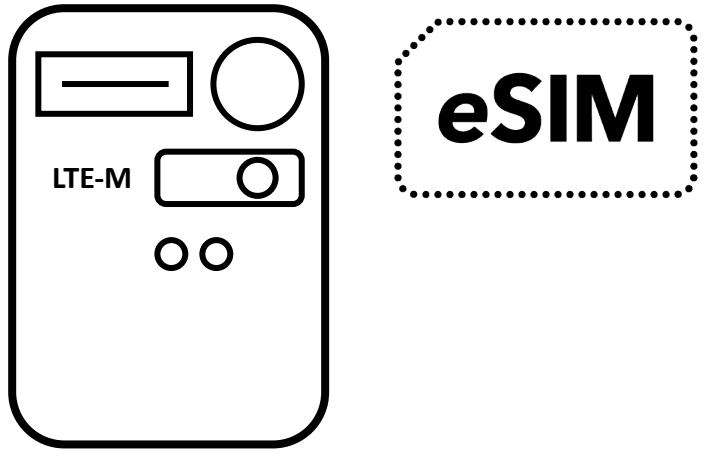
eSIM with remote SIM provisioning for small scale LTE-M smart meter

- At Alliander we primary roll-out CDMA smart meters, but at places without sufficient coverage we roll out GPRS meters.
- With the operator announced end of live of GPRS by 2025 we needed a quick solution to replace the GPRS smart meter.
- For this we developed an LTE-M smart meter and contracted the a new LTE-M network connectivity including:
  - eSIM
  - Remote Sim Provisioning platform

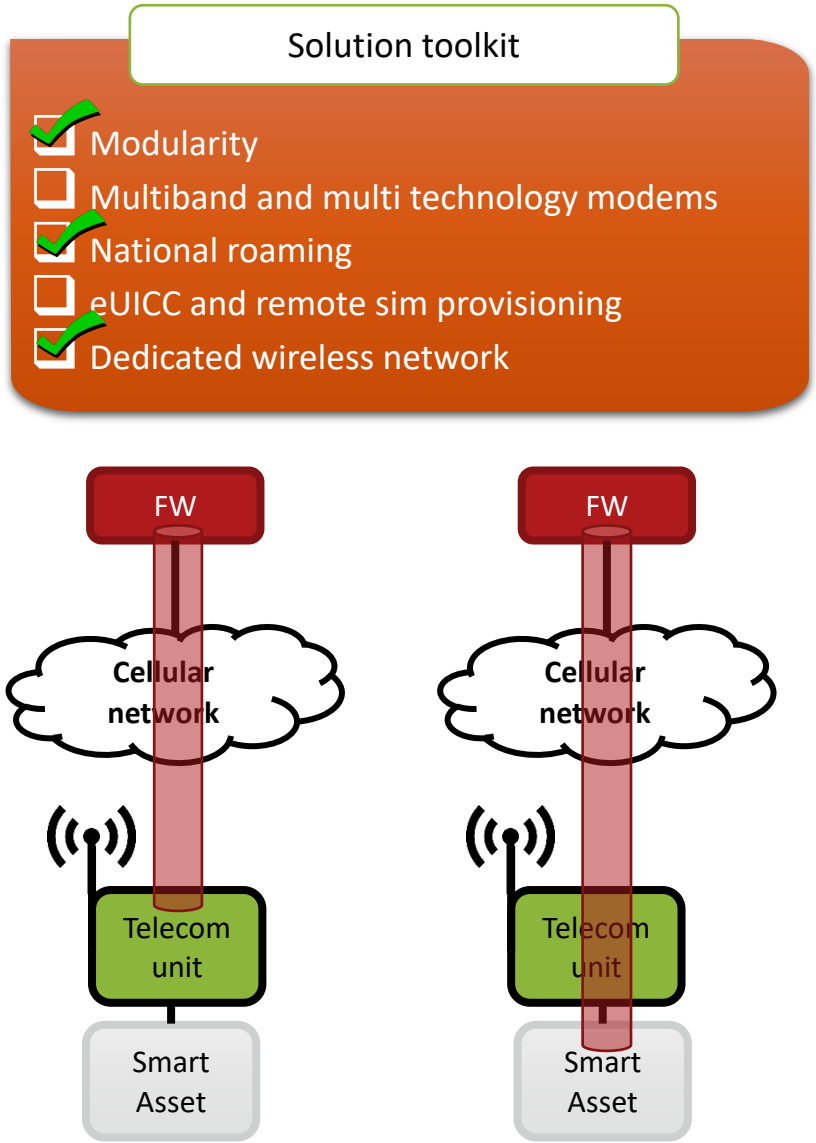
Solution toolkit

- ☐ Modularity
- ☐ Multiband and multi technology modems
- ☐ National roaming
- ☑ eUICC and remote sim provisioning
- ☐ Dedicated wireless network



Independent telecom unit for RTU's and other IED's

- Smart assets for distribution automation in MV grids we use cellular networks to connect the assets to the central control center.
- For all small assets we have a separate telecom unit with a standardized interface on Ethernet.
- 2 communication technologies:
  - CDMA
  - LTE with National Roaming
- 2 standardized connection models:
  - IPsec tunnel to router
  - Destination NAT with port forwarding (for encryption tunnel to smart asset)
- Next step: go for multi band and multi technology modem into telecom unit.



Modular telecommunication for smart meter

- Current smart meters have a fixed telecommunication module into the smart meter. We have 3 different models: CDMA, GPRS and LTE-M.
- For the next generation of smart meter we will take modularity between smart meter and telecommunication module into account.
- Several options are investigated:
  - Modular into the smart meter housing
  - Modular in a separate housing
  - Connection of other metering devices like water and gas