Using a shared MNC for M2M

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- Who are we?
  - Stratix: consulting firm with a focus on electronic infrastructure
  - Working for government, regulators and industry clients
  - Covering strategic and practical questions on innovation and new technology

- Stratix and the Dutch Ministry of Economic Affairs
  - Telecommunications policy: spectrum, competition, new technology, M2M, …
  - Involved in numbering and addressing issues since 1996
  - Stratix research into "Shared MNC's for M2M", 2013

(for more info: see www.stratix.nl)

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Context – the M2M market

- A few large-scale M2M applications
  - **Millions or more devices**
  - Smart Meters (7 million in the Netherlands)
  - E-Call (potentially 7 million in NL)
  - Other?

- Many 'small' scale M2M applications
  - **Hundreds of devices, up to hundreds of thousands**
  - Road signs, traffic signaling
  - Navigation devices (TomTom)
  - Water management

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Problem – operator lock-in

- SIM model allows regular users to avoid lock-in
  - Customer buys phone
  - SIM is provided by operator
  - New operator means swapping SIM

- Assumptions in the SIM model:
  - SIM and SIM swap are 'cheap' (compared to overall costs)
  - Makes it viable to "renegotiate" network contract (i.e. go to shop and 'buy' a new contract) with other Network Operator

Example: business user with thousands of contracts, €50 per user per month, spends €10 per user on SIM swap

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M2M is different

- Dataplan:
  - Data usage is low
  - Monthly fee is low
  - Thus: SIM is relatively expensive (compared to monthly fee)

- Device:
  - Automated devices that operate independently from 'humans'
  - Device is 'in the field', underground, or behind closed doors
  - SIM itself is in closed box and may be soldered on a PCB
  - Thus: SIM swap is *very* hard

Example: smart meter, €1 per device per month, spends €100 per device on SIM swap

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Conclusion:

- Large scale M2M applications need a way to change operators without swapping SIM cards

- In particular for M2M devices which are hard to access (e.g. smart meters)

- Using an MVNO doesn't solve the problem
  - Creates lock-in with the MVNO

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How to change operators without swapping SIMs...

- Change the operator on the SIM over the air (OTA)
  - New identifier (IMSI) on the SIM
  - New authentication/encryption key (K_i)

Or

- Use identifiers which have no relation with the operator
  - M2M user/service provider needs an IMSI range

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OTA is not a solution at this time

- Over the Air (OTA) changes to SIM already possible
  - Used for settings like SMSC number, APN name, …

- Reprogramming IMSI/Ki over the air is more difficult
  - Could work in theory
  - Depends on connectivity from current provider
  - Need to send encryption keys "over the air"
  - Needs a trusted connection with a trusted mechanism within the SIM
  - Problem: no working and proven OTA mechanisms for IMSI/Ki reprogramming available at this time (or in the foreseeable future)
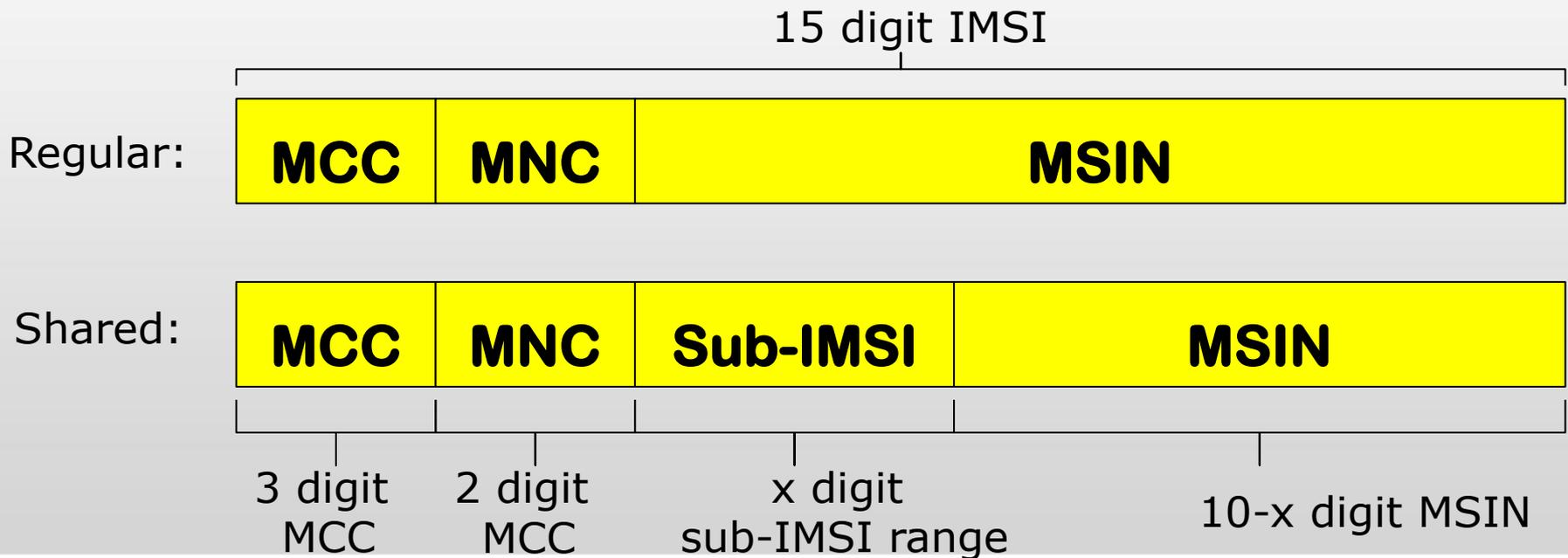
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Only one real solution left: operator independent identity

- M2M provider needs an IMSI range
  - Implies an operator independent MCC/MNC* combination

- Assign MNC to large scale M2M operator:
  - MNC gives control about network choice
  - Allows "wholesale access" through roaming/MVNO model

- Problem: number of available MNCs is limited
  - 2-digit: 100 MNC's possible
  - E.g. in NL: 32 out of 100 MNCs already in use

* MCC = Mobile Country Code, MNC = Mobile Network Code (ITU-T E.212)

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Proposed Solution: MNC for shared use

- Dutch Ministry of Economic Affairs proposes to use an MNC for shared use by large-scale M2M users

- Create many 'small' IMSI-ranges to be assigned to participants

15 digit IMSI

Regular:	MCC	MNC	MSIN		

Shared:	MCC	MNC	Sub-IMSI	MSIN

3 digit MCC   2 digit MCC   x digit sub-IMSI range   10-x digit MSIN

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How would that work?

- Assign an MNC to a "collaboration" of M2M users

- Participants:
  - Each get own IMSI sub-range
  - Each negotiate their own airtime contracts with an MNO/MVNO

- New parties can join later:
  - IMSI sub-ranges are allocated in small blocks to avoid depletion

- Participants keep full control of the collaboration
  - Still a lock-in situation, but locked in with an entity under their control

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Complication:

- Regular Networks not equipped for IMSI sub-ranges

  - Only three-digit MCC and two-digit MNC analyzed in network
    (three-digit MNC possible in theory, but not in real networks)

  - Therefore, MNO can't differentiate between participants
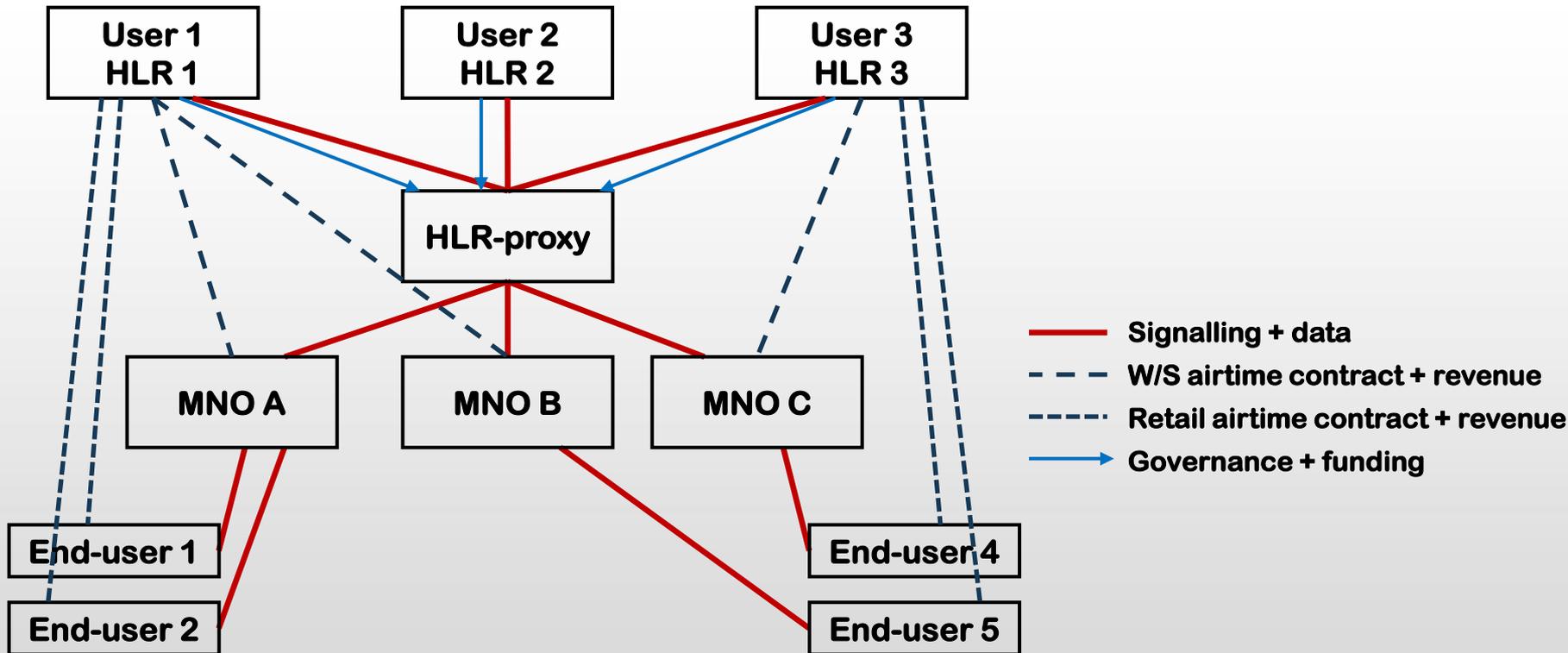
Solution:

- Assign MNC to central "entity" that facilitates routing based on IMSI sub-range

  - Operators routes everything for the MCC/MNC combination to this entity

  - Looks identical to a regular "full" MVNO for the operator

  - Entity routes to M2M-users based on further digits

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Central entity operates an 'HLR-Proxy'

Operators "see" a regular MVNO

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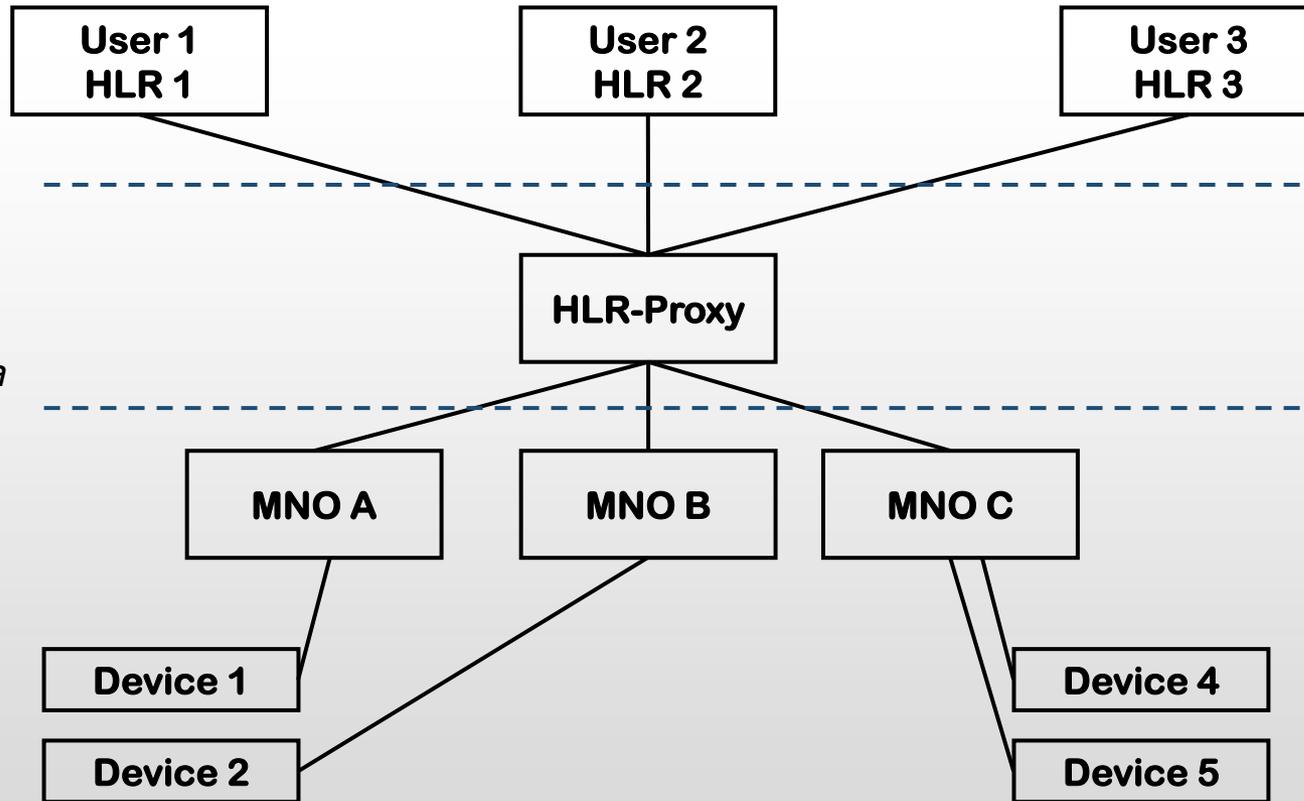
Technical relationships are through the HLR-proxy, commercial relationships are direct

Solution allows assignment of IMSI sub-ranges for all kinds of use

- Other (large) users of 'regular' *mobile services* can participate
  - For example for Voice:
    - Proxy can function as voiceswitch
    - Buy other services (core, voicemail) separate from airtime
    - Avoid lock-in
  - (national) roaming contracts can be used together with a p-GSM solution (that uses different MNC)

- No need to restrict situations in which it may be used
  - Market may come up with other types of usage
  - No need to restrict size to very large numbers

- Only restrict on technical conditions (i.e. use for virtual network only)

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Similar to standard MVNO model

- Although "standard" MVNO methods are used towards the operators, the model deviates from a "regular" MVNO

  - Central entity is connected to multiple MNOs (same as international roaming partners)

  - Participants negotiate their own airtime contracts to be used with same MNC

  - Number of devices is much higher then with regular MVNO (largest MVNO in Netherlands has half million subscriptions, now talking about millions of M2M devices)

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Challenges

- Challenges relate to:
  - Technology
  - Cost
  - Governance
  - Commercial issues

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Technical Challenges

- HLR-proxy is 'new' concept, however:

  - Similar concepts are used inside a network to assign IMSI ranges to different HLRs

  - Estimate is that it can be done in approximately 6-8 months, once specifications are clear

- International Roaming (if needed) is more complicated

  - Not all M2M users need international roaming

  - If needed, requires a roaming agreement with all potential visited networks

  - Could use roaming brokers (e.g. BICS, Telefonica)

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Technical Challenges (2)

- Signaling load on other networks

  - M2M device tries one network, but not the one contracted by the owner

  - Network accepts "shared" MNC and sends request to owner via central entity

  - Owner sends reject code, and device moves on to next network

  - All this creates extra load on networks

- Solution:

  - Use *preferred network* and *forbidden network* lists to steer network selection

  - Define guidelines for reject codes to be sent by M2M users

  - Clear the *forbidden* list at regular intervals
    (*refer to GSMA "Embedded Mobile Guidelines Rel. 3", march 2012*)

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Cost

- Cost for core systems
  - Set up MVNO core (in central entity or per participant)
  - For large numbers, HLR is main cost driver
    - €1-€1,50 per entry
    - But: those costs have to be made anyway (either at MNO or at MVNO)

- Overhead cost of Governance structure

- Relatively high startup costs
  - Can make it less attractive for small M2M-users contracts
  - But MVNEs or a central shared core can play a role here

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Governance

- Participating partners will want their interests represented in central solution

  - Possibly diverging interests: simple solution vs. more expensive, feature-rich service

  - As users are "locked in" with central entity, they need assurance that their interests are taken into account

- Diverging legal obligations

  - Obligation for European tendering, if (semi)government organizations participate (e.g. smart meters)

  - Dutch Energy law forbids regulated energy distribution companies to participate in profit-making entities

- Central entity must be not-for-profit, governed by users

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Commercial Challenges

- Cooperation of MNOs is not a given
  - MNOs prefer to use 'own' SIMs – create lock-in
  - Taking the HLR out of the service reduced added value from MNO standpoint
  - Needs large scale users to make it interesting for MNOs!

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Implement full MVNO core or just HLR-Proxy?

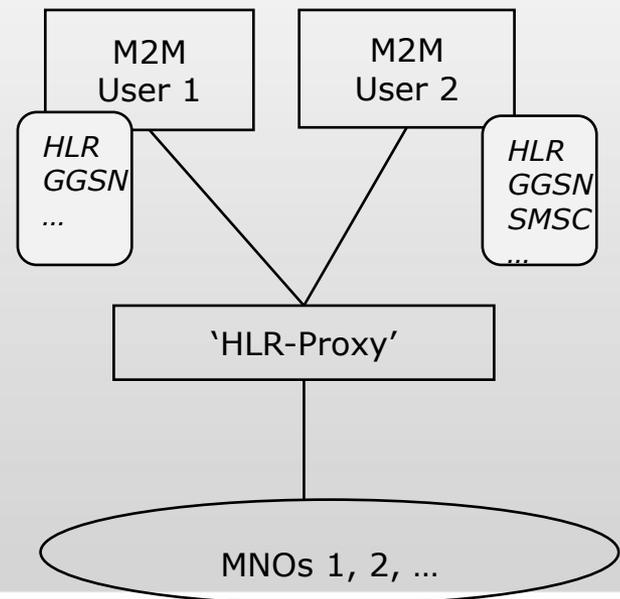- **Shared MVNO core**
  - Leads to economy of scale
  - Shared core makes it easier for small parties to join
  - Governance is harder since interests vary
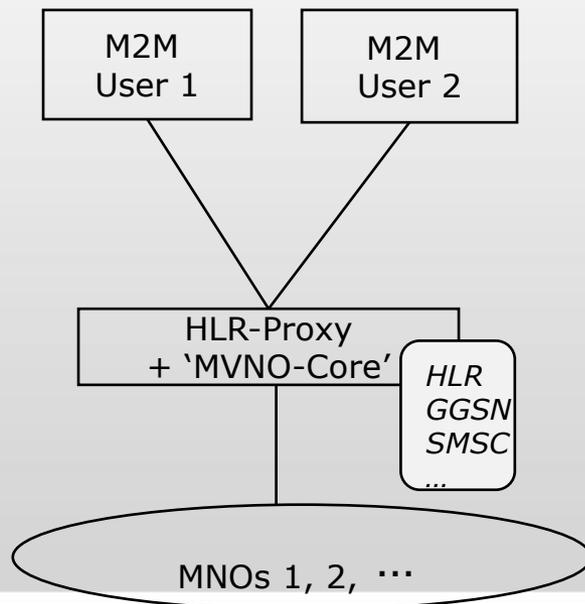
- **M2M-users each have own MVNO core**
  - Own responsibility
  - Participants are more flexible
  - Allows different implementation choices per M2M-user

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Regulation

- Conditions for the allocation of an MNC
  - Not-for-profit entity? Only for specific type of use?

- Size of IMSI sub-ranges
  - Allow for future growth
  - Allocation size should match expected use (e.g. 100k, 1 million)

- Conditions for use
  - Not for identifying radio networks, only "virtual" operator

- Supervision
  - NRA (OPTA in Dutch case) should verify compliance with conditions

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For whom?

- M2M in general, or for specific application?

  - More specific assignment makes governance easier because of converging interests

  - Disadvantage: more MNCs needed to be assigned to various groups (i.e. one for Smart meters, one for commercial applications, one for automotive, one for all kinds of water management, etc)

- Only large applications (i.e. million or more)?

  - Many small scale application might benefit from these possibilities

- Only in MVNO model – no radio network allowed?

  - Using the same MNC in private networks makes matters more complex

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Summary (general)

- A shared MNC allows M2M-users and other types of users to negotiate and switch airtime contracts

- Model requires a "proxy" that looks like an MVNO to the Operators, and takes care of routing to M2M-users

- Technology involves:

  - Regular MVNO/international roaming procedures

  - Condition of use (only for MVNO-type functionality, not to identify home network, specific timer settings, reject codes, …)

  - Functionality is "new" but can be realized in 6-8 months

- Main challenges:

  - Governance: creating organization and governance structure that meets the demands of very different participants.

  - Commercial: getting MNOs to cooperate

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Summary (Smart Meters specific)

- Energy distribution companies and Smart Meters have specific interests and obligations/restrictions
  - Obligation by law to roll out between 2014-2020 (7 million households)
  - Obligation to purchase services through European Tenders
  - Not allowed to engage in commercial enterprise
- Smart meters are very different from cars and other applications
  - More difficult to swap SIMs (need access to households)
  - Longer lifetime (15-20 years)
- Solutions might be:
  - One MNC for smart meters, and another for everything else?
  - One MNC for all utilities together, and one for all automotive applications? (and one for all vending machines, and one for …)
  - One for governmental/regulated applications, one for commercial?
- Where to draw the line?

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