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What services will use LTE-Advanced ?
Taking a glimpse into 3GPP requirements

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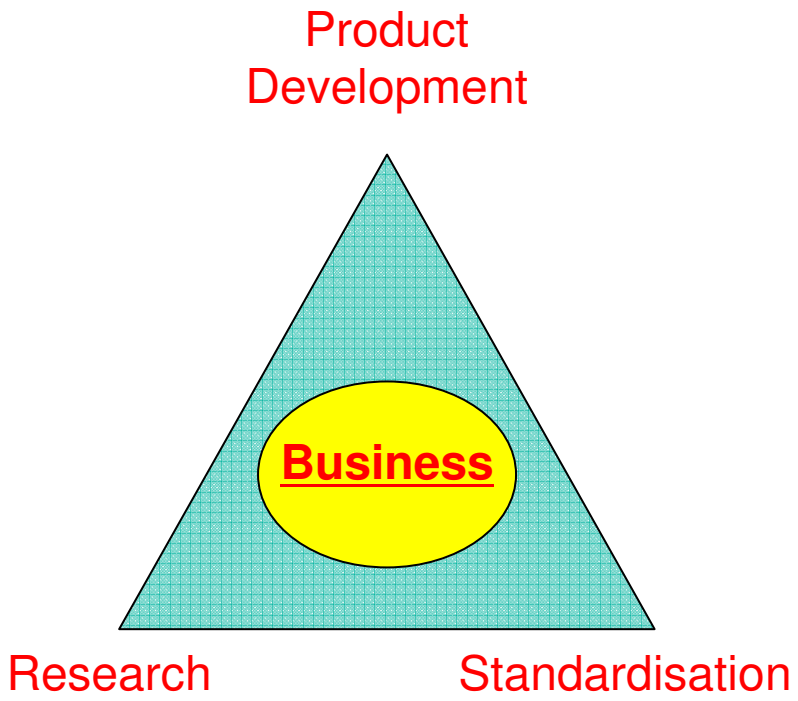
Preamble: (3GPP) standards - how do they fit together with research and industrial product development ?

- Research
  - Inspires products
  - Is basis for standardisation
- Products
  - Require compatibility standards
  - Pay for research (and standards)
- Standards
  - Support markets for products
  - Create "economy of scale"

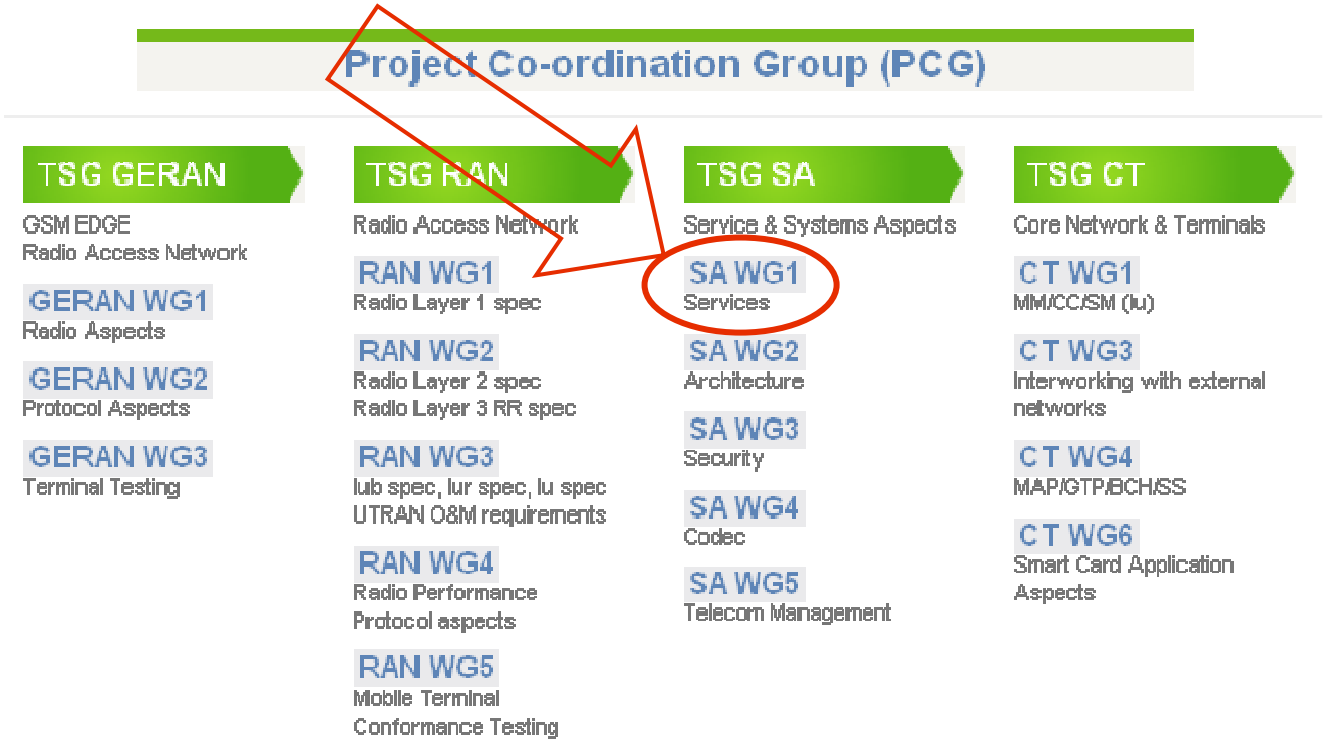
The industry tries to create

... **the "magic" triangle** ...



The 3GPP Standards environment: How does the 3rd Generation Partnership Project (3GPP) look like ?

- The 3rd Generation Partnership Program (3GPP) is a collaboration among "Organizational Partners" (OPs) i.e. telecommunications related standards bodies (ETSI, ATIS, CCSA, ARIB, TTC, TTA), that in turn have "individual members" (operators, manufacturers..)
- 3GPP TSG SA WG1 ***specifies service requirements for 3GPP***



Recent developments that will profit from LTE-(advanced)

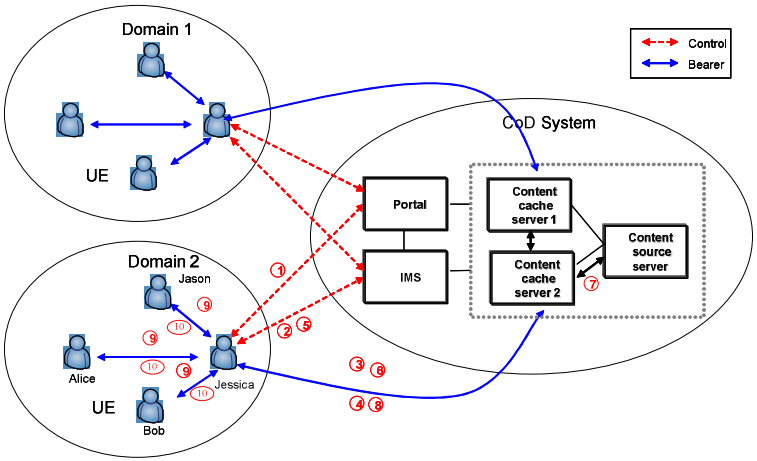
- IMS based Peer-to-Peer Content Distribution Services
  - Study started in 2009, now expecting normative work
  - Main proponents: China Mobile, Huawei, ZTE, Motorola
- Home NodeB/eNodeB and Local IP Access / Selective IP Traffic Offload (aka 3GPP Femto-cells)
  - Work started already in 2008 (comprising UTRAN and LTE)
  - Most of the major 3GPP operators and manufacturers supported it
- Network Improvements for Machine-Type Communications (aka Machine-to-Machine)
  - Based on an early study 3GPP started normative work in 2008
  - Main supporters: KPN, China Mobile, Telecom Italia, Airbiquity, InterDigital ... and an extension of the work in 2009 included all major players as supporters.

... All specifications can be found here:
http://www.3gpp.org/ftp/Specs/html-info/22-series.htm

IMS based Peer-to-Peer Content Distribution Services (I)

- Problem statement:
  - explosive growth of media content consumption
  - *number of media servers* to provide streaming services is required to be increased almost *linearly with the number of users*
  - centralized streaming media servers require considerable demands towards the bandwidth of the backbone IP network.
    ➔ need to *deploy more and more edge servers close to UEs* to guarantee service quality with the increasing number of users.
- Proposed solution:
  - Use Peer-to-peer technology between edge servers and UEs
  - *edge servers handle the requests from locally served UEs,* but also can handle requests transferred from the neighbouring edge servers.
  - Similarly, if the UE's capabilities permit, the *UE can offer spare uplink bandwidth and storage space* to upload data to other requested destinations
  - Use *IMS for user authentication, registration, service discovery, and multimedia session control* etc.

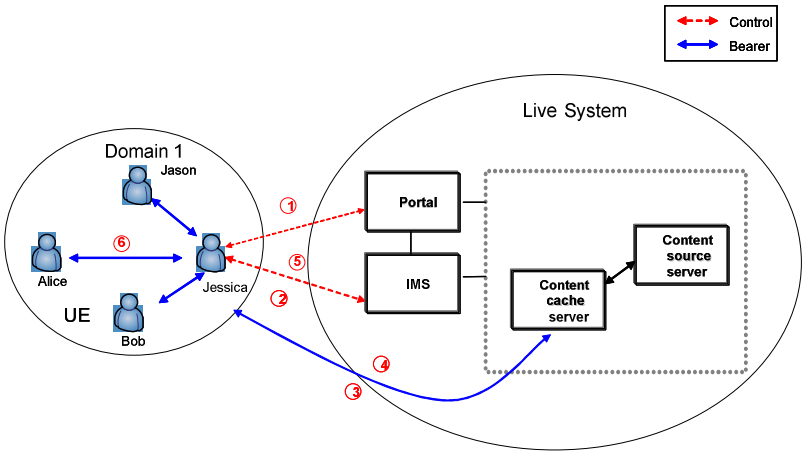
IMS based Peer-to-Peer Content Distribution Services (II) - use cases



Use-case: Content-on-Demand Service for Large numbers of Online Users

- Jessica (domain 2) receives a popular film fom content cache 2
- Others in her domain also request the film; parts are available on cache 1
- Traffic from both caches gets congested. Jessica's UE now acts as a cache for close-by UEs

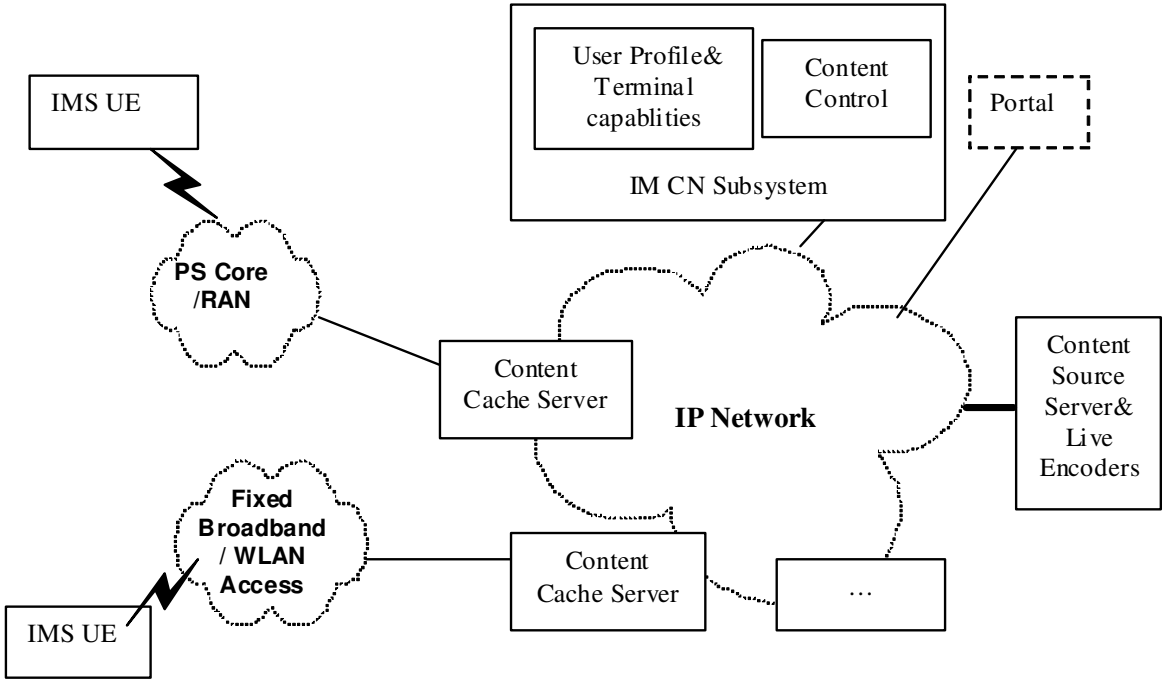
Similar use-case: Software distribution to a large number of UEs



Use-case: Live Streaming Service for Large numbers of Online Users

- Jessica is watching a live football game, streamed as IP muticast via content cache
- Others also want to see the game but cannot, because e.g. capacity bottleneck or the access router doesn't support IP multicast
- Jessica's UE relays the video for others with very short delay (quasi live)

IMS based Peer-to-Peer Content Distribution Services (III) - schematic system view



- IMS can select qualified User Peers
  - Preferred: UEs attached to access networks which can provide upload/download bandwidth higher than a predefined limit by the operator.
  - UEs which maintain stable network connections (e.g. fixed network).
- IMS can provide the UE with the appropriate server to obtain the addresses of Peers

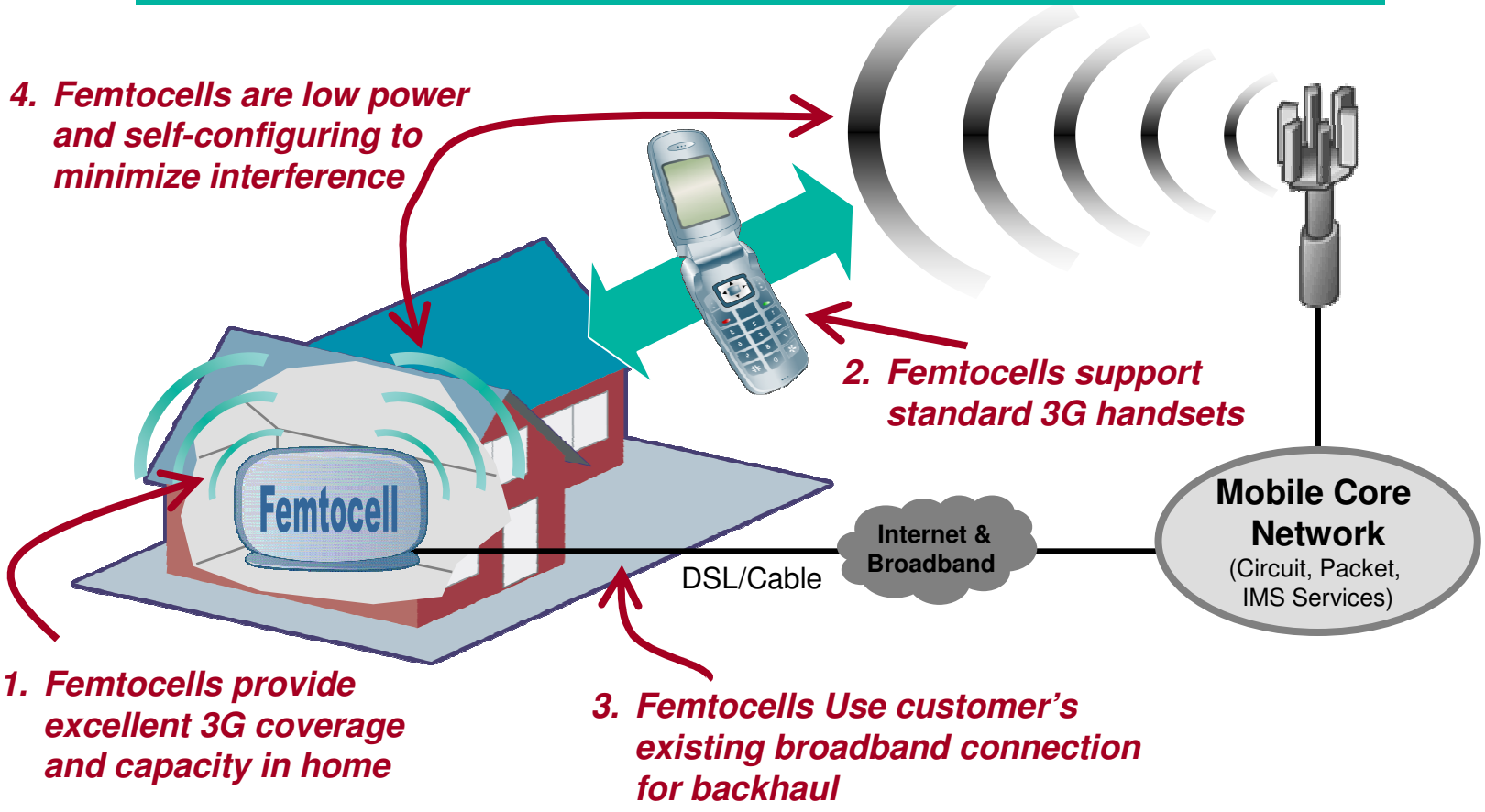
➔ Also combination with Femto-cells highly relevant !

Home NodeB/eNodeB (Femo-cells) and Local IP Access / Selective IP Traffic Offload (I)

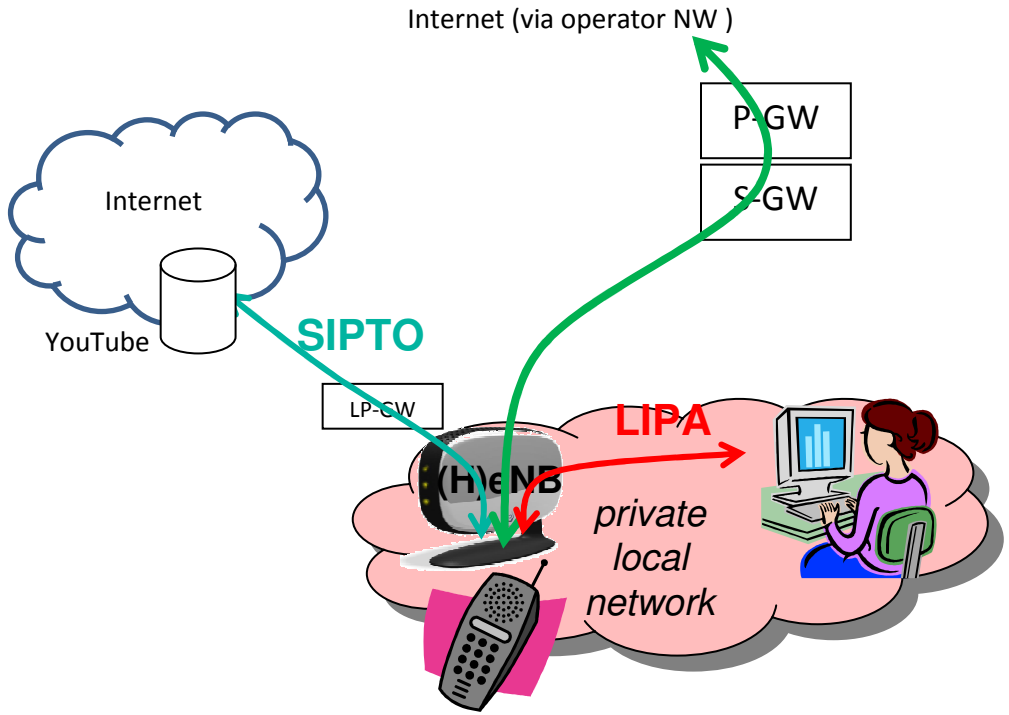
- Problem statement:
  - In many parts of the world coverage (UTRAN, LTE) is still an issue.
  - Indoor coverage gets worse the higher transmission frequencies.
  - Big cells with many users decrease individual bitrate per user. Difficult to compete with achievable bitrates in the fixed net (xDSL, FTTH..)
  - Setting up and maintaining (macro-) base stations is costly
  - High data troughput (e.g. generated by iPhone) eats up operator resources
- Proposed solution:
  - Use Femto-cells with very small cell sizes that are shared by only a few users.
  - Usage of Femto cells may further be restricted (e.g. to family members) by establishing Closed Subscriber Groups.
  - In addition to routing IP traffic through the operator's network:
    - Local IP traffic (e.g. to the user's home LAN) may break out locally into the user's private LAN (Local IP Access - **LIPA**)
    - Selective IP traffic to the Internet (e.g. Video streaming from local servers) may break out at the Femto-cell or at an entiy close to it – without traversing the operator's network. (Selective IP Traffic Offload – **SIPTO**)

Home NodeB/eNodeB (Femo-cells) and Local IP Access / Selective IP Traffic Offload (II)

Femtocells solve the challenge of poor 3G mobile coverage, low bandwidth and high mobile usage costs in the home



Home NodeB/eNodeB (Femo-cells) and Local IP Access / Selective IP Traffic Offload (III)



Local IP Access (LIPA)

- Allows very high data rates to user due to only few users per cell
- Allows mobility of data sessions e.g. within an enterprise (multiple femto cells connected to the Intranet)

Selective IP Traffic Offload (SIPTO)

- Offloads high volume IP traffic from operator's core network
- Can also be used in the macro network (i.e. from eNBs)

Network Improvements for Machine-Type Communications(I)

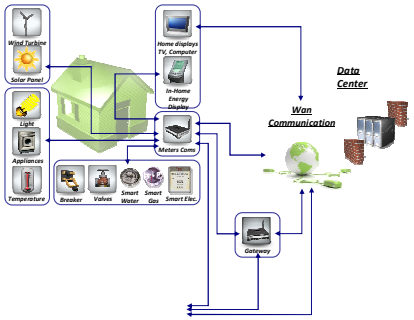
- Problem statement:
  - A big market for Machine-to-Machine communication is expected soon.
    - EU issued a mandate on Smart Metering (M441) to European SDOs, ITU-T has created a focus group on Smart Grid (energy)…
    - Currently mainly "vertical" markets for M2M exist (services/devices only usable for one dedicated purpose). "Horizontal" markets could boost business.
    - Costs per service and/or device need to be dramatically lower than today
  - Current (3GPP) networks are designed for human-to-human communication (telephony) or server-to-human (video streaming). They need optimization for M2M purposes.
- Proposed solution:
  - Implement optimisations in 3GPP that allow:
    - Reduced mobility (a vending machine usually doesn't move)
    - A huge number of mobile devices to attach to the network (orders of magnitude)
    - maintain connectivity to a large number of devices (including low-volume traffic)
    - A device to go into "deep sleep" state (e.g. for energy saving) and "wake-up" again
    - Charging mechanisms for groups of devices …

➔ *Also note, that ETSI has started a TC on M2M in 2009!*

Network Improvements for Machine-Type Communications(II) - scenarios

Example M2M Smart Meter use cases

Examples:
- Provide periodic meter reads
- On-demand meter reads
- Provide Profile data
- dispute resolution
- billing accuracy and precision
- online bill presentment
- prepaid metering
- consumption management
- remote service changeover
- time-of-use rate structures
- slab/block tariffs
- Shift tariff times
- customer equipment monitoring
- customer equipment management
- Meter Alert and Diagnostic
- Maintenance Management,
- Meter software upgrade.
- remote connect/disconnect
- threshold alerts
- Apply threshold
- Synchronise time
- tamper detection and history recording
- power quality information
- security monitoring
- security management
- outage management
- voltage and reactive power management
- load management
- Demand response,
- bulk power management
- managed islanding
- integration of distributed generation



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Example M2M eHealth

Examples:
- Wearable sensors
- Disease management (tracking blood sugar..)
- Aging Independently (Tracking activity level of seniors...)
- Personal fitness and health improvement (pulse, fat burning..)
- …

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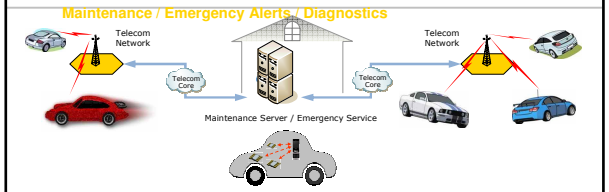
Example Automotive M2M use case



Stakeholders	Scenario	Information Exchange
•Vehicle owner •Vehicles with location-enabled M2M modules •Diagnostic sensors connected to M2M module acting as an aggregator (M2M Area Network) •Telecom network and operator •Maintenance service/ Emergency Alert service	•Vehicles are fitted with maintenance, diagnostic, and/or crash sensors connected to GPS-enabled M2M modules •Modules autonomously transmit maintenance & emergency data to servers •Servers can trigger vehicle diagnostic self-test •Servers can schedule maintenance or alert help	•M2M device initiates a data session with Maintenance Server or emergency data call with Emergency Server •Module aggregates sensor data •Data contains vehicle id, date/timestamp, location, sensor data •Server can initiate communication for diagnostic purposes

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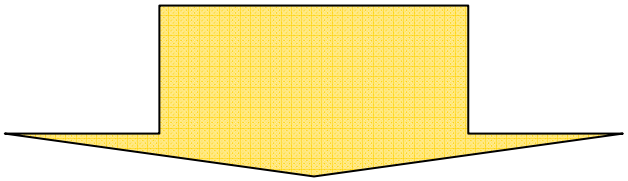
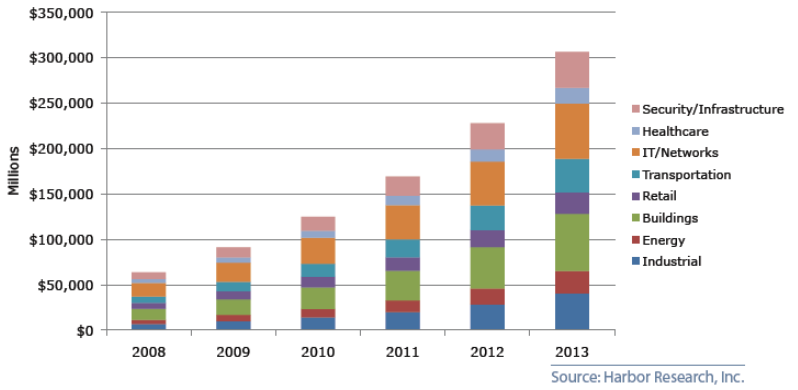


Exhibit: Value-Added Application Services By Venue



Source: Harbor Research, Inc.

Network Improvements for Machine-Type Communications(III)

- M2M is probably not the "killer-application" for LTE / LTE-advanced, but:
  - Will create applications for high-data usage (video monitoring, surveillance ..)
  - Will create applications for low-data usage (metering...) that may run over existing old technology – e.g. Use SMS for transmission.
  - ... Will for sure create areas for new business that we currently are not thinking about....

Conclusion

- We can anticipate that in some service areas (e.g. P2P) high volume data over the air will require LTE / LTE-advanced
- In other areas (Femto-cells) high mobile data usage will be encouraged through introduction of these technologies.
- Machine-to-Machine communication will open up an opportunity for a completely new usage of mobile networks. We cannot yet foresee what the impacts on mobile data usage will be.

Thank you !

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