The Internet of Things Beyond the Buzz: Use Cases and Industry Trends

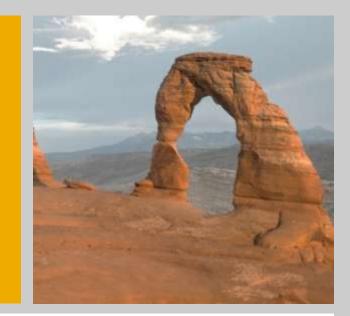
SYSTEMATIC THOUGHT LEADERSHIP FOR INNOVATIVE BUSINESS

Stephan Haller, SAP Research

ACM Mobility 2009 Nice, France September 2, 2009

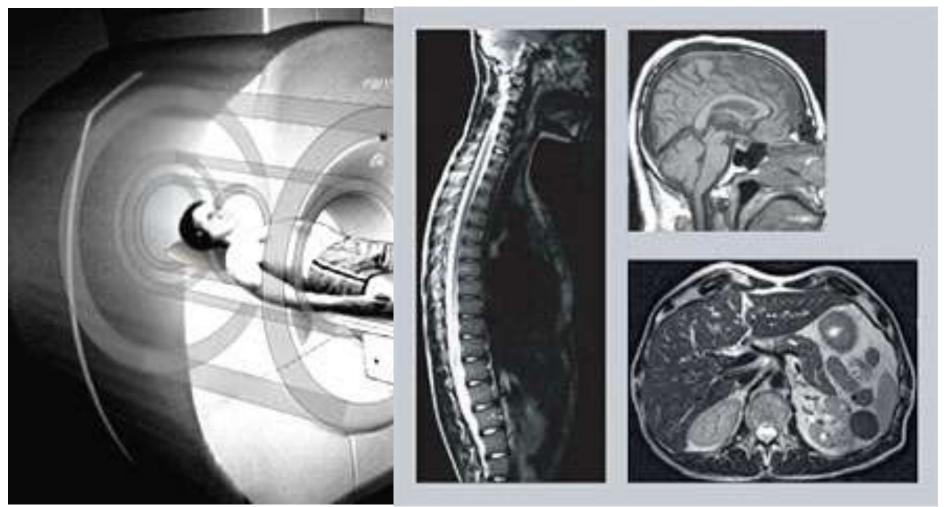






Just as X-rays and MRI advanced medicine, and as microscopes changed physics and biology, ...

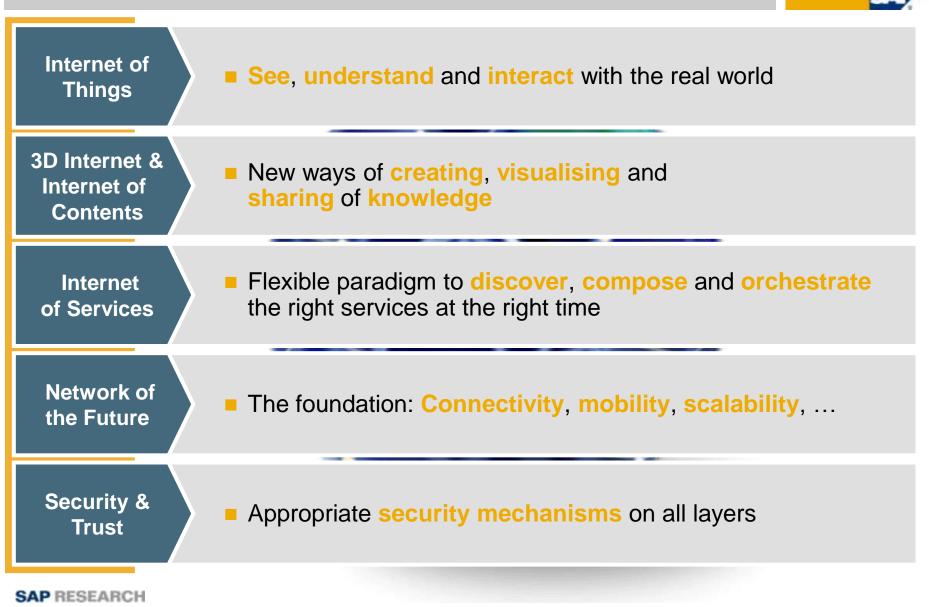




Source: nobelprize.org



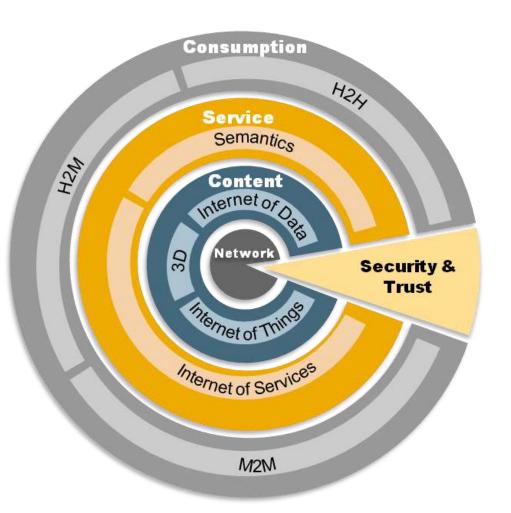
... the Future Internet will change the way we live and do business!



Internet of Things: An Integral Part of the Future Internet

... with specific aspects:

- Real-World Integration
- Heterogeneity of "Devices" and Networks
- Mobility
- Identity Management
- Managing Scale
- Continuous Sensemaking
- Distributed Intelligence





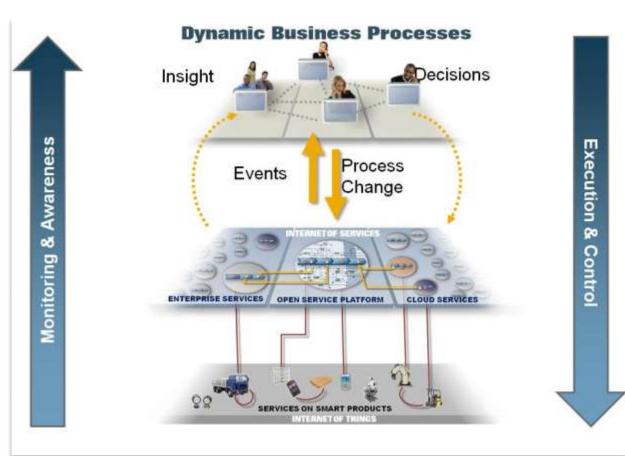
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Internet of Things: An attempt at a definition

"A world where physical objects are seamlessly integrated into the information network, and where the physical objects can become active participants in business processes.

Services are available to interact with these 'smart objects' over the Internet, query and change their state and any information associated with them, taking into account security and privacy issues."





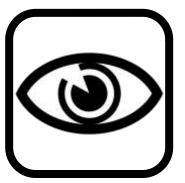
3 Key Concepts





Unique Object Identification

Serialization



Real-World Visibility

- Object Location Tracking
- Object Status Monitoring
- Object Context Monitoring



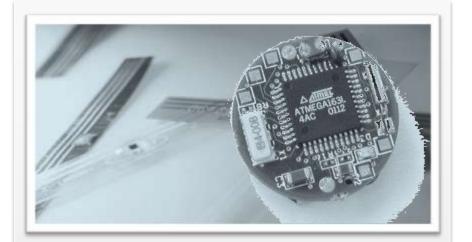
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Real-World Control

- Real-World Actuation
- Configuration Changes
- Autonomous Objects

Many Technologies Exist, But...





Heterogeneity of Devices and Networks

- RFID
- Wireless Sensors & Actuators
- Mobile Phones
- PLCs & Embedded Systems



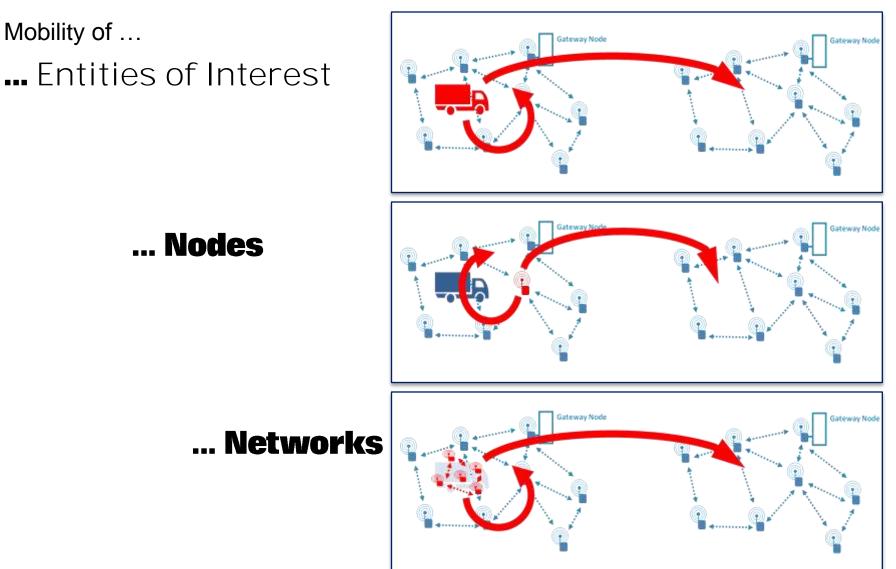
Identification of Objects

- EPC, ucode, industry-specific IDs
- Encoding vs. "true" identity
- Identification vs. addressing

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Mobility: What and Where



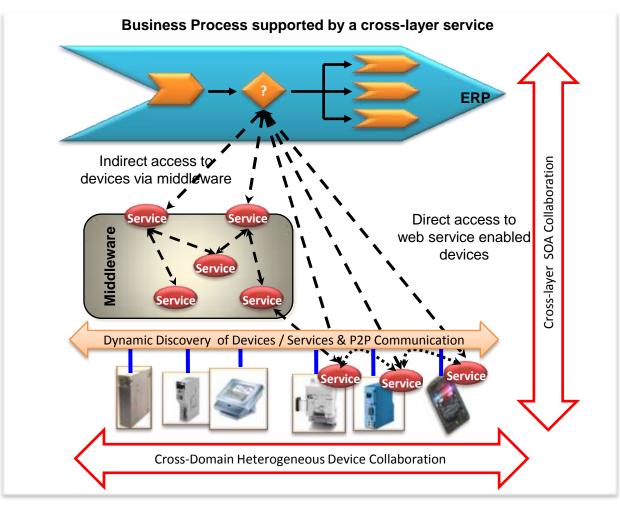




In-Network Processing and Distributed Intelligence



- Cooperating Objects
- Decomposed Business Processes
- Deployment and Management issues!
 - Evaluation of pro's and con's of a distributed approach necessary





Additional Challenges

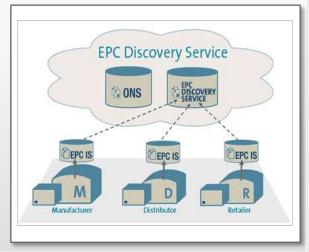


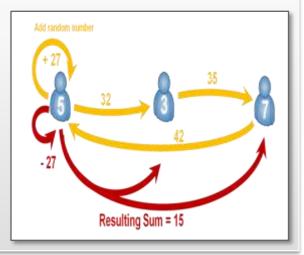
High Performance Data Management and Discovery

- Is it possible to construct a universal, global discovery service for any type of application scenarios?
- Confidentiality of data and scalability are key properties
- ONS is not the answer!

Trust, Security & Privacy

- State of the art access control methods and models do not scale
- Consider privacy saving multi-party computations at the application layer and claims-based identity schemes
- Continue research on device and tag level privacy and consumer awareness





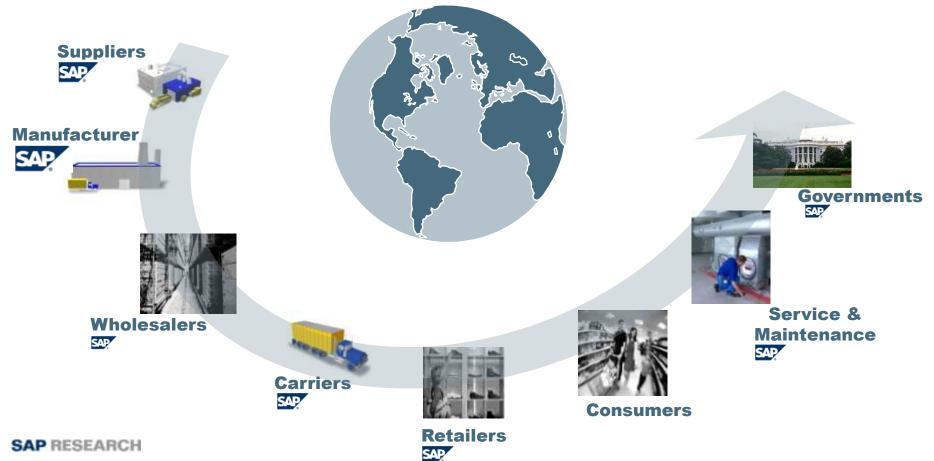


Today's Internet of Things – Disconnected 'Local Area Networks of Things'



Enterprises have been deploying their own Intranet of Things

■ Focus on isolated scenarios, no real global scenarios in operation that use serialized item information (stored in RFID tags, barcode, etc.)



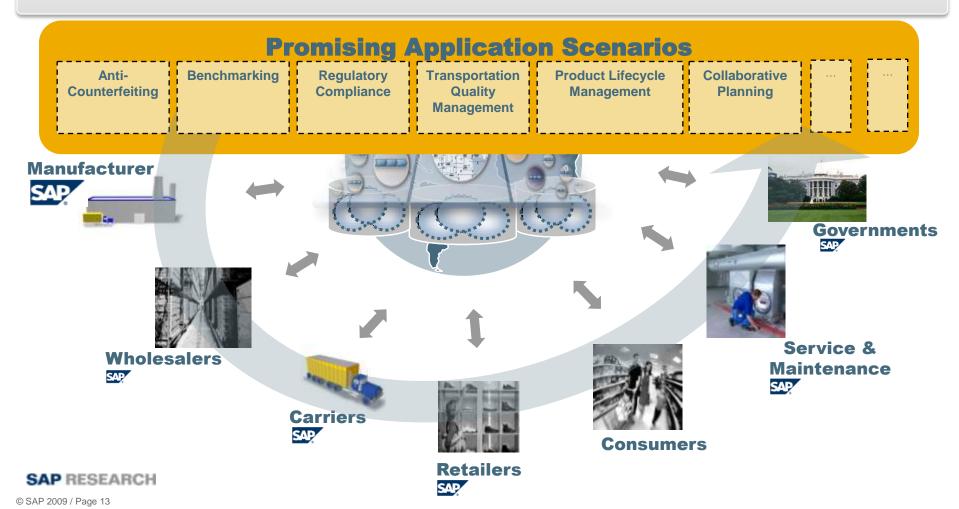
SAP 2009 / SAPSE2vices for Internet of Things / Zoltán Nochta / 12

Tomorrow's Internet of Things – Collaborative Application Scenarios



Connecting different parties along the logistics chain and using their respective data has enormous potential

Appropriate technologies and some rethinking needed



Major Application Areas



Manufacturing



- Automation & Decentralized
 Shop Floor Control
- Machine Maintenance

Supply Chain Management



- Track & Trace
- Supply Chain Integrity

Health



- Ambient Assisted / Independent Living
- Early Diagnosis and Prevention

Automotive



- Car-to-X
- Vehicle Relationship Management

Energy



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- Automated Metering Infrastructure (AMI)
- Smart Grid

Insurance

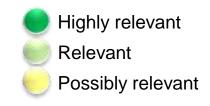


- Risk Assessment
- Loss Minimization

Major Application Areas & Relevance of Key IoT Concepts



Key IoT Concepts		Manufacturing	Supply Chain	Energy	Health	Automotive	Insurance
Unique Object Identification		۲			$\overline{\bigcirc}$	۲	
Real-	Object Location Tracking	\bigcirc	۲	۲	۲	۲	
World	Object Status Monitoring	۲	۲			۲	
Visibility	Object Context Monitoring	۲	۲		١	۲	
Real- World Control	Real-World Actuation		\odot			\odot	\sim
	Configuration Changes	۲				۲	\bigcirc
	Autonomous Objects	۲		۲		\odot	





European Road Traffic

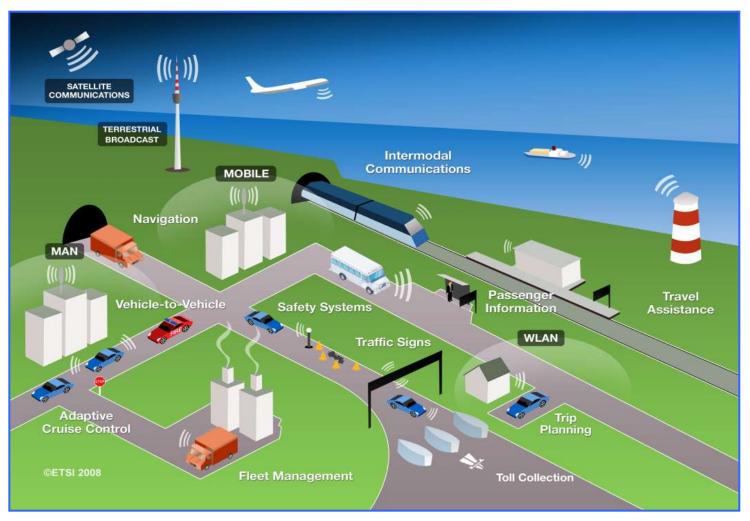


- The transport industry accounts for about 7% of European GDP and for around 5% of employment in the EU
- With around 41 600 deaths and more than 1.7 million injured in 2005, road remains the least safe mode of transport
- Congestion costs amount to 50 billion € per year or 0.5 % of Community GDP and by 2010 this figure could go up to 1% of EU GDP
- Volume of road freight grew by 35% contributing to 7 500 km or 10 % of the network being affected daily by traffic jams
- In 2002 the transport sector consumed 338 million tonnes oil equivalent (MToe) representing 31% of the total energy consumption in the EU
 - Road transport consumed 281 MToe, or 83% of the energy
 - Up to 50% of fuel consumption is caused by congested traffic

How to reduce fatalities, reduce cost, fuel consumption, and protect environment?

Deploy Intelligent Transportation Systems (ITS)

Intelligent Transportation System







Traffic Safety and Efficiency Applications



Traffic Safety

- Approaching emergency vehicle
- Emergency electronic brake lights
- Wrong way driving warning
- Post crash warning
- Car breakdown warning
- Slow vehicle warning
- Overtaking vehicle warning
- Intersection collision warning
- Hazardous location notification
- Traffic jam ahead warning
- Signal violation warning and preemption
- Stop sign violation
- Lane change assistance
- Pre-Crash sensing warning

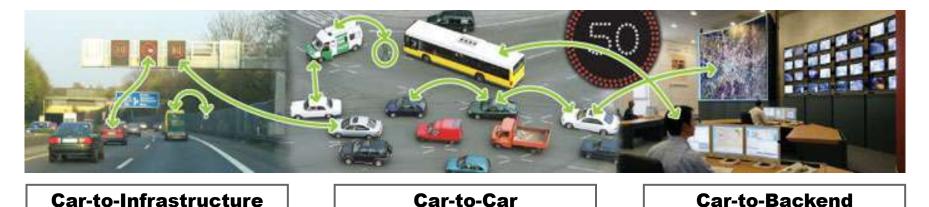
Traffic Efficiency

- Decentralized floating car data
- Regulatory and contextual speed limit
- Green Light optimal speed advisory
- Traffic information and recommended itinerary
- Enhanced route guidance and navigation
- Intersection management
- Cooperative flexible lane allocation
- Adaptive drive train management

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ITS for Road Traffic: Features of a Cooperative System Approach





Decentralized approach (cooperative)

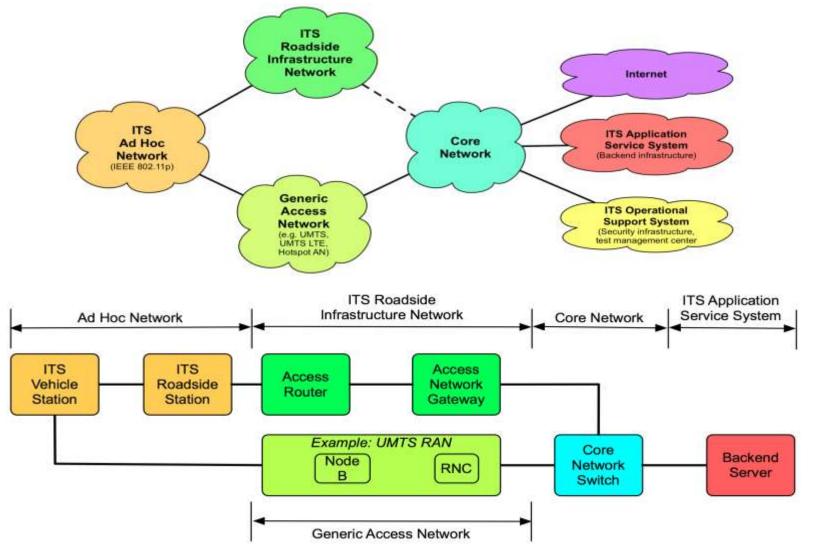
Vehicles cooperate seamlessly (across models and vendors)

Safety and traffic efficiency applications have very specific requirements

Delay, locality, relevance, etc

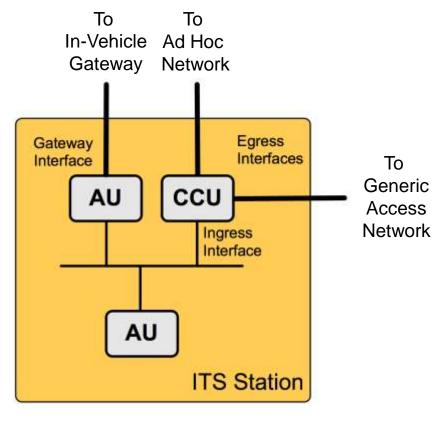
Picture from http://www.cvisproject.org

The Complete ITS System Architecture

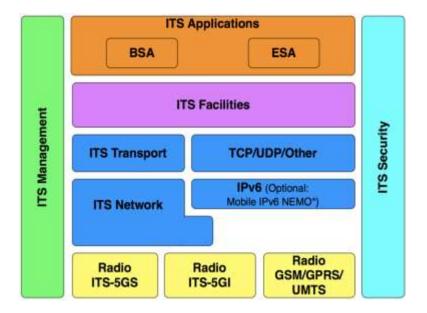


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In-Vehicle Architecture



AUApplication UnitCCUCommunication Control Unit



BSA	Basic Set of Applications
ESA	Extended Set of Applications
ITS-5GS	ITS 5 GHz Safety (IEEE 802.11p
ITS-5GI	ITS 5GHz Infotainment (IEEE 802.11a)

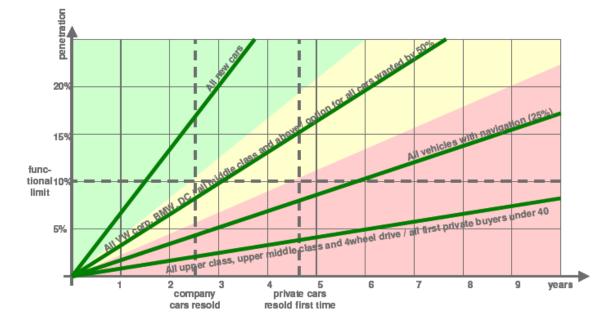
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Cooperative Systems: Open Issues

No viable business model behind traffic safety and efficiency applications

- Continues to prevent market introduction
- Spectrum assignment for safety applications only
 - Prevents any commercially relevant application to be used in the ad hoc domain

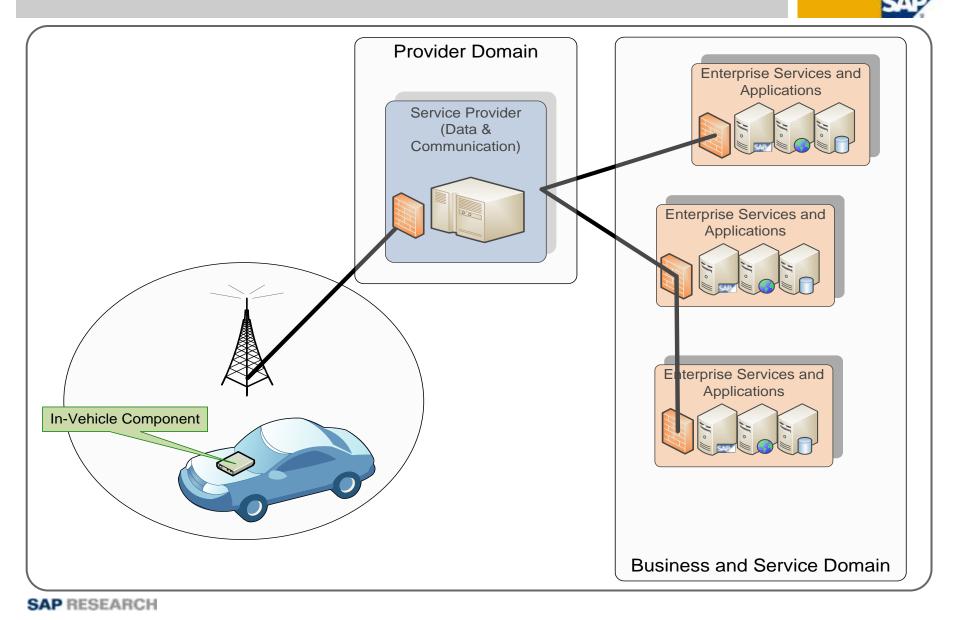
Decentralized and cooperative nature requires a minimum penetration rate



Source:

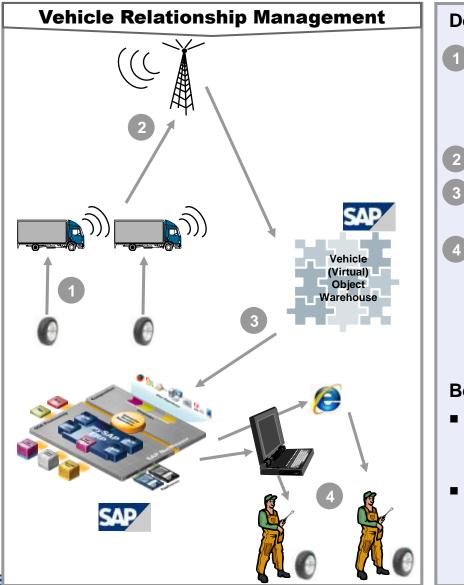
Kirsten Matheus, Rolf Morich, Andreas Lübke: "Economic Background of Car-to-Car Communication"

Vehicle-to-Business: The Concept



Vehicle Relationship Management





Description of services

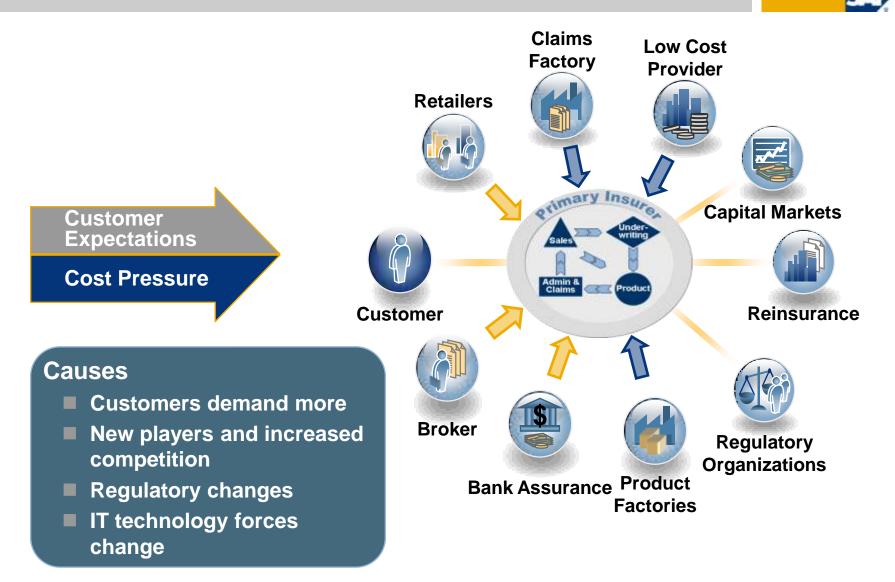
- Provide information about vehicle (e.g., expendable items, tire pressure, temperature) available from in-vehicle sensoric systems (CAN Bus)
 - Transfer data to central data center / backend system
 - Route data to the corresponding system/application ("SaaS")
 - Conduct preventive maintenance (e.g., optimize wheel pressure for truck flee, schedule service order), roadside assistance or improve long-term product design

Benefits

- Car Drivers
 - Higher availability of assets for car drivers
 - Immediate error recovery
- OEMs
 - Access to invaluable data over the whole product lifecycles
 - Increased customer satisfaction



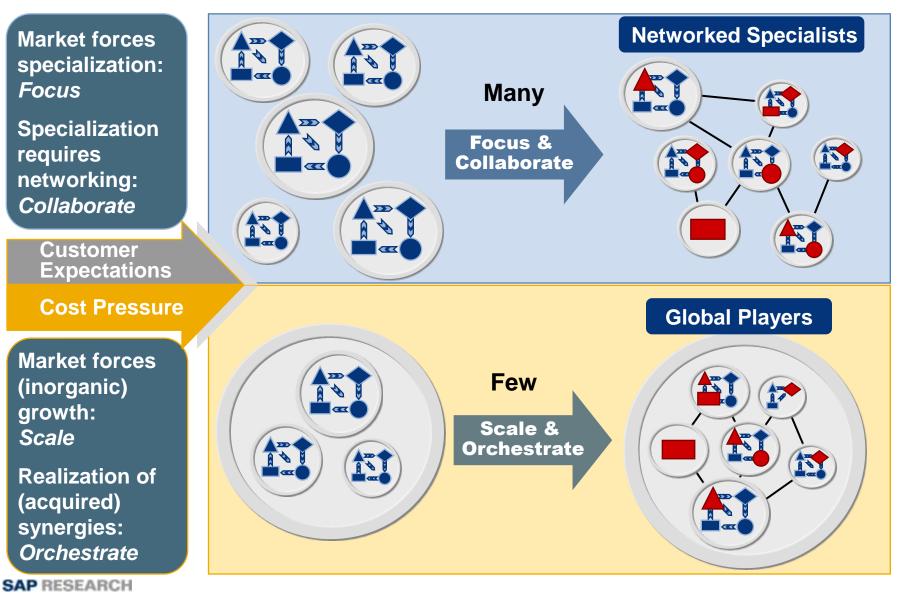
Insurance Industry: Challenges for The Traditional Value Chain



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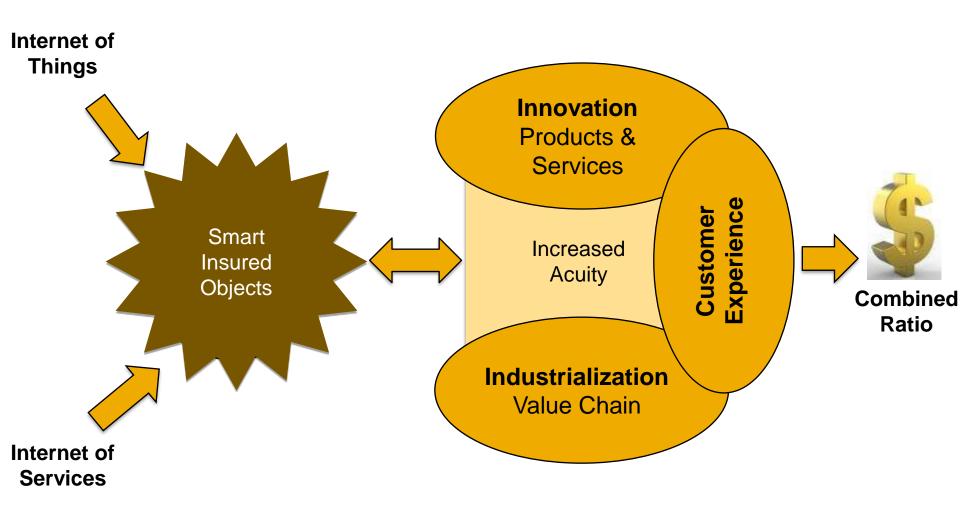
Trend in the Insurance Industry: Network Collaboration is Key





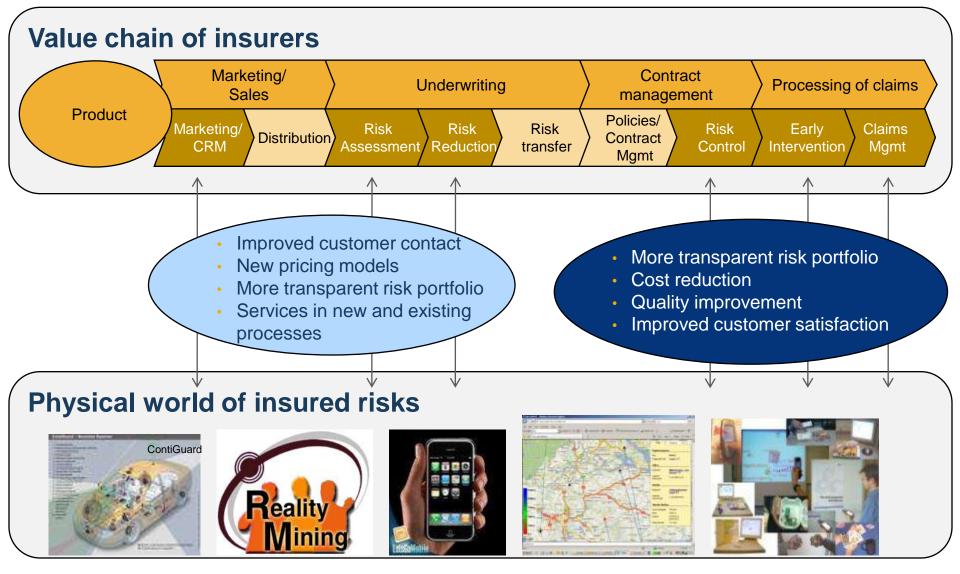
Smart Insured Objects change the Insurance Industry Mechanics







The Internet of Things will change how the Insurance Industry works



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Source: I-Lab, ETH Zürich & Univ. St.Gallen

Claims Management



Problem Statement

Insurance Domain	Technology Trends				
High costs due to late loss reports, incomplete case circumstances, and insufficient business networks Studies estimate cost saving potential of pro-active claims management to be up to 15 % Need for differentiation through innovative and comprehensive services	 Increasing maturity of Ubiquitous Computing technologies (localization, telemetry, identification,) Ubiquitous availability of mobile devices and unified mobile device platforms Regulatory developments drive technology adoption (eSafety initiative and eCall technology) 				

Research Question

How can claims management business processes benefit from Ubiquitous Computing technology?

- 1. Which pain points with respect to data quality, data completeness, timeliness, and media breaks in existing claims management business processes can be identified based on an empirical analysis of insurance claims?
- 2. Which business process improvements are technically feasible and economically justified?
- 3. Which technical infrastructure is necessary to implement the identified business process improvements?
- 4. What is the economic impact for insurance companies?

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Demonstrator: Mobile First Notice of Loss









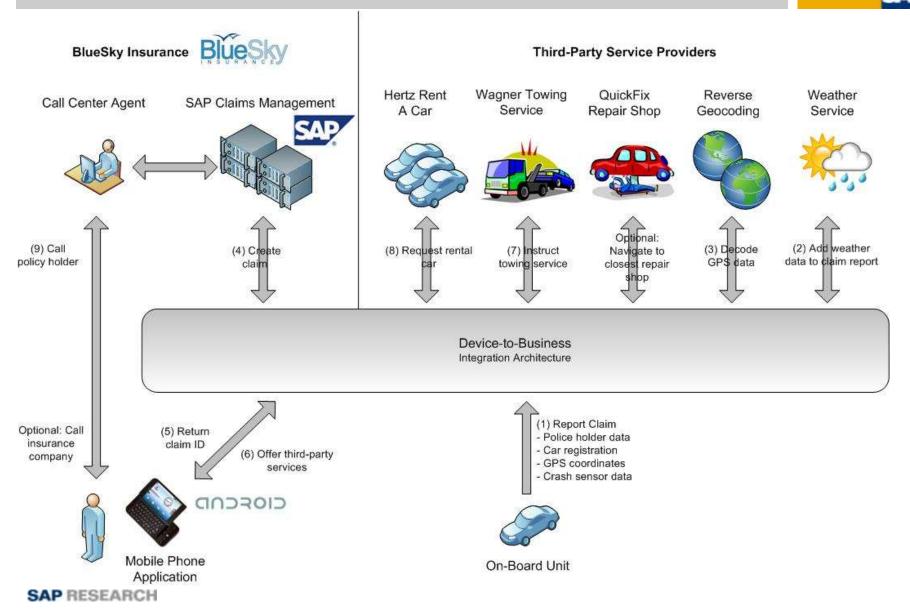
Android

iPhone OS

Blackberry OS



Extended Scenario & Service Architecture for Mobile First Notice of Loss Example



Mobile First Notice of Loss: Benefits



Value-Added Services for Customers (Insurees)

- Superior customer service and reduced paperwork / administrative overhead
- Immediate support from 3rd party service providers
- Potentially lower premiums



Business Value for Insurance Companies

- Reduction of claims and process costs through business process innovations
 - Reduced time to first contact and to settlement
 - Reduced average loss per claim
- Increased customer retention and cross-selling opportunities



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The Internet of Things is an integral part of the **Future** Internet

- Holistic Approach: No separate architectures for the Internet of Things, the Internet of Services, the Internet of Contents etc.
- However, mobility, heterogeneity and "design for change" needs to be taken into account

Many possible application areas; services and **service platforms** provide the glue and are key for interoperability

Start to build successful applications now!



Thank you!

Stephan Haller

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