Car-to-Car Communication - Market Introduction and Success Factors

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Car-to-Car Communication

What is the scope of Car-to-Car applications?

Which market mechanisms apply to Car-to-Car communication?

How can it be introduced to the market?

Which premises have to be accomplished?

What does it mean to vehicle manufacturers?
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Communication Channels for Car-to-X Communication

- Car-to-Car
- Car-to-Mobile Device
- Car-to-Enterprise (private / fleet business)
- Car-to-Infrastructure (public)
- Home-to-Car
- WLAN
Car-to-Car Communication is generally agreed to have the potential to significantly improve road safety.

But: No common view exists on how to economically exploit the technology and on how to introduce the technology to the market.
Car-to-Car Communication is subject to the market mechanisms of technologies with network effects.

Network effects means that the customer value of this technology grows with its dissemination.

Particularly for Car-to-Car Communication the customer perceivable value with sufficient quality of service requires a minimum market penetration.
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Thresholds of Market Penetration to enable Car-to-Car Functions

**Information**
- > 5 % De-central traffic information

**Warning**
- > 10 % Road condition warning
  - Congestion warning
  - Breakdown ahead warning
  - Emergency alert warning
  - Crash ahead warning

**Cooperation**
- > 95 % Intersection collision avoidance
  - Lane change warning
  - Take over collision avoidance
  - Cooperative driving
Market Penetration of Car-to-Car Communication depending on Equipment Rates. Case: Germany

- 50% of vehicles (all BMW, DC, VW; or all middle class cars and above)
- 25% of vehicles (all vehicles with navigation system, forecast)
- 8% of vehicles (upper and upper middle class)
- 10% of vehicles (all vehicles with navigation system, forecast)

Years:
- 2 business cars resold
- 4 private cars resold first time
- 6
- 8
- 10 first cars scrapped
- 12
- 14
- 16
- 18

Safety effect:
- 10%
- 20%
- 30%
- 40%
The Dilemma....

1. **Car-to-Car Communication Functionality must be installed in more than 25% of all new vehicles if it shall be available in a reasonable time frame.**

   This is why it is not possible to introduce Car-to-Car Communication in the classical top down approach.

2. **The safety and information features of Car-to-Car Communication work only if all car makers apply the same technology at the same time.**

   This is why standard Car-to-Car Communication Features do not enable unique selling points.

3. **A car maker who waits until others have generated sufficient market penetration has economic benefits and thus a competitive advantage.**
Strategic Options to Resolve the Dilemma (1)

Mandatory introduction to improve road safety
- penetration is secured
- safety improvements are not measurable before 15 years after introduction.....
- ... if measurable at all: autonomous driver assistance systems will continue to improve road safety, so that the effect of C2CC is difficult to separate.
- Safety improvement by C2CC cannot be measured by the generation who have introduced it.

Free market mechanisms
- driven by customer value
- roadmap: next slide
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**Strategic Options to Resolve the Dilemma (2)**

**Free Market Mechanisms**

- Car makers equip several million vehicles with C2CC units and start selling the feature as soon as minimum market penetration has reached.
  - penetration is secured
  - huge initial cost without pay back

- Car makers package C2CC features with other C2XC functions that use the same or similar technology.
  - C2CC functionality is sold on top as soon as required penetration is achieved.
  - slow penetration
  - cost on top must be marginal

**X = public infrastructure**
- vehicle communicates with/via traffic infrastructure
  - requires upfront public investments, or...
  - ...possibly re-use of existing infrastructure (e.g. road toll) if technical requirements are met

**X = consumer electronics and/or private networks**
- vehicle communicates with WLAN-equipped (consumer) devices and local networks
  - roadmap: next slide
The Vehicle in the Connected World of Tomorrow (1)

- vehicles are wirelessly connected with mobile consumer electronics
  - *smart phone*, MP3 player, fitness monitor, laptop etc.

- novel functions in the mobile context
  - end-to-end navigation
  - mobile device as data carrier from/to vehicle
vehicles are wirelessly connected to local networks

- data exchange between PC at home/office and vehicle in garage/parking
e.g. for travel preparation or appointment navigation

... and networks with open access (e-commerce)

- media download e.g. at gas stations, drive through
- location based services: event, sales offerings, sightseeing locations...
- new cross-business models

enabled by mobile-device-to-hot-spot
car-to-hot-spot
car-to-home, car-to-office
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The Vehicle in the Connected World of Tomorrow (3)

- vehicles communicate wirelessly with car maker and dealer
  - digitalized front desk with service point
  - diagnostics and software updates at service station
  - wireless data connection to vehicle in production
  - remote diagnostics

- ... and fleed carrier
  - e.g. automated rental car return

enabled by after market solutions for fleed carrier

wireless car-to-service

wireless car-to-production

2005  2010  2015  2020
vehicles start communicating wirelessly with other cars (soft applications)

- decentral traffic data collection – everywhere and up to date
- improved road safety, e.g. warning of incidents in blind corner, ice warning...
- improved vehicle distance control (swarm control)
- local coordination of rescue forces
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The Vehicle in the Connected World of Tomorrow (5)

- vehicles communicate wirelessly with traffic infrastructure
  - local traffic control / guidance e.g. in construction areas, event areas
  - supplementary traffic sign information
vehicles communicate and interact wirelessly with other cars in an open network

- collision mitigation and avoidance
- platooning of cars
The Roadmap to Car-to-Car Communication

- Car-to-Car (Hard Applications) Open Network
- Car-to-Car (Soft-Applications)
- Car-to-Infrastructure
- MobileDevice-to-HotSpot
- Car-to-HotSpot
- Car-to-Service, Car-to-Production
- Car-to-Home, Car-to-Office
- Car-to-MobileDevice

after market solution for fleet carrier

2005 2010 2015 2020
The basic Car-to-Car Communication functions have to be developed and implemented in enabling Car-to-X Communication systems as soon as possible. Future systems need to be backward compatible.

System synergies between IEEE 802.11p solutions for reliable and real time communication and 802.11 a/b/g solutions for consumer electronics have to be exploited.

Major Car-to-Car Communication applications require a reliable real time communication. This can only be achieved by allocation of an exclusiv frequency (in discussion: 5.9 GHz band).
Architecture of a combined car-to-car and car-to-consumer solution. Synergies help to achieve the cost targets.

- IP applications
  - middleware, e.g. OSGI
  - TCP / UDP
  - IP / IP router
    - e.g. Bluetooth
    - e.g. UMTS

- MAC extensions
  - IEEE 802.11 MAC
  - 802.11p 5.9 GHz
  - 802.11a 5 GHz
  - 802.11b/g 2.4 GHz

- C2CC network layer
  - middleware
  - geo referenced applications

- Vehicle world
  - Security
Even though final Car-to-Car Communication applications are still far away, the premises for their market introduction are being laid today:

- Car-to-X Communication is anchored in the electronics roadmaps of vehicle manufacturers.

- Car-to-Car Communication technologies and applications are being standardized across the automotive industry by the European Car-to-Car Communication Consortium.

- The necessary frequency domain must be allocated.
Thank you!