ECHORING™

Unwiring Everything

March 15th, 2018 – EchoRing™ Intro

by Jasper Büsch

R3 Communications GmbH

EchoRing™ roadmap.

EchoRing™ – in various reliable real-time wireless use cases.

Optimization

Enablement

current activity & growth focus

future growth opportunities

HMI[1]

CRANE

ROBOTICS

ECHORING™ Unwiring Automation

ECHORING™ Unwiring Cabins

ECHORING™ Unwiring MedTech

YEAR

AGRICULTURE

AGV[2]

EDGE COMPUTING

ECHORING™ Unwiring Fleets

ECHORING™ Unwiring Everything

2

1 HMI: human machine interface 2 AGV: automated guided vehicles

How we realize determinism.

token rotation.

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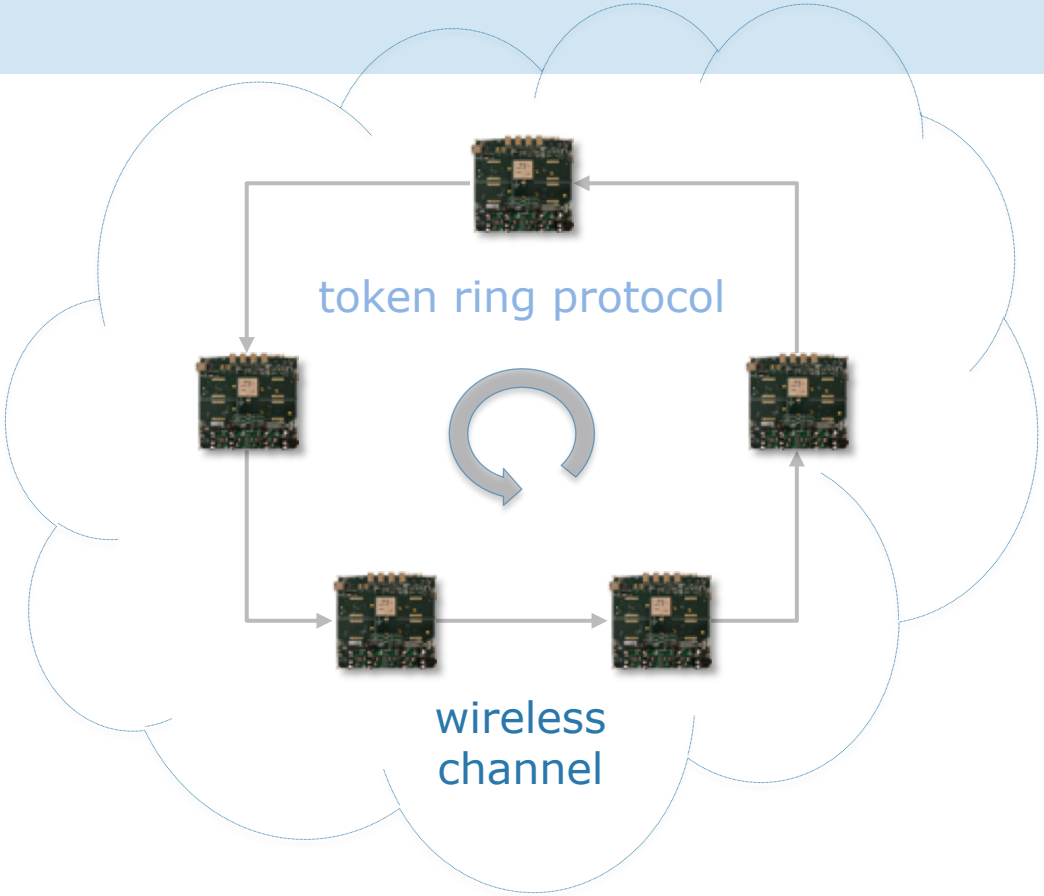

How we improve reliability.

massive cooperation.

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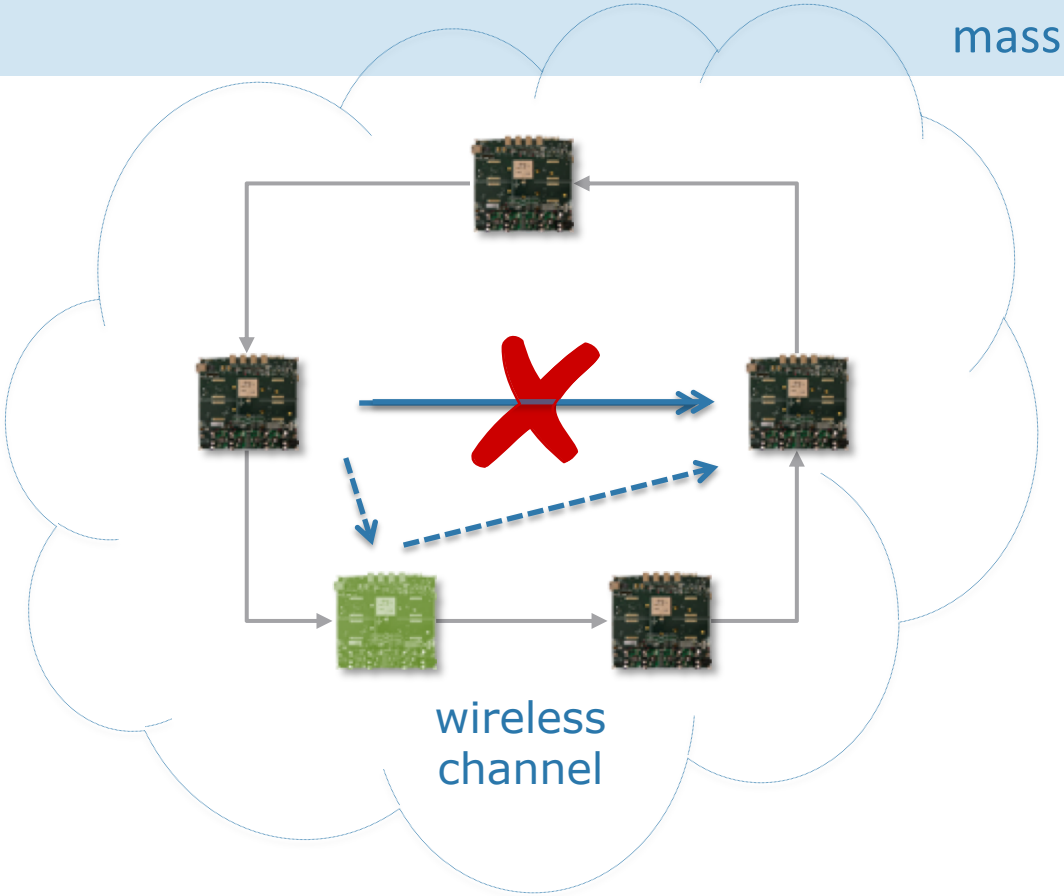
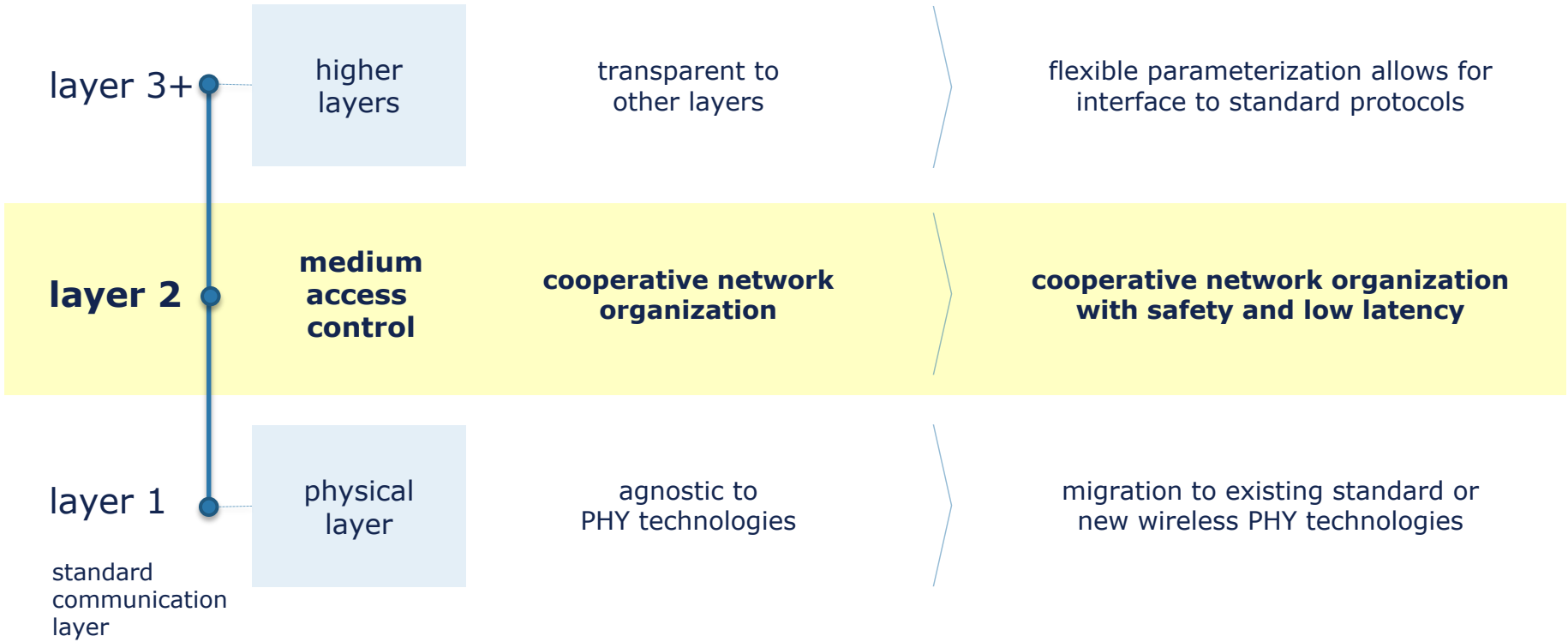


Where do we place it?

agnostic to lower layers and transparent to higher layers.



EchoRing™ system block diagram.

driver firmware

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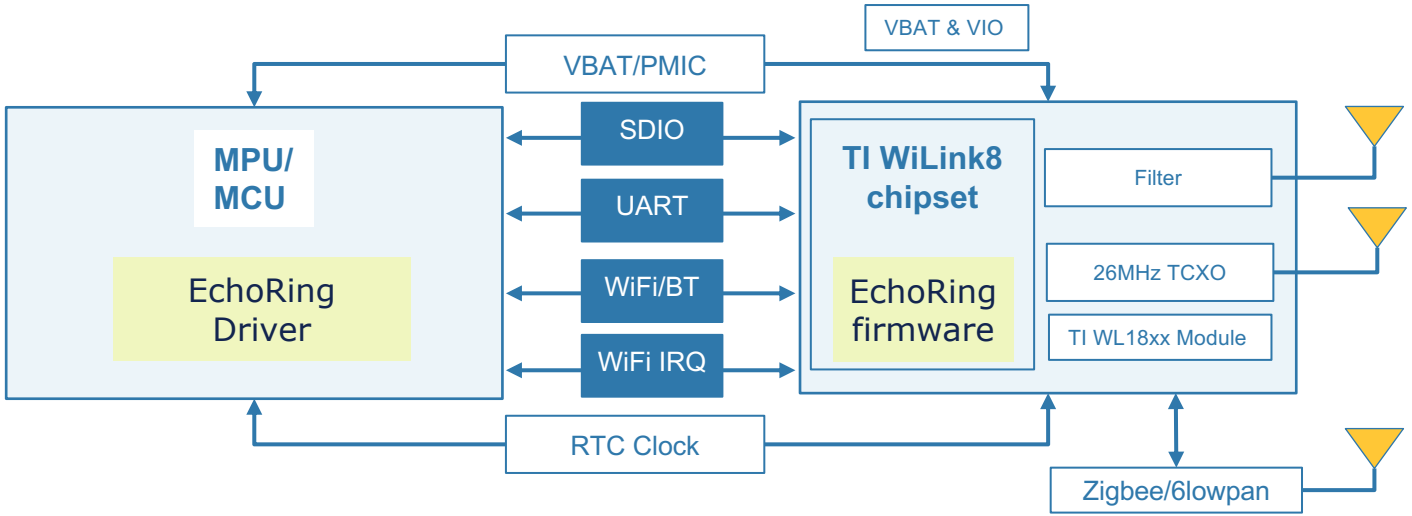
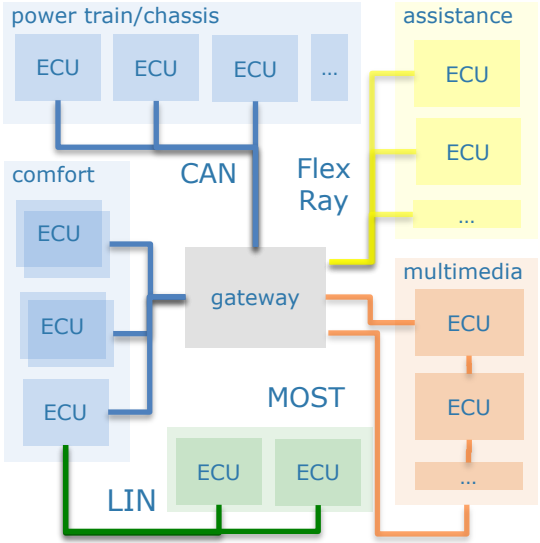


Regular performance

high end performance

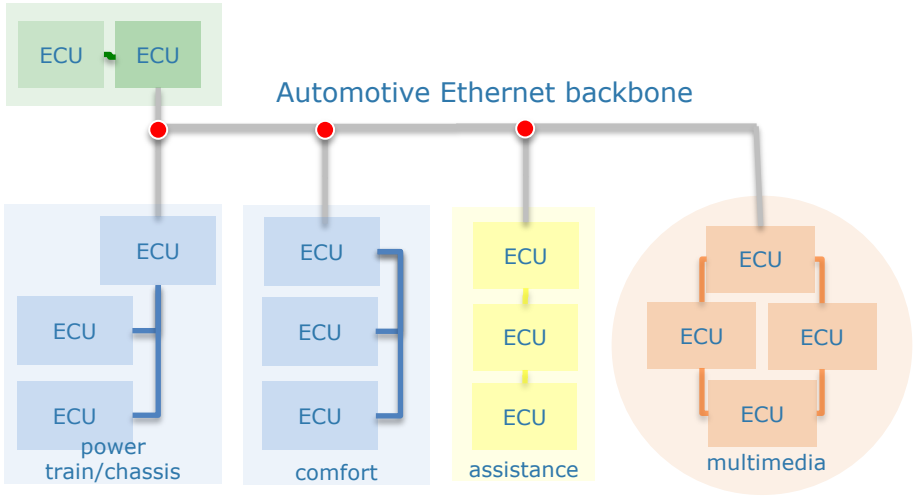
The harness is a car's nervous system…

legacy



gateway approach

modern

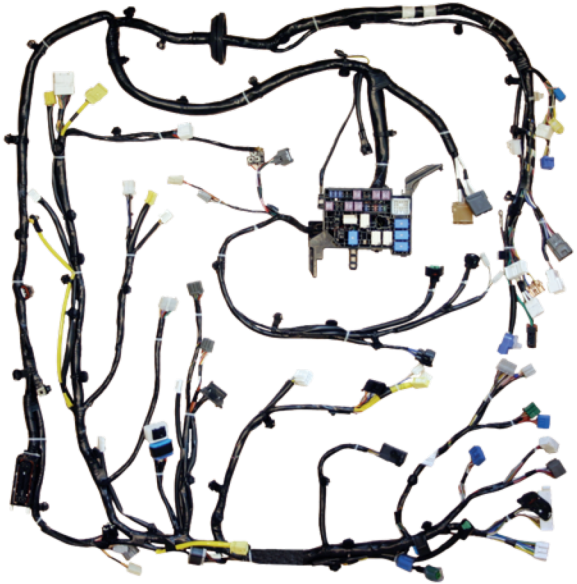


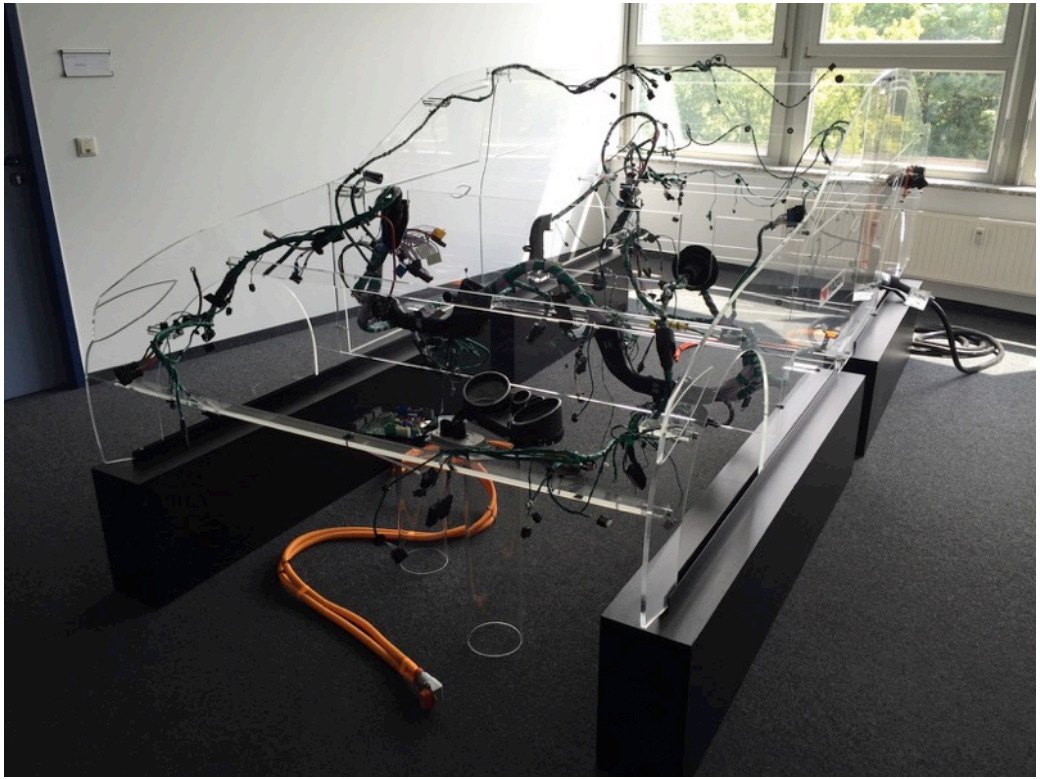
organized domain approach

Ethernet Switch

ECU = Electronic Control Unit

..and: a major paint point in automotive.





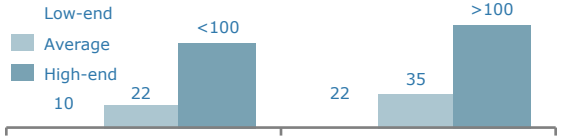
ECU = Electronic Control Unit

Future trends emphasize problematic tendency.

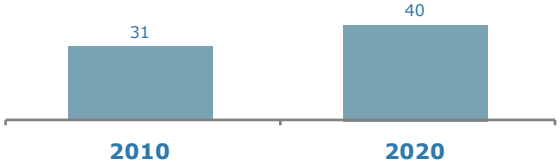
Expected development car electronics

development worldwide intra-vehicle nodes (M#)[1]

average electronic controlling units per car (#)[1]



cost electronic components per car (%)[2]



general cost forecast

wireless cost forecast

ECU

- hardware
- integration
- ECU service/repair

- wireless chips
- less variety

HARNESS

- cabling + plugs
- assembly + checks
- integration

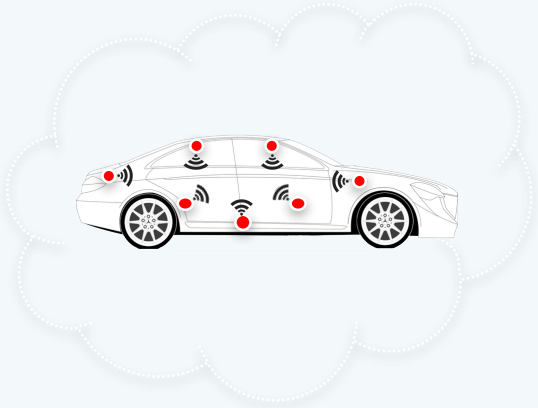
- less cable
- less assembly
- less integration

MISC

- total vehicle weight
- architectural flexibility
- quality assurance

- less hardware
- easy add-ons
- easy fault analysis

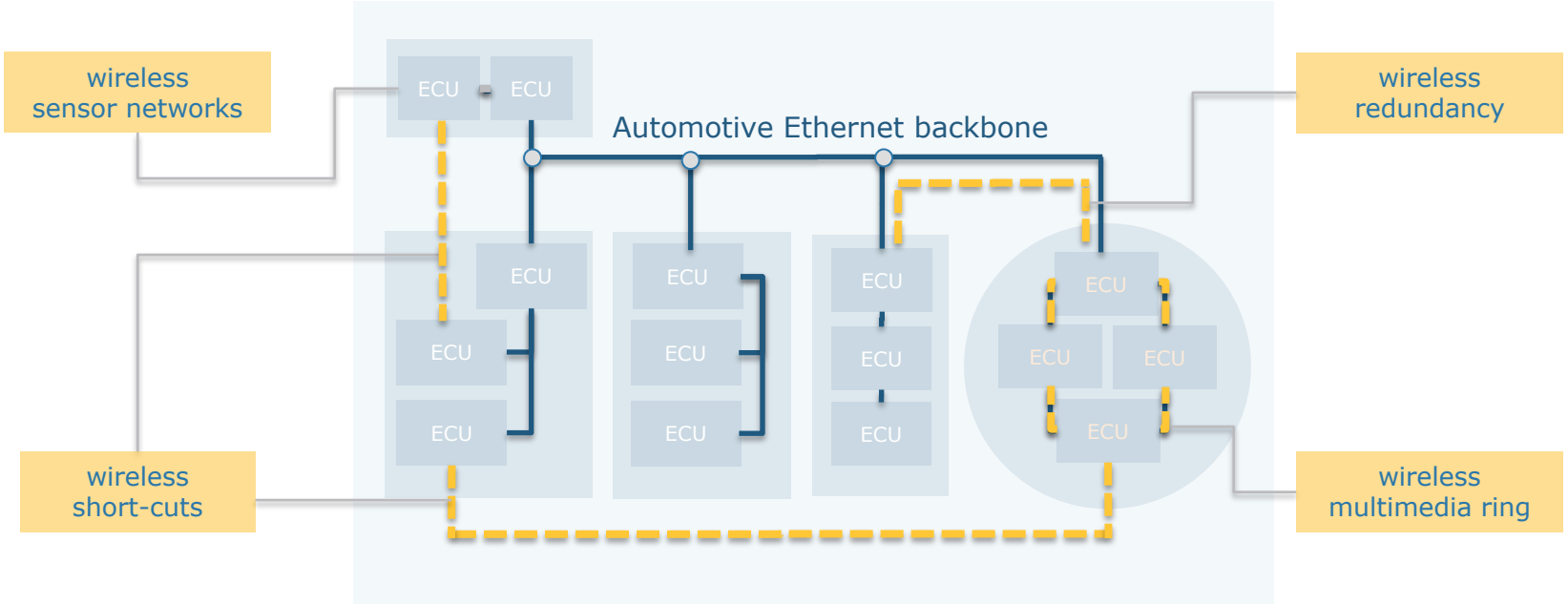
Vision – intra-vehicle reliable wireless network…



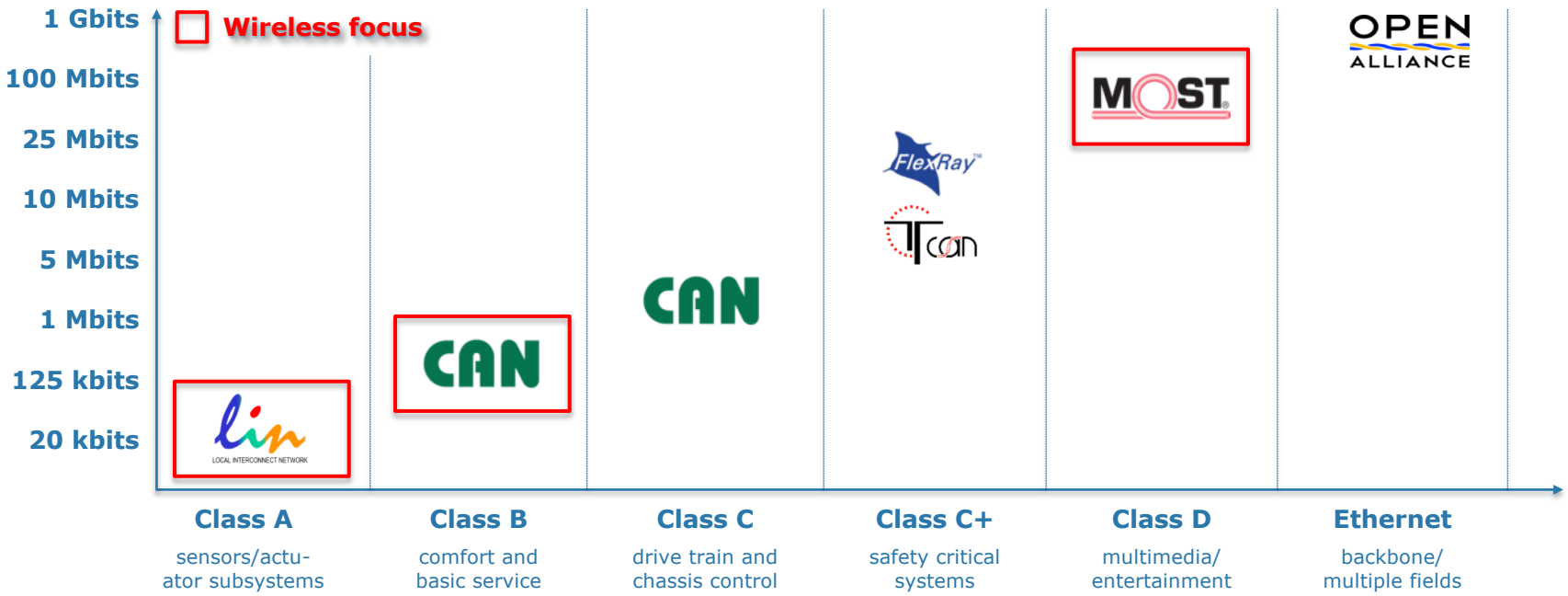
intra-vehicle communication via wireless harness solution (e.g. short cuts/redundancy)

1. high flexibility and less complexity
2. easy assembly and integration
3. less total cost compared to cable

... with different application areas.

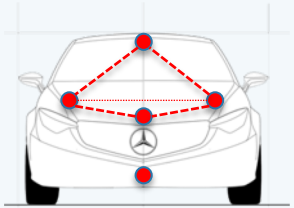


Initial application in non-critical systems.



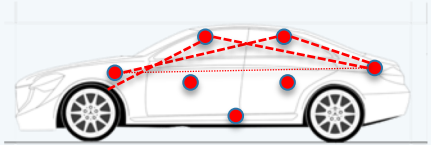
Example – selection of intra-car applications.

front view



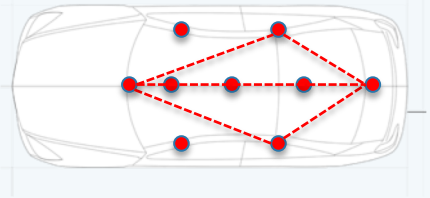
e.g. window regulator transmission

side view



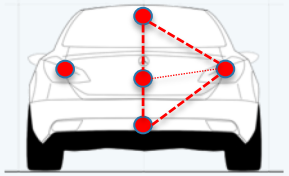
e.g. light control transmission

top view



e.g. rear video signal transmission

rear view



e.g. turn signal transmission

ECU/wireless node direct transmission relay transmission

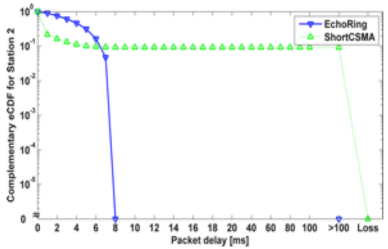
Prototype automotive performance.

parameter

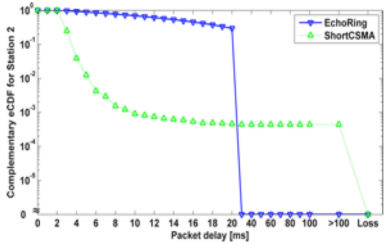
- frequency channel: 5,7 GHz
- transmit power: 0.2-5.0 mW
- payload size: various
- latency: various
- duration: several hours

delay profiles

100 B, 10 ms

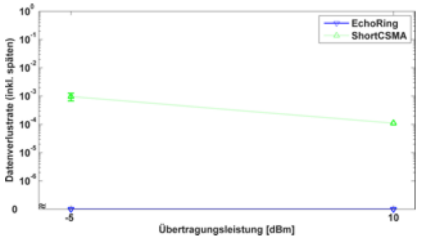


1450 B, 30 ms

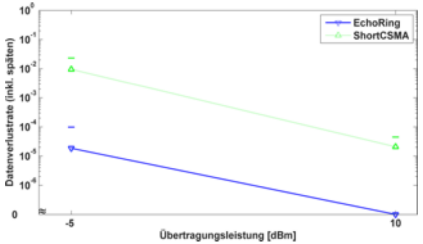


PER results (station 5)

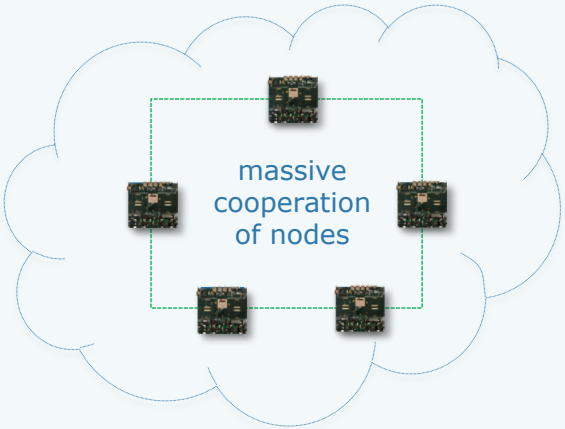
100 B, 10 ms



1450 B, 30 ms



EchoRing™



Logical ring structure
w/ massive cooperation

Wireless Harness

- **A** Today's harness in cars are not fit for the future
- **B** Wireless harness extensions good option to overcome problems
- **C** Wireless systems need high robustness and real-time features
- **D** Co-existence among wireless systems is a must
- **E** EchoRing™ has been shown to provide superior performance
- **F** While being based on COTS hardware and software modifications

THANK YOU!

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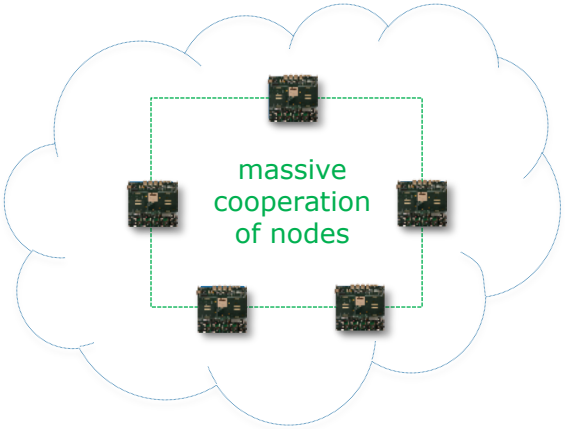
Backup Slides

EchoRing specifics in comparison.

	EchoRing	LIN	CAN	FlexRay	MOST	OPEN ALLIANCE
Area of usage	subnets/soft real-time	subnets	soft real-time	hard real-time	multimedia	multimedia
Application domain	body, chassis, comfort	body	power train, chassis	chassis, power train	multimedia, telem.	Multim., telem., comfort
Transmission	asynchronous	synchronous	asynchronous	(a)synchronous	(a)synchronous	asynchronous
Identification	identifier	identifier	identifier	time slot	-	identifier
Architecture	distributed	single master	multi-master	multi-master	multi-master	distributed
Access control	virtual token ring	polling	CSMA/CA	TDMA	TDMA / CSMA/CA	CSMA/CA, VLAN
Data rate	flexible	20 kbps	1 Mbps	10 Mbps	24 Mbps	100Mbit / 1Gbit
Medium	wireless	single wire	dual-wire	dual-wire/op. fi.	dual-wire/op. fi.	single-twisted-pair
Latency jitter	load dependent	constant	load dependent	constant	data stream	load dependent
Babbling protection	provided	-	not provided	provided	-	-
Extensibility	very high	high	high	low	high	high

Different cooperative systems design available.

basic principle



leveraging instantaneous channel-state knowledge

implementation design

1. EchoRing: Token-based medium access with cooperation
2. synchronous TDMA with decentralized cooperation
3. synchronous TDMA with centralized cooperation

flexible system design for different applications

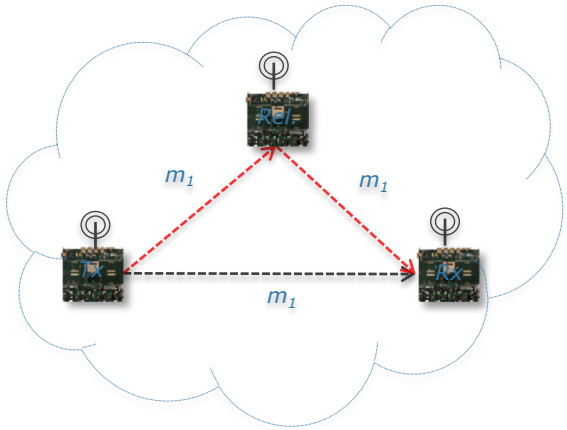
advantages

- extremely high reliability without modifications of the PHY
- software realization on standard COTS transceivers
- potential combination with other reliability enhancing mechanisms

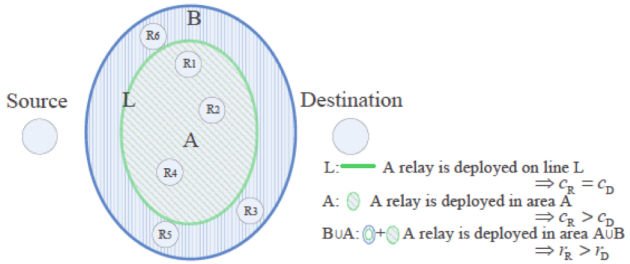
hardware/PHY agnostic technology

Relaying and low latency.

system model



research results

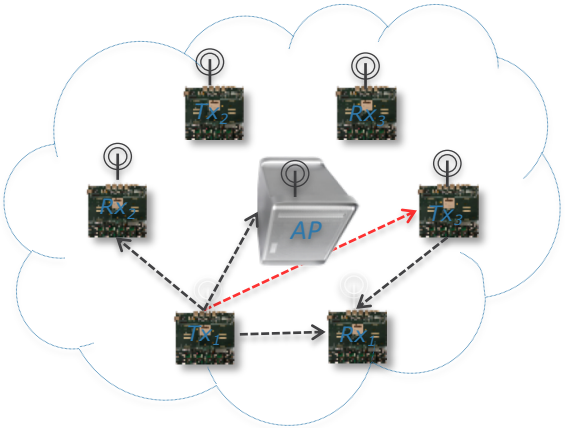


relaying gain: Higher robustness for fixed deadline

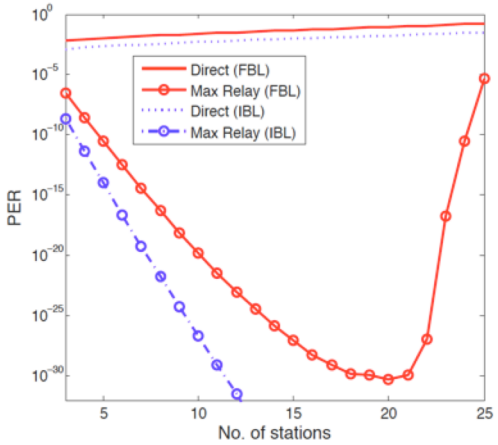
Source: Y. Hu, J. Gross, "On the Performance Advantage of Relaying Under Finite Blocklength Regime" IEEE Comm. Letters, in press, available online

Cooperation and low latency.

system model



research results



cooperation gain: Higher robustness with higher load at fixed latency

Source: Y. Hu, J. Gross, et al. "Finite Blocklength Performance of Multi-Terminal Wireless Industrial Networks", submittted