Dirk Rossberg

ETHERNET – THE STANDARD. NOW IN THE CAR.

DR DIRK ROSSBERG, BMW GROUP TECHNOLOGY OFFICE USA
IEEE, JULY 2012

BMW GROUP

BMW GROUP TECHNOLOGY OFFICE USA

MISSION AND VISION STATEMENTS.

We scout for, evaluate and develop cutting edge technologies with US partners for the BMW Group.

- Continuously explore technology
- Identify upcoming trends and opportunities
- Build prototypes for proof of feasibility
- Develop promising innovations into products
- Transfer technology to our internal partners
- Contribute the BMW Group's Product Strategy
- Represent BMW Group Research and Technology in the

We contribute innovative solutions to support BMW Group's technology leadership now and in the future.

BMW GROUP TECHNOLOGY OFFICE USA



Core topics

- Trends scouting & technology partnerships
- Sustainable mobility
- Driver assistance systems
- Design for user experience
- Connected platform solutions

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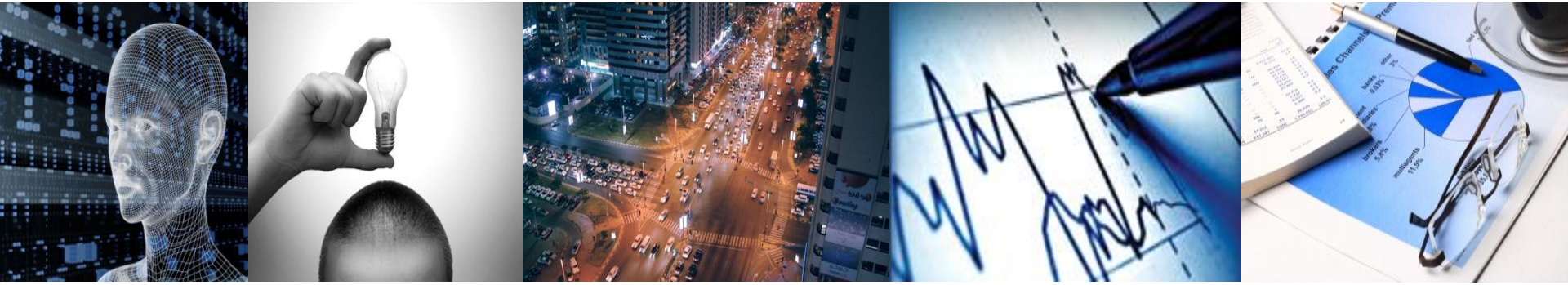


Connected platform solutions

BMW APPCENTER MOUNTAIN VIEW.
BMW AND MINI CONNECTED.

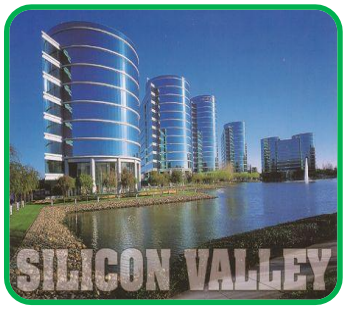
Brand specific feature set within the BMW / MINI App:

– Web Radio (both)
– Twitter (both)
– Facebook (both)
– Google Local Search + Send to Car (MINI)
– Last Mile Navigation (both)
– Mission Control (MINI)
– Dynamic Music (MINI)
– MINIMALISM Analyser (MINI)
– Calendar (BMW)

BMW APPCENTER MOUNTAIN VIEW.
3RD PARTY APPS.

- **New Partners:**
- Pandora – personalized Radio
- MOG – Music on demand
- **BMW Group in a new Role:**
- New Relationships
- New Development-Process
- BMW providing Development Kits

BMW APPCENTER MV.
GLOBAL NETWORK FOR SOFTWARE EXCELLENCE.



AppCenter
Mountain View

AppCenter
Munich

AppCenter
Shanghai

The Challenge

Shared Roadmap

Shared Technology and Tools

Shared Culture

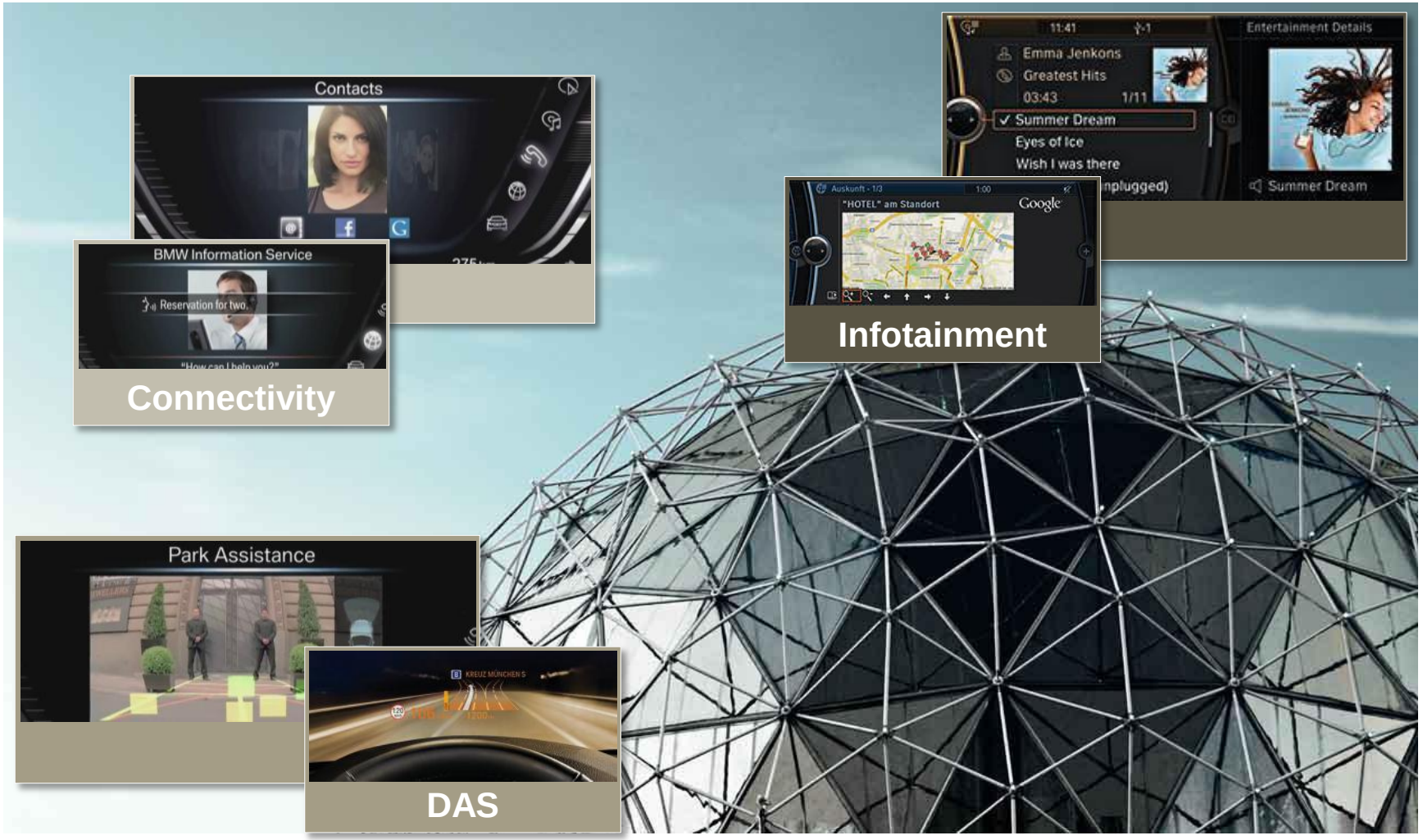
Differentiated Products

Different Markets

Different Timezones

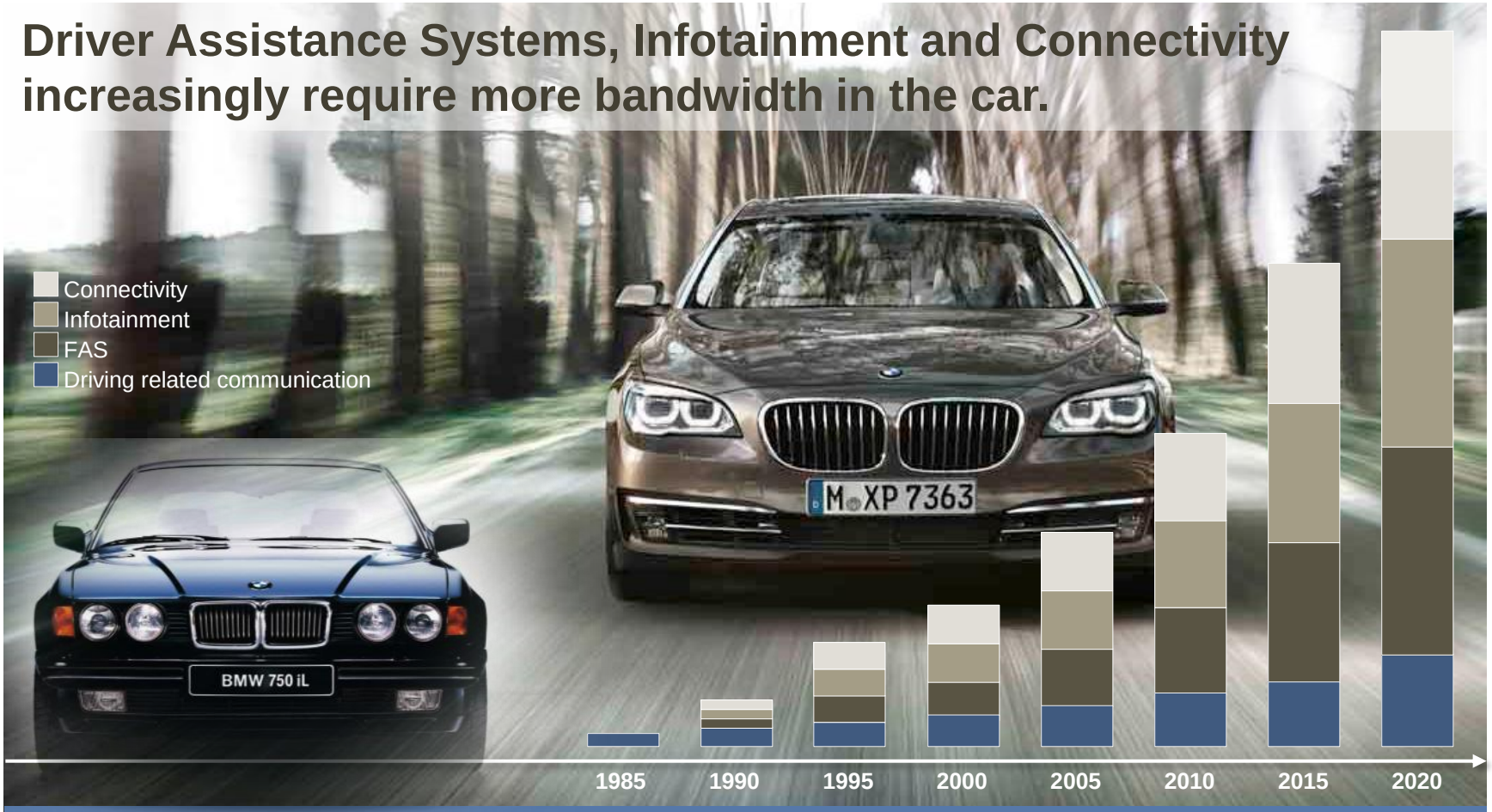
ETHERNET – THE STANDARD. NOW IN THE CAR.

CONNECTCTIVITY AS A BASIS FOR THE INTELLIGENT MOBILITY OF TOMORROW.



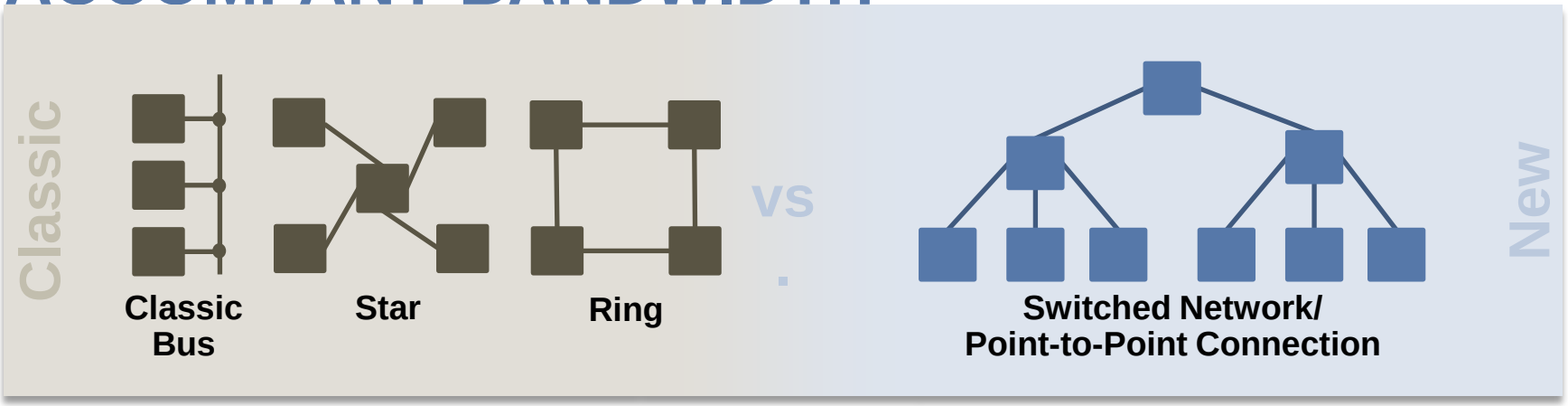
INNOVATION REQUIRES A STABLE INFRASTRUCTURE IN THE CAR.

Driver Assistance Systems, Infotainment and Connectivity increasingly require more bandwidth in the car.



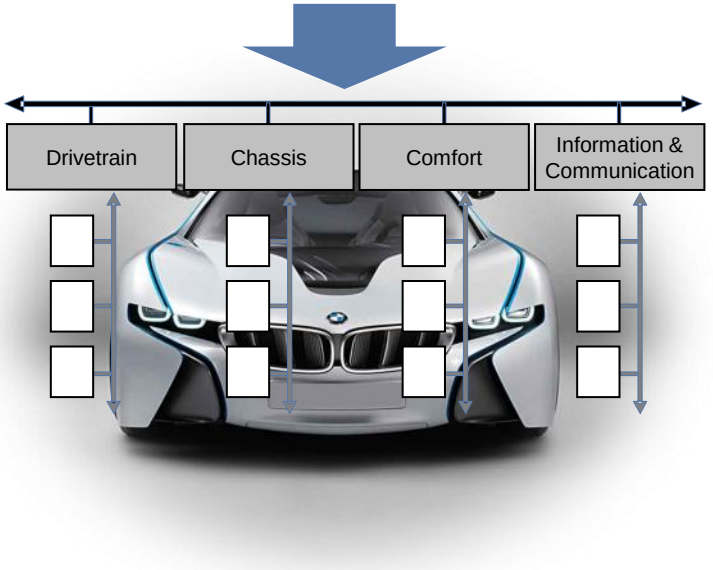
Connected Functions bring with them new challenges for the E/E archticture .

FOR MAXIMIUM PERFORMANCE, AN EFFICENT E/E ARCHITECTURE IS NECESSARY TO ACCOMPANY BANDWIDTH



Future BMW E/E Architecture:

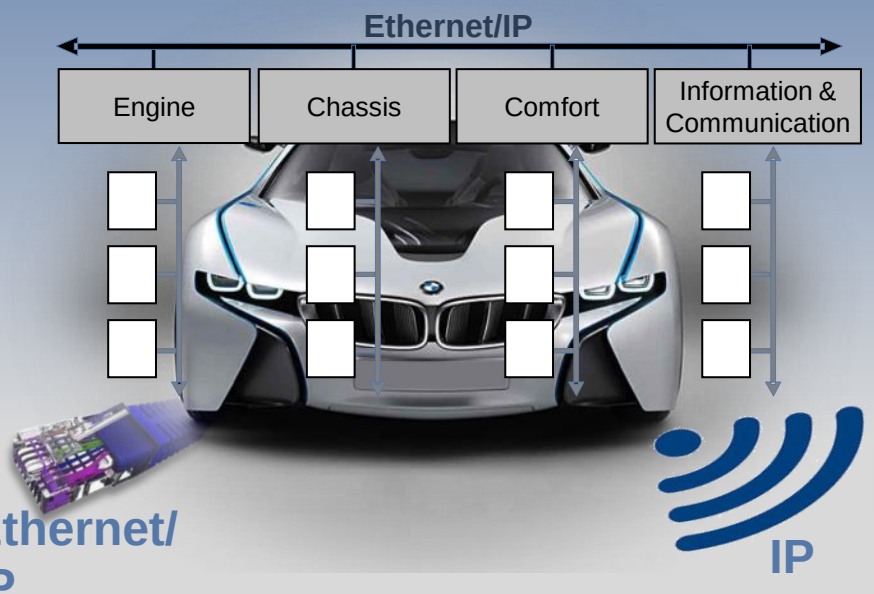
- Hierarchisation and stable interfaces
- Functional separation
- Separation of BMW and industry building blocks
- Scalability across all derivatives and configuration variations
- Subsystems



ETHERNET/IP @ BMW: ETHERNET IS A KEY COMPONENT OF FUTURE E/E ARCHITECTURE.

Communication Backbone

A powerful Ethernet/IP backbone connects functions domains within the car.



Diagnose/ Update.

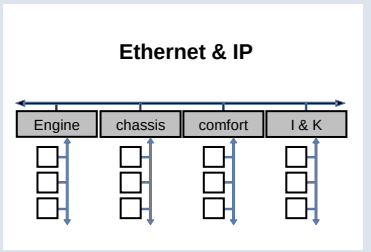
Connection between testers und ECUs via IP. Quick flashing and updating via OBD Ethernet interface.

Car in the cloud.

Connection to IP-based communication devices and applications, as well as with cars and infrastructure (Car2X).

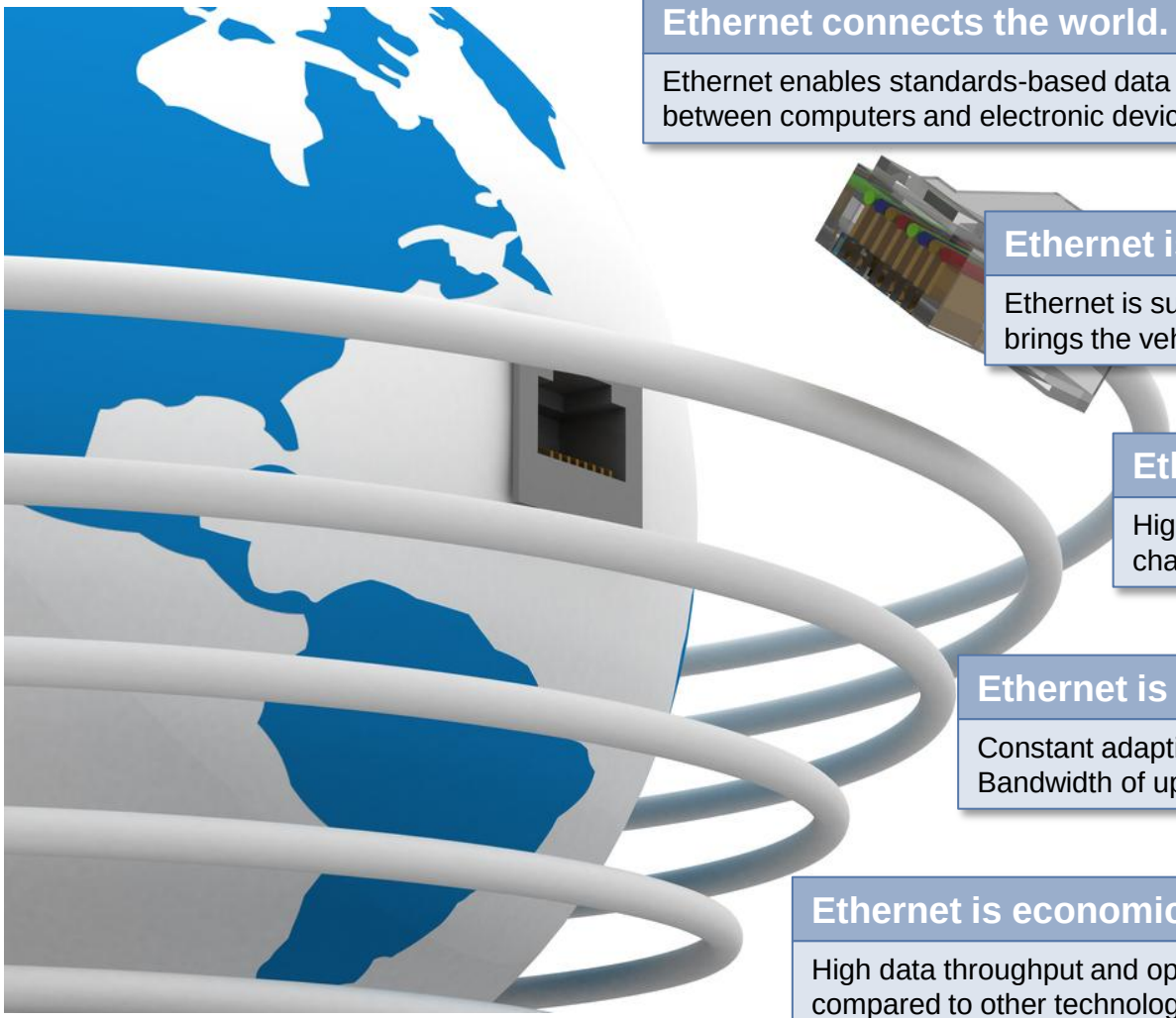
Ethernet/IP serves as a communication backbone inside of and outside of the car.

ETHERNET/IP @ BMW: WORK WITH ETHERNET AT BMW BEGAN IN 2008.

2008	2013	2015	2018
			
			
Vehicle Programming	Transfer of Video Data	System bus for Infotainment & DAS Systems	Ethernet as a Communication Backbone.

Ethernet at BMW. Current applications and outlook for 2013, 2015 and 2018.

ETHERNET/IP FULFILS ALL REQUIREMENTS OF FUTURE DATA NETWORKS.



Ethernet connects the world.

Ethernet enables standards-based data transfer between computers and electronic devices.

Ethernet is compatible.

Ethernet is suitable for all sorts of applications. Ethernet brings the vehicle and the IT world together.

Ethernet is scalable.

High scalability across the physical layer without changes to transmission protocols.

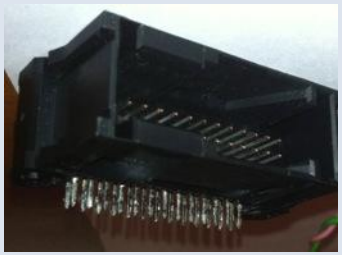
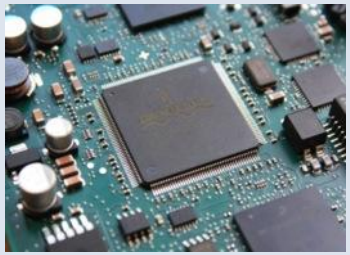
Ethernet is future-friendly.

Constant adaption to new technologies and requirements. Bandwidth of up to 10 GBits/s already possible.

Ethernet is economic.

High data throughput and optimal cost-benefit ratio compared to other technologies.

TECHNICAL IMPLEMENTATION OF THE ETHERNET STANDARD IN THE CAR.

IT Standard		Automotive Standard
 CAT5	Cables	 Unshielded Twisted Pair
 RJ45	Plugs	 MQS
 Stand Alone Switch	Switches	 Integrated Switch

Ethernet is suitable for automotive use with only minor adjustments.

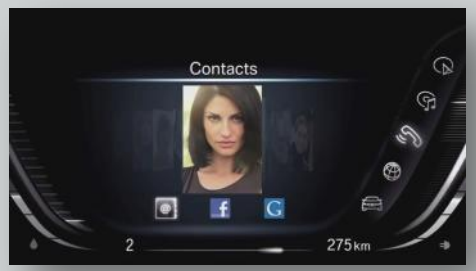
ETHERNET/IP – SCALABILITY AND INTEROPERABILITY.

Customer Experience.
Innovative E/E applications bring a value-add for customers

Infrastructure.
More systems result in higher cost

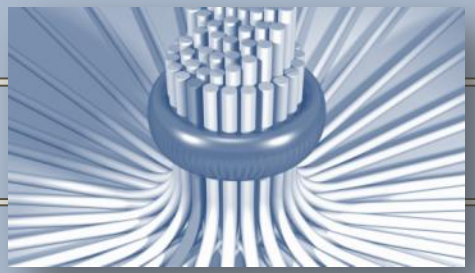
Customer Functions

Layer 5 - 7 | Application



Infrastructure

Layer 4	Transport		
Layer 3	Network		
Layer 2	Data Link		
Layer 1	100Mbit	1 Gbit	…



Standardised protocols and a scalable Physical Layer enable interoperbility and flexibility in meeting future bandwidth requirements.

ETHERNET IS THE DATA NETWORK OF THE FUTURE FOR MANY OEMs AND SUPPLIERS.

Slide will not be sent on Monday

"Ethernet/ IP will replace MOST as a bus system in the medium term. The complexity in the car will be manageable as we will have fewer bus systems and can connect the various functions more effectively."
Dr. Daniel Herrscher, Project IT Drive, BMW.

"…Volkswagen is creating the technological basis for the use of ethernet as the broadband bus technology in future cars."
Dr. Ulrich Hackenberg, Brand Director of Development, VW

"The car will become a node in the web."
Elmar Frickenstein, VP E/E, BMW.

"We need flexible and cheap connectivity solutions in our car network which can fulfil the increasing requirements of our customers."
Sachin Lawande, CTO, Harman.

"Ethernet, with its time synchronisation features, is suitable for all domains in our cars. BMW is the first OEM/automaker to bring this technology to the car."
Helge Zinner, Architecture/Data Network, Continental.

"With Ethernet, BMW is heading in the right direction. Even the development of other bus systems costs money. Therefore it makes sense to utilise an independent, standardised system, which can meet the challenges of the future."
Christoph Dallmayr, Branch Manager Munich, Vector Informatik GmbH.

Dr. Dirk Rossberg, BMW Group Technology Office USA.

ETHERNET – THE STANDARD. NOW IN THE CAR.

Standards create space for innovation. BMW focuses on standards.

Giuseppe Mascolino, EI-3.

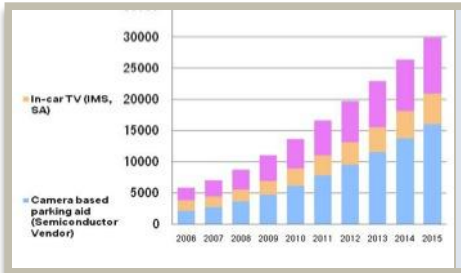
THANK YOU FOR YOUR ATTENTION.

ETHERNET – THE STANDARD. NOW AVAILABLE IN CARS.
DR DIRK ROSSBERG, BMW GROUP TECHNOLOGY OFFICE USA

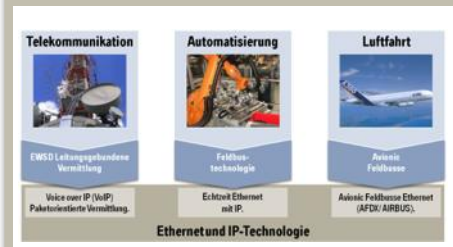
BMW GROUP

BACKUP SLIDES (INTERNAL ONLY).

ETHERNET AND IP ARE THE COMMON BASIS AS THE COMMUNICATION BACKBONE OF THE INDUSTRY



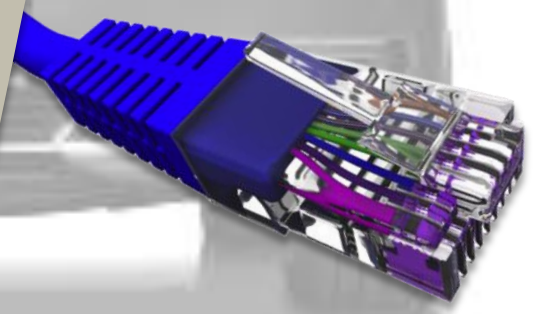
Future-orientation.
- High bandwidth (up to 10GBit/s).
- Extensible & compatible.
- Separation of ISO/OSI layers.



Established industry standard.
- Standard Ethernet can be used for software and microcontrollers.
- Physical Layer suitable for automotive.

Risk minimisation via pilot phase.
- First pilot use as a video connection in XNF models in 2013.

Ethernet
as a system bus.



Ethernet, an industry standard, is suitable for use in cars.

ETHERNET CONNECTS THE WORLD.

Telecommunication

Voice over IP (VoIP) Packet-oriented Communication.

Automation

Realtime Ethernet with IP.

Aerospace

Avionic field busses (AFDX/ AIRBUS).

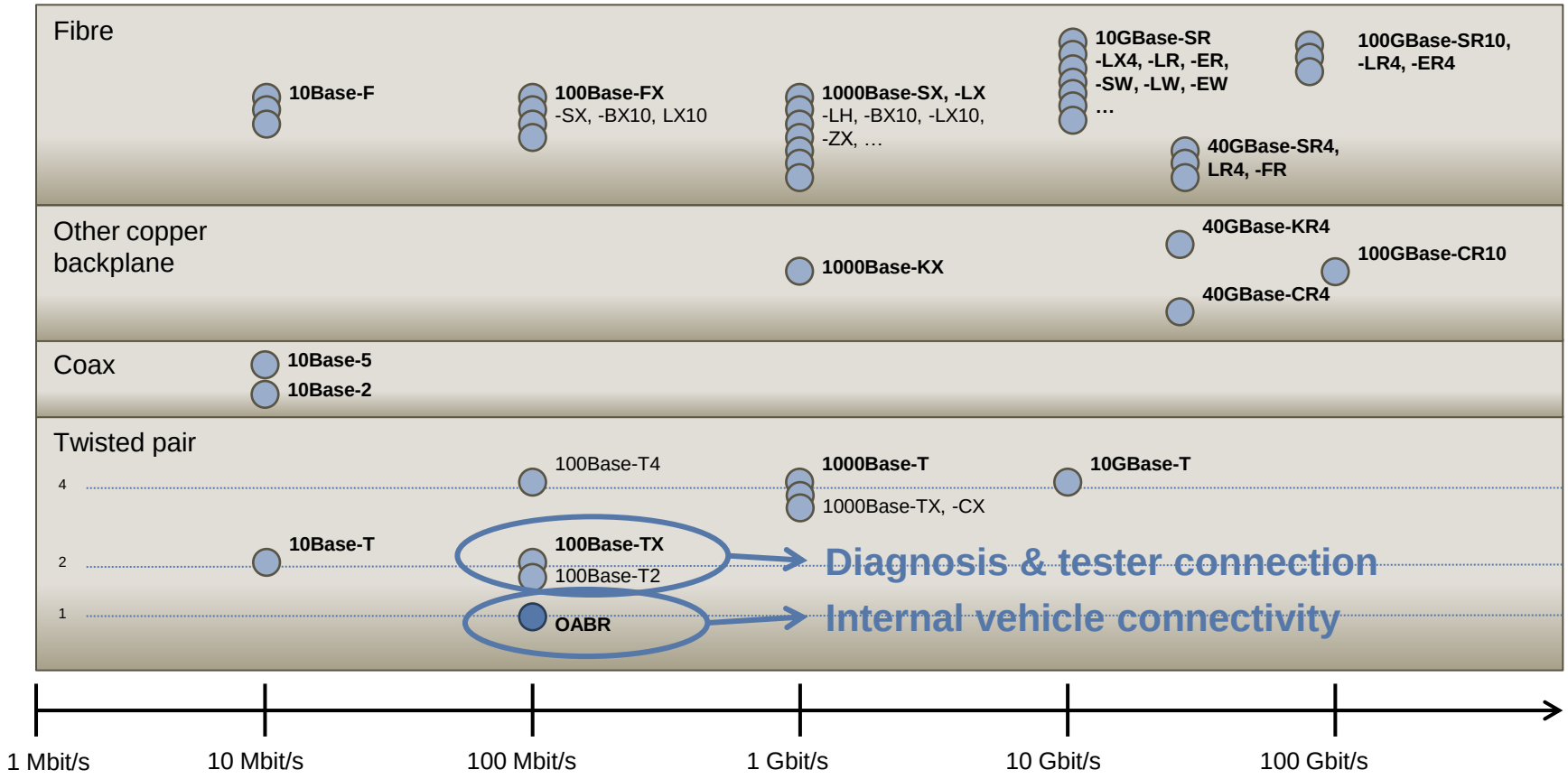
Automotive

UTP-Ethernet based on OABR Physical Layers.

- Multiple automotive requirements (e.g. EMV) are fullfilled by OABR Physical Layer.
- Layer separation and standards like AUTOSAR allow for use in automotive, using standard IT protocols and communication sequences.
- Ethernet/IP simplifies the use of IT related standard components in the car.
- UTP-Ethernet is suitable for automotive use.

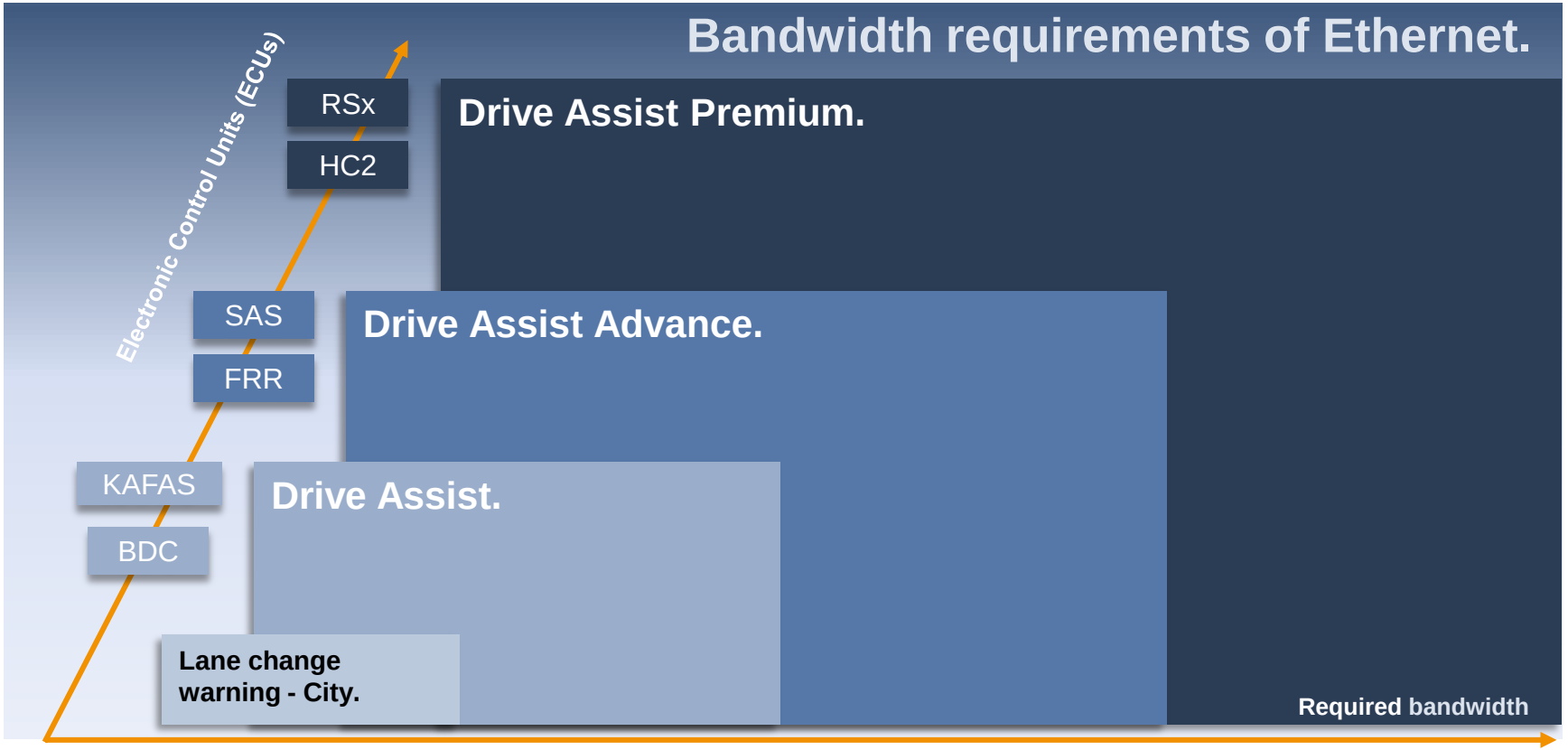
The Ethernet standard, used in multiple industries, is coming to automotive.

THE PHYSICAL LAYER. AN OVERVIEW OF VARIOUS SOLUTIONS.



A diverse number of physical layers for Ethernet exist. Open Alliance BroadR-Reach (OABR) is one solution. Physical layers are easily exchanged.

DEMAND OF BROADBAND ALTERNATIVES FROM 2015. LIMITS LIE AT DRIVER ASSISTANCE SYSTEMS.



Ethernet Communication (BDC) is supplied with a customer order of Drive Assist. The number of ECUs is based on the appropriate configuration level according to the extras (SA) list. With CAN networking, the config level Drive Assist Premium would not be possible.