
era
CONTACT

era-contact: IP network backbone with era-transceiver®

1 GBit/s communication over automatic couplers

25.11.2009

Railway interior, Cologne

Dr. Thomas Paral, CTO aichele-group

Content

era-contact

1928
Foundation of FABEG as AEG subsidiary

The success story of era-contact Germany started with the production of steam turbo generators to generate electricity to substitute petroleum lighting.

1932
First electric coupling on track for the tram line Zwickau.

Start of cooperation with Scharfenberg

1946
New start-up of FABEG in Bretten.

FABEG

2000
era Group take over the part of „electric coupling" from Schaltbau. Foundation of era-contact in Bretten. Shifting of cable harnessing from Herrenberg to Bretten

Cooperation with Voith Turbo Scharfenberg.

era contact

2006
Reorganisation of era group

aichele GROUP

Today 80 years after, era-contact Germany is a global player with production sites on three continents (Germany, Tunisia, China) with over 450 employees.

OUR SUCCESS STORY...

Our products and solutions

ELECTRIC COUPLING SYSTEMS

- Automatic couplings
- Permanent (short) couplings
- Hand couplings
- Jumper cablesl

CONTACT SYSTEMS

- Pusch-pusch
- Fixed-mobile
- Male-female
- Coax (single, twin, quartax)
- Optical rado link transmission
- Break / open contact
- Earthing contact

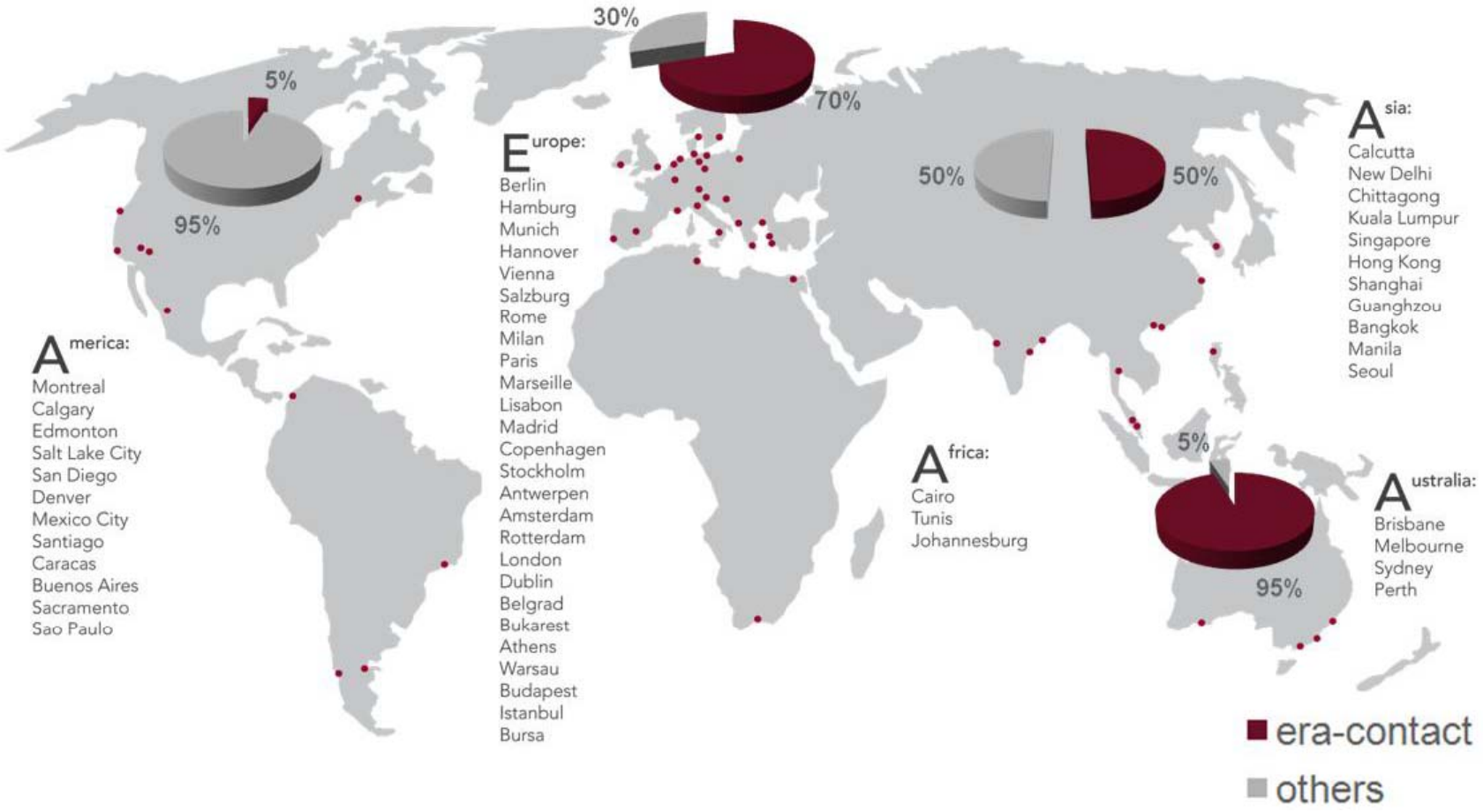
CABLE SYSTEMS

- Cable harnessing
- Cabel sets for components
- Cable sets for vehicles (top, botton or side modules)
- Development and optimising of customer specific cable layouts in complex assemblies

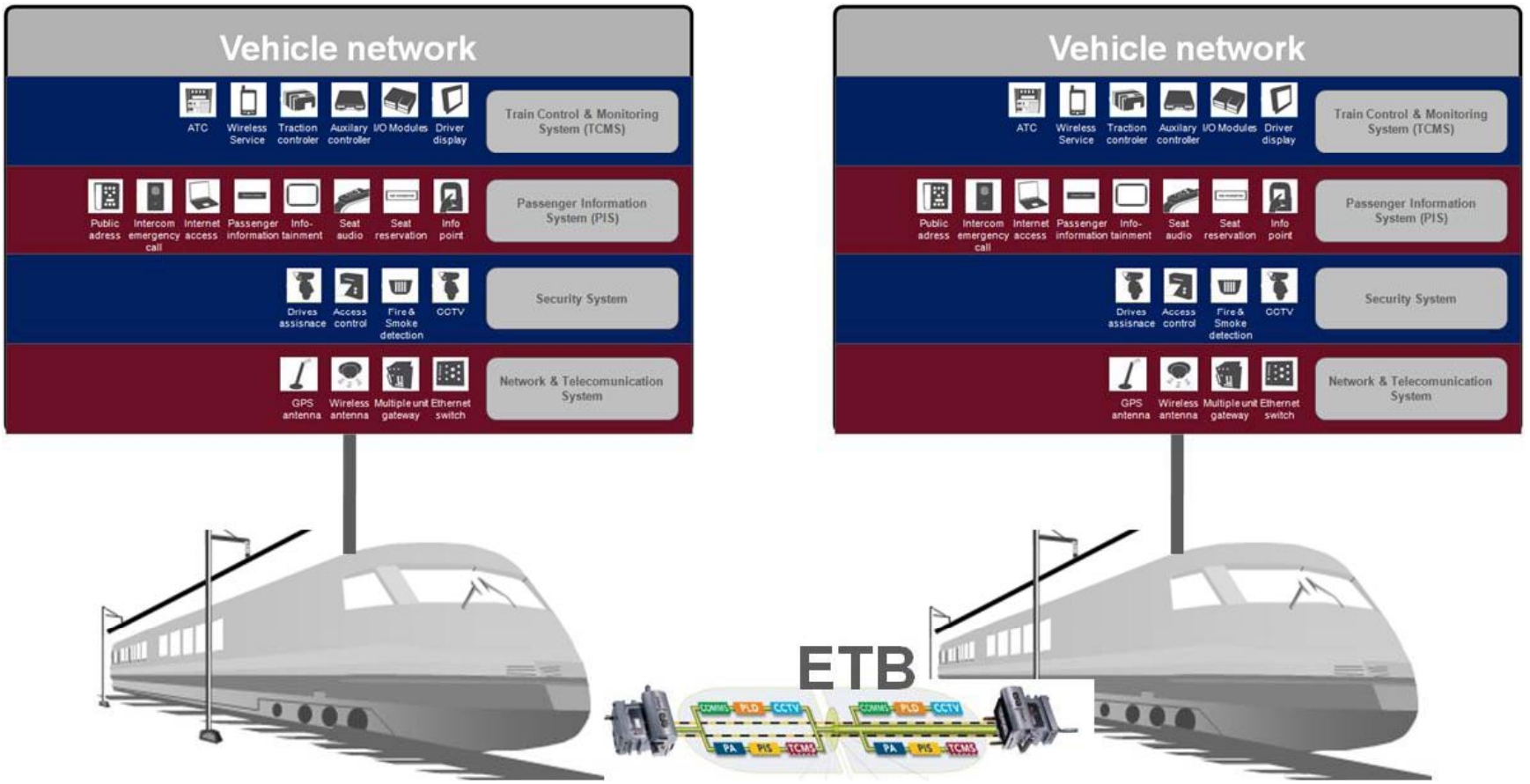
ELECTRO MECHANIC SYSTEMS

- Micro controls
- Switches
- Switching cabinets
- Underfloor switching boxes
- Driver desks (harnessing)

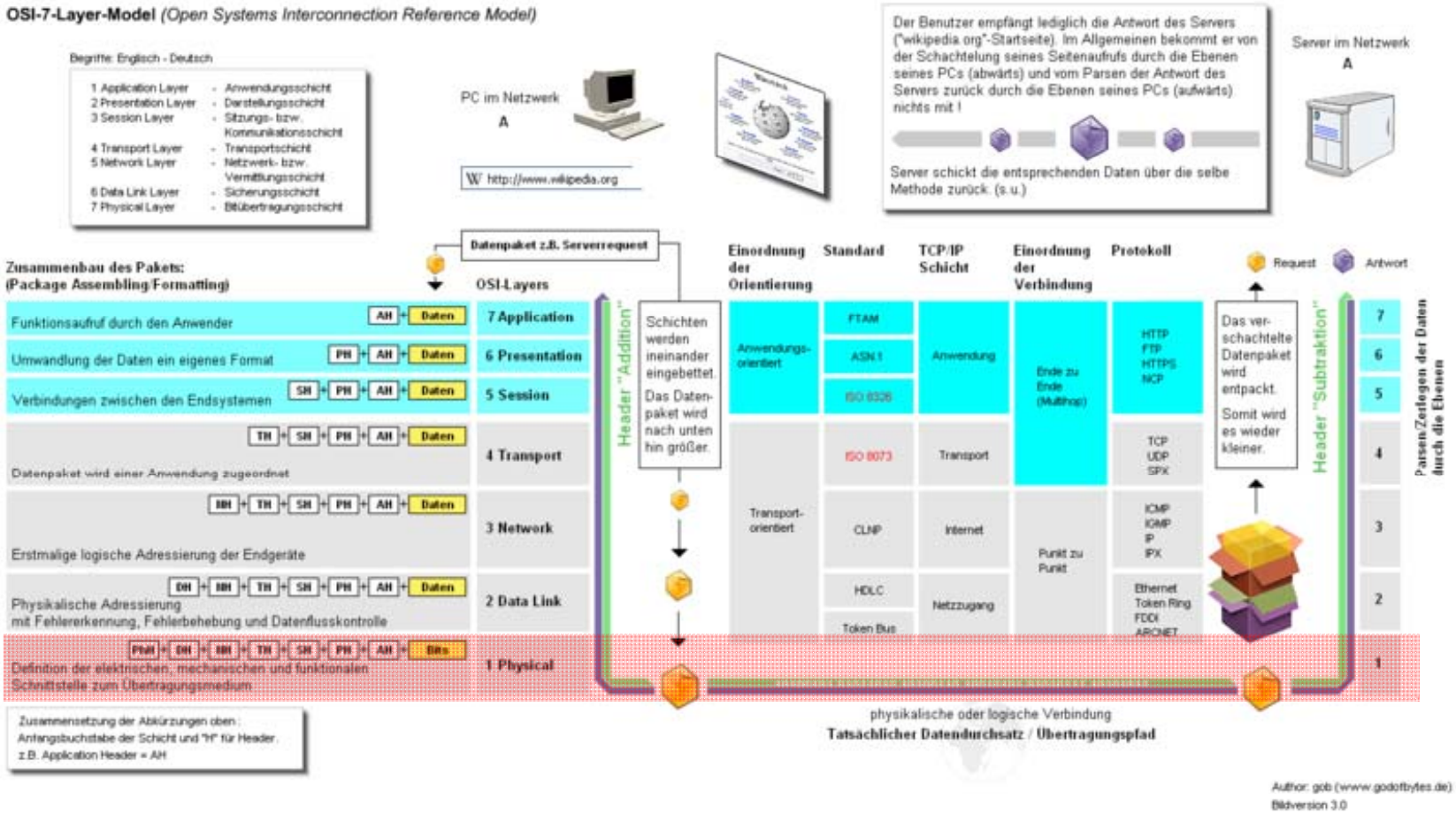
Technology and market leader in automatic couplers



The aimed applications is the transmission of

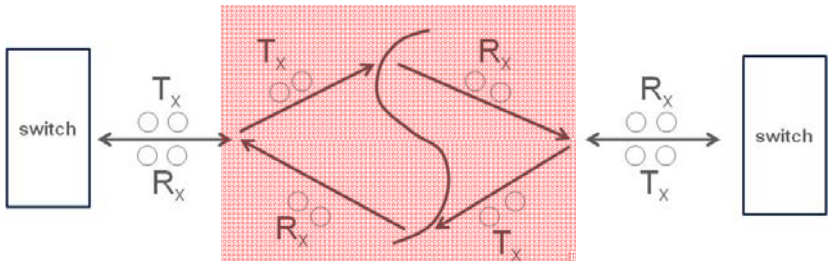


The IP application

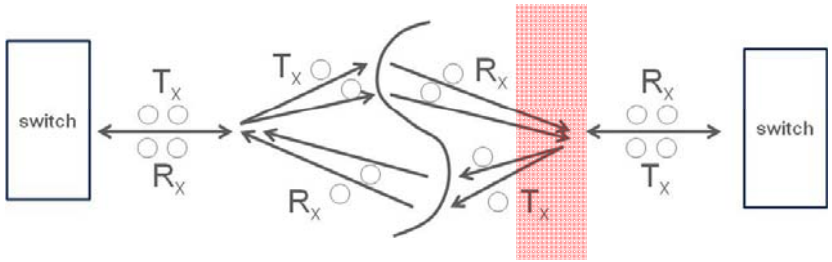


Existing wired solutions

- Shield is connected on one side of electric coupler
- Cross cable connection
  - golden male-female contact



  - era-quartax D22

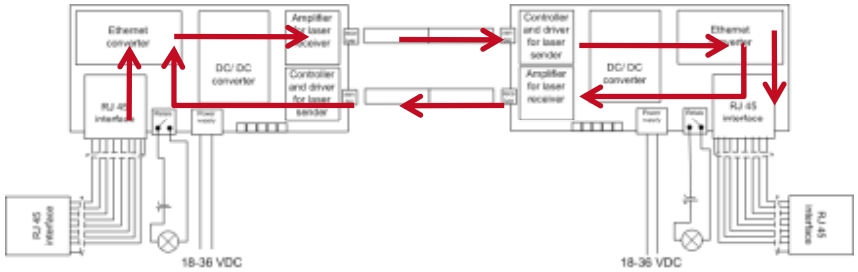


Consequences

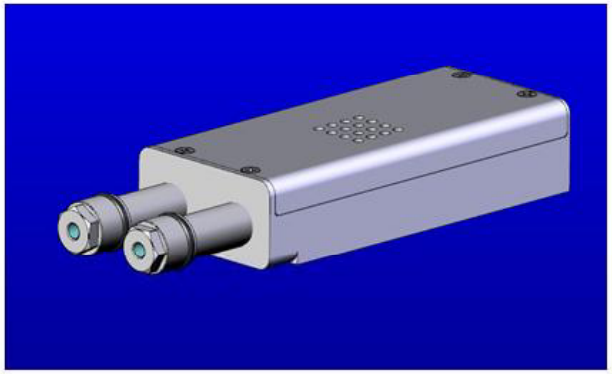
- Shielding is not in line with IEEE 802.3
  - No defined impedance
    - Because of shielding concept
  - High bit failure rate because of package loss
    - Through radiation between Tx and Rx
    - Through radiation because of interference
- Quality of service is not in line with IEEE 802.3
  - Reduced bandwidth
    - Because of package loss
- Additional costs for intelligent switch for Fast-Ethernet IP transmission
- Not applicable for Gigabit-Ethernet IP transmission!

Concept of era-transceiver®

- The patented concept is based on the conversion of the physical Ethernet signal into an optical radio link signal
- This radio link signal is transmitted and received by laser diodes
- After receiving the radio link signal is re-converted into a physical Ethernet signal
- The electronic prove the existing full duplex mode loop before the transmission of the data is started
- The transmission in in line to IEEE 802.3



Data sheet *era-transceiver*® family



Optical dara:

Optical receiver		Optical emitter	
Sensitivity:	ca.-24 dBm	Transmitting power:	+0 dBm
Angles of reception:	± 18 °	Laser class:	1M
Dynamic range:	24 dB	Sampling angle:	± 7 °
Wave length:	850 nm	Wave length :	850 nm

Interfaces: 100 BaseTX: RJ 45, M12 (12/ 2009)
100 Base FX: SC multimode 1310 nm
1000 Base Fx SC multimode 1310 nm (12/2009)
1000 Base Tx RJ 45 (03/ 2010)

General data:

Power supply:	24 V DC	Life time cycles:	500 000 h
Electric strength:	3,5 kV	Data rate:	brutto 150 MBit/s
Power consumption:	< 5 W	Bit failure rate:	$< 10^{-12}$
Radial contact tolerance:	± 10 °	Operating temperature:	-25 (-40) ... 85 °C
Weight:	approx 236 g	Max. temperature:	80 °C

era-contact GmbH, Gewerbestrasse 44, D-75015 Bretten, Tel.: +49-(0)7252-971-0, Fax.: +49-(0)7252-971-200, www.era-contact.de, e-mail: contact@era-contact.de

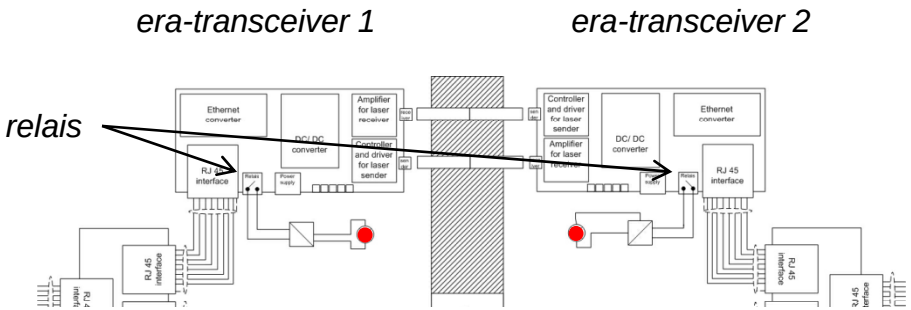
Automatic failure identification

To fulfill requirements of transmitting SIL 4 signals the *era-transceiver*® has a double intelligent concept of a duplex redundancy

Each era-transceiver® is equipped with a failure relay

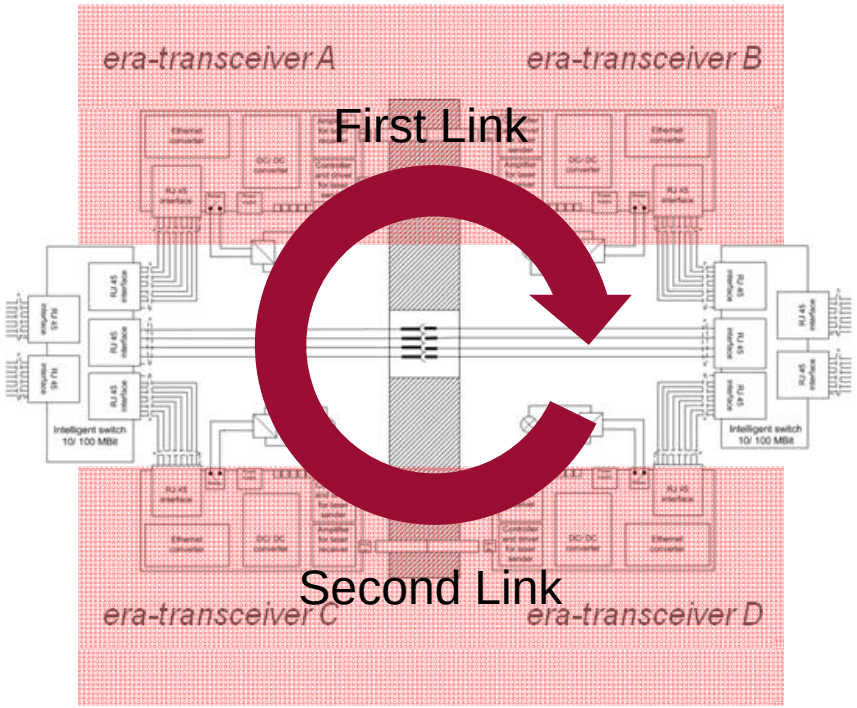
1. If the *era-transceiver*® does not work because of a power breakdown or too much dirt on the contacts, the relay closes.
2. If the *era-transceiver*® receives no answer to his full duplex mode request the relay quits either.

- in case of break down of one component of the era-transceiver® the relay is closing
- this isolated contact can be connected to any control unit to identify the failure and start an safety action



Redundancy

- With the era-switch in both train ends we can ensure a maximum level of operational availability by using the Fast recovery technology
- The era-Switch is checking permanent the state of each era-transceivers® in a ring and transmit a breakdown to the other train end to easy detect the accordant component
  - If both links are active, there is a data rate of 200 MBit/s to transmit data between the trains
  - If era-transceiver® A has a breakdown the second link already transmit the signal with 100 MBit/s
  - The visual signal is transmitted to the driver
- If all four era-transceiver® quits the signals is transmitted through standard gold plated male and female contacts with a reduced 10 MBit/s data rate
  - The visual signal is transmitted to the driver.



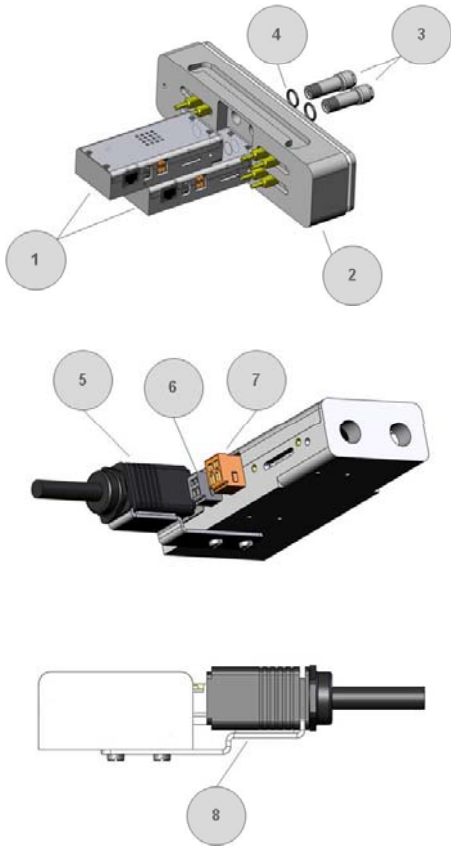
Installation and service

Easy plug and play installation

- era-transceiver® is installed from backside and fixed with screwed contacts from the front side
- CAT5 cable is connected and secured with era-contact strain relief
- Mounting and dismounting is done in minutes

Maintenance

- era-transceiver® is working until 95% of the visible area in the contact area is closed by dirt
- Cleaning with a dry fluffy free glove once a year is recommended
- After six years the equipment is to check and change if performance is not sufficient
  - Test device can be ordered from era-contact Service Department



1 era-transceiver®
2 contact block
3 contacts
4 seal ring
5 connector
6 relay
7 power supply
8 strain relief with tie wrap

Benchmark

	Optical radio link era-transceiver®	era-quartax	Powerline	D-Rex	Geo Fokus	Wirless LAN
Data rate (brutto/netto)	150/100 (1000 / 800)	100/ 80	100/ 15	100/30	100/30	60/ <54
Bit Failure rate (delays)	10^{-12} (delays < 5ms)	Depends on screen			10^{-8}	
transmission media in coupler	era-transceiver®	4-pin coax plus screen	Male-female contacts		Magnetic contacts	Radio link contacts
Cable spec	all CAT 5 / CAT 5e / CAT 6/ CAT 7 cables of all existing supliers	CAT 5e Huber & Suhner / Nexans	2 wires of UIC cable	CAT 5e	CAT 5e	
Connecting device	direct to backbone switch	direct to backbone switch	Powerline modem	direct to back-bone switch	Magnetic link box	Radio link device
IEEE 802.3 compliance	yes	no			yes	802.3 g
Standards	EN50155, EN 50121, RFC 2544, IEEE 802.3,	IEEE 802.3 screen connected	EN 50155			
EMC interference	No because of radio optical link	Yes, bacause of disconnected screen	Yes		no	yes
Upgrade to higher data rates	Yes, limit today 40 GBit	No, limit is 100 MBit	no		possible	no
Installation and service	Easy, by plug and play	Complicated, only with educated service possible				
Link testing	Easy from hand plug to coupler	Expensive hardware necessary				
Redundancy by contact system	Yes, tripple redundancy is possible	No, only by backbone				no
Transmission of SIL 4 IP signals	possible	not possible				Public bandwidth

Test and validiation

- DIN EN 50155 Railway applications - Electronic equipment used on rolling stock
- DIN EN 50121-3-2 Railway applications - Electromagnetic compatibility
- Standard IP test quality of service (QoS)
- RFC 2544: testing of ethernet services in telecom networks
- Mechanical long term stress test

References

Berlin Metro, BVG Germany

- Prototype filed test
- Automatic coupler two vehicles over six month 2006

Mont Blanc Express, SNCF France

- Full 100 Mbit backbone in three trains
- 36 era-transceiver at AC and Jumper
- Start 04/2009 → 100% availability

Overhaul Edmonton U2, Bombardier North America

- Full 100 Mbit backbone in 37 trains
- 74 era-transceiver at AC
- Start 11/2009

Scotrail, Siemens

- Full 100 Mbit backbone in 38 trains
- 228 era-transceiver at AC
- Start 09/ 2010

Flirt Nordhessen

- Full 100 Mbit backbone in 47 trains
- 94 era-transceiver at AC
- Start 10/2009

Advantages era-transceiver®

- IP based systems can be connected easily over standard interfaces (switch, router, hub)
  - no additional device is needed
  - easy mounting and servicing
- World wide unique transmission principle for automatic couplers which is in line with Fast- and Gigabit Ethernet standards (IEEE 802.3)
  - Data rates of 10MBit/s to 2000 MBit/s and more over electric couplings in real time
- Process secure transmission of IP networks
  - by galvanic independent transmission → No EMC impact
  - Failure identification relay &
  - Intelligent integrated redundancy concept (IIR-concept)
- Easy and flexible integration end expansion in and of existing networks by the using of standard IP components
- Mobile easy link tester for problem identification on the track

Questions?

era CONTACT GERMANY
CHINA
TUNISIA
FRANCE
USA

era-contact GmbH Germany
Gewerbestrasse 44
75015 Bretten-Gölshausen
Deutschland/Germany
Phone +49 (0) 72 52 –971-0
Fax +49 (0) 72 52 – 971-200
info.germany@era-contact.de
www.era-contact.de

era-contact Tunisia S.A.R.L.
Boulevard de l´Environnement
Zone Industrielle
7021 Zarzouna/Bizerte
Tunesien/Tunisia
Phone +216 72 – 59 31 57
Fax +216 72 – 59 31 71
info.tunisia@era-contact.de
www.era-contact.com

era-contact (Suzhou)
Co. Ltd. China
Building 21
Gang Tian Road
(Gang Tian Industry Park)
215126 Suzhou
P.R. China
Phone +86 (0) 5 12 6299-1800
Fax +86 (0) 5 12 6299-1830
info.china@era-ct.com
www.era-contact.com

era-contact France
Chez MCM TREUHAND
40 Avenue Georges Pompidou
69003 LYON Cedex
Frankreich / France

era-contact USA, LLC
50 North New York Avenue
Huntington, NY 11743
USA
Phone +1 631 351 - 6993
Fax +1 631 271 - 8274
info.usa@era-contact.com
www.era-contact.com

Thanks for your attention

Dr. Thomas Paral, CTO aichele-group

Mail: t.paral@era-contact.de

Phone: +49-7252-971-130

Back up

Standard railway application tests

DIN EN 50155 Railway applications - Electronic equipment used on rolling stock

- Function test (EN 50155, article 10.2.2) ✓
- Insulation test (EN 50155, article 10.2.9) ✓
- Cooling test (EN 50155, article 10.2.3) ✓
- Dry heat test (EN 50155, article 10.2.4) ✓
- Damp heat test, cyclic (EN 50155, article 10.2.5) ✓
- Salt mist test (EN 50155, article 10.2.10, class ST4) ✓
- Vibration, shock and bump test (EN 50155, article 10.2.11, class B) ✓
- Performance test (EN 50155, article 10.2.11, class B) ✓
- Equipment stress screening (EN 50155, article 10.2.13, class 2) ✓

Standard railway application tests

DIN EN 50121-3-2 Railway applications - Electromagnetic compatibility

- Transient burst susceptibility test (EN 50121-3-2) ✓
- Radio interference test (EN 50121-3-2) ✓
- Interference resistance vs. surge (EN 61000-4-5) ✓
- Interference resistance vs. electrostatic discharge (EN 61000-4-2) ✓
- Interference resistance vs. transient burst (EN 61000-4-4) ✓
- Interference resistance vs. disturbance HF (EN 61000-4-6) ✓
- Interference resistance vs. electromagnetic HF-field (EN 61000-4-3) ✓

Standard IP tests quality of service (QoS)

Windows network

- Windows 2003 server,
  - Active Dicertory,
  - Exchange server,
- XP prof. clients
  - Office 2003 aplication

Test duration: 100 h

Work with

- different programs
- Permanent sessions

Result

- While working and during all sessions no interruption was detected
- 100% availability
- No signal loss
  - Bit failure rate < 10^{-12}
- No difference between CAT 7 wire and era-transceiver
  - Average latency[1] < 4 ms
- Test passed ✓

CAT 7 wire

era-transceiver

[1] latency is given by the used switches und transmission media (cables and era-transceiver)

RFC 2544: testing of ethernet services in telecom networks

Sending and receiving data are 100% equal

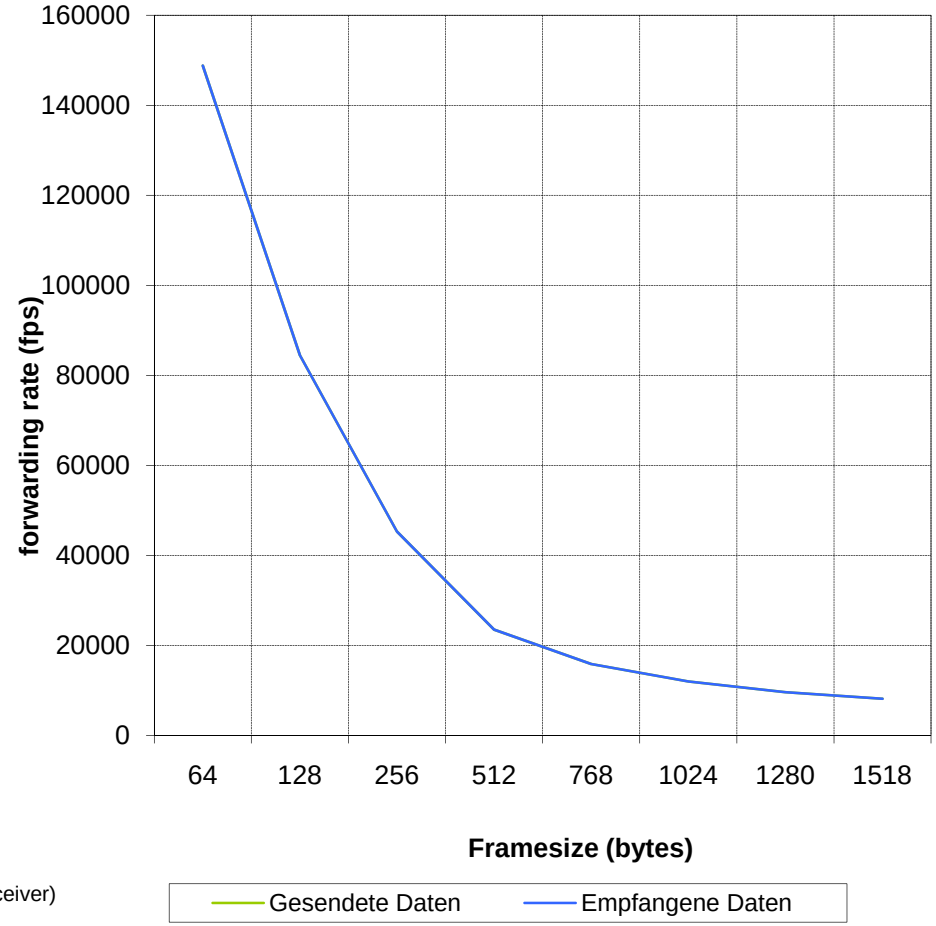
Average latency[1]: 3,5 ms

No error

100% availability

Bit failure rate < 10^{-12}

Test passed ✓



[1] latency is given by the used switches und transmission media (cables and era-transceiver)

Mechanical long term stress test

Duration

- 2 month
- 24 h per day

Actuator

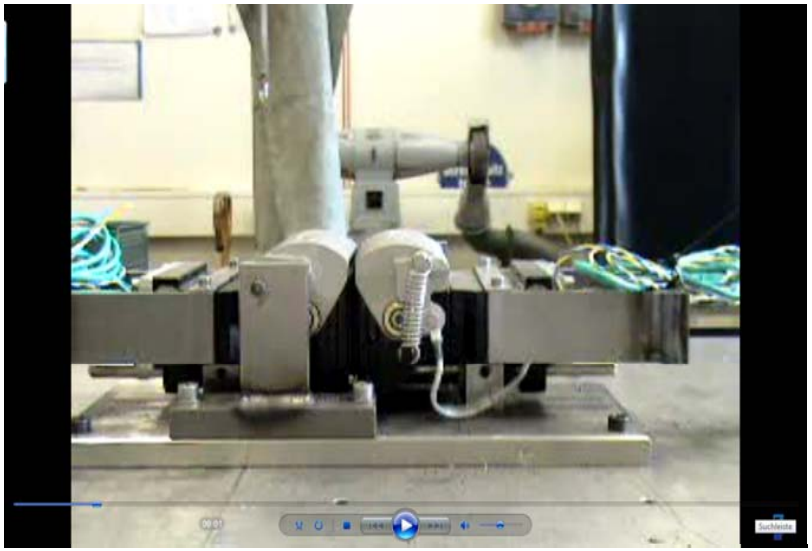
- pneumatic 10 bar direct in line

Break down

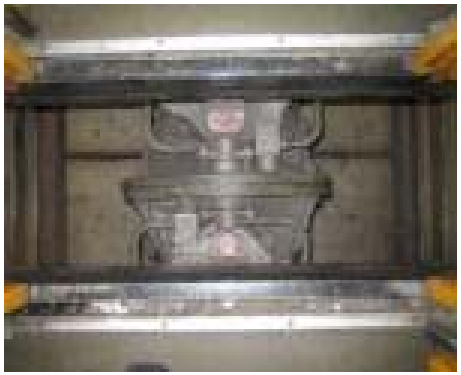
- after 160.000 coupling cycles

Result

- 5 coupling cycles per day
- 365 days per year
- life time ~ 80 years



Berlin metro



Test environment

- Metro Berlin (BVG)
- Vehicles 273 and 279

– Automatic electric coupler
  – *era-transceiver* V2.0

Mont blanc express, SNCF France

- Homologation of era-transceiver for SNCF
- Three Stadler trains with 36 era-transceiver
- Equiped with 100 Mbit full redundant backbone
  - automatic couplers
  - managed switches
  - vehicle wiring
  - jumper cables
  - GPS/GSM controlled
- Start 04/2009
- Duration 12 month

Edmonton, Bombardier NA

- Transmission of
  - CCTV
  - Passenger Announcement
  - Displays
- Full 100 Mbit Backbone with cables and switches
- 37 cars → 74 era-transceiver couplers
- First Delivery 11/2009
- Sub contracted by Bombardier

Scotrail, Siemens

Transmission of

- CCTV
- PIS

Full 100 MBit transmission over coupler

38 trains cars 3 era-transceiver per coupler

→ 114 era-transceiver

First Delivery 09/2010

Flirt Nordhessen, Stadler

- Transmission of
  - PIS
- Full 100 MBit transmission over coupler
- 47 trains cars one era-transceiver per coupler
  → 94 era-transceiver
- First Delivery 10/2009