The future of driving.

Final Event

Brake-by-Wire on Heavy Truck

First Hotel Grand, Borås, Sweden
June 21-22, 2011

Fredrik Seglö
Haldex

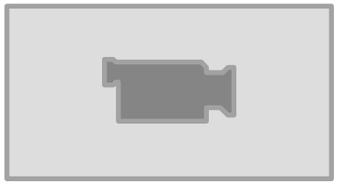
Brake by Wire on Heavy Truck
Motivation

- Increased road transportation with higher traffic intensity.
- Passenger cars and heavy vehicles are sharing the same road infrastructure.
- Rear end collisions is the most frequent accident situation involving trucks in Europe.
- Potential exists for improved braking performance by new technology.
- A full Brake by Wire Truck to be reviewed according to ECE-R13.

Brake by Wire on Heavy Truck
Motivation

Example:

- Conventional electro-pneumatic brake system (left)
- Brake by Wire system using Electro-Mechanical Brakes (right)
- Full braking from 55 km/h on wet asphalt.



Brake by Wire on Heavy Truck
Project objectives

- To further develop the concept of Electro Mechanical Brake system from Haldex towards driving on open roads.

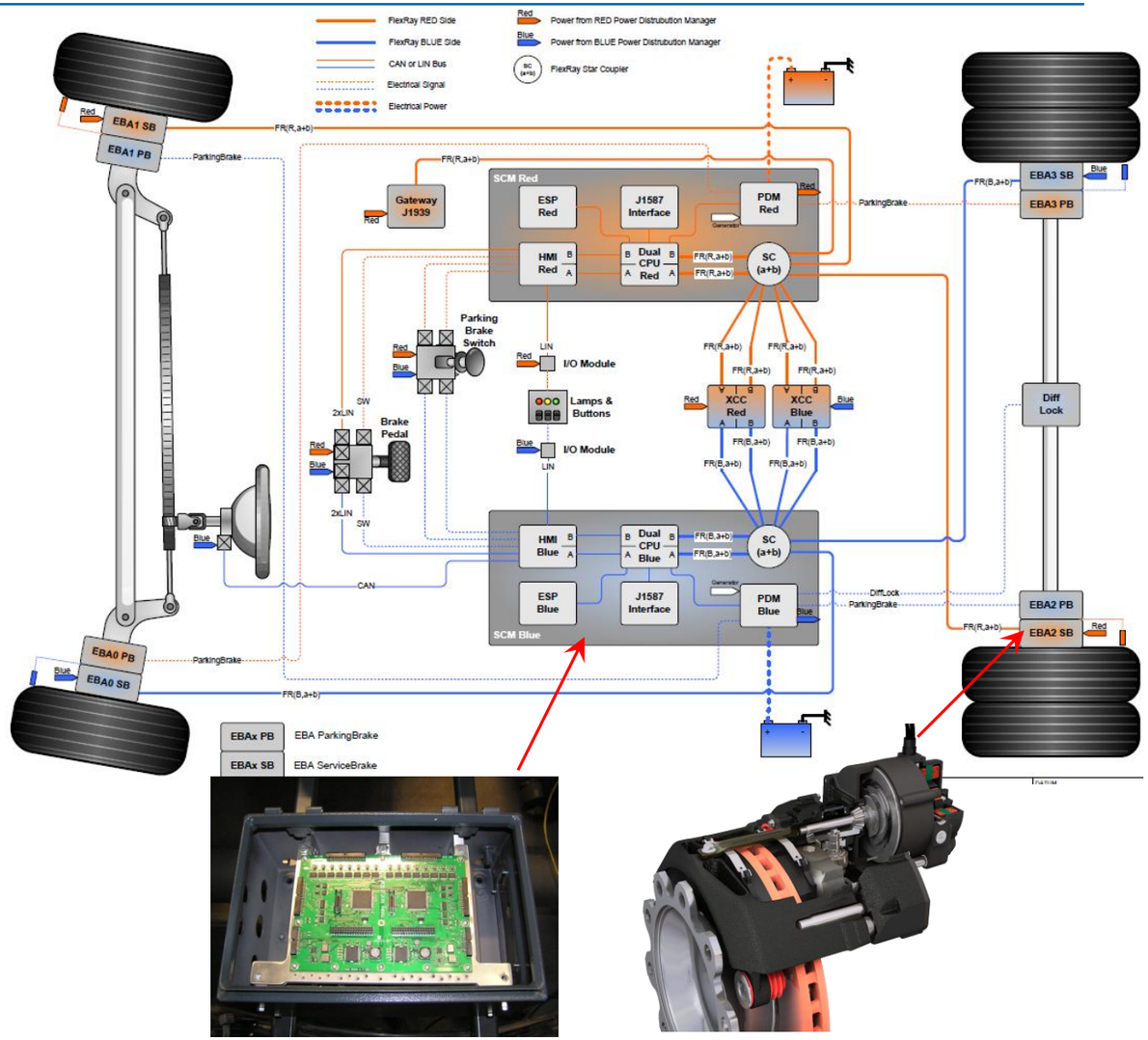
  Partners: Haldex VOLVO EXPLINOVO ILS

- Technical review of system according to ECE-R13 together with TÜV Nord, Germany.

- Improved braking performance and stability control.

Brake by Wire on Heavy Truck
System architecture

- Two circuit X-split system architecture for power management and control functions.
- Redundancy management using FlexRay, failsafe ECUs and gateway to CAN.
- Fully electric service brake and parking brake system.
- Electro Mechanical Brakes for actuation and advanced slip control.
- Implementation of improved brake system functions for increased performance.
- Integration of diagnostic functions of HAVEit system into existing dashboard panel.



Brake by Wire on Heavy Truck
Review according to ECE-R13

- The EMB system of HAVEit has in many aspects been able to comply with ECE-R13.
- Specific focus on annex 18 of ECE-R13 “Special Requirements to be applied to the Safety Aspects of Complex Electronic Vehicle Control Systems” during the review.
- Amendments prepared where terminology has been limiting.
  Example: Actuation forces using electrical energy not foreseen in ECE-R13, but only hydraulic or pneumatic energy.

19 Summary

Based on the submitted documentation presented by the manufacturer **Haldex Brake Products AB**, the **Haldex EMB**$^{+}$ system as described in ID_EMB has been technically assessed according to the “Table "Scope of assessment" of paragraph 2.2 taking also into account of its footnotes.

As described in detail in paragraph 2.4 the new EMB technology is not been fully covered by the technical requirements of ECE-R13. This is due to the fact that the EMB produces actuation forces using electrical energy instead of hydraulic or pneumatic energy in the case of conventional braking systems. Therefore, due to the nature of the electro-mechanical braking system the Haldex EMB^{+} system cannot literally meet all of the technical requirements of ECE-R13.

For the requirements which cannot be met proposals are made (see paragraph 2.4) for updating ECE-R13.

This report assesses the **Haldex EMB**$^{+}$ system for vehicles of categories N_3 and M_2 /M_3 according to the requirements of ECE-Regulation No. 13 including Draft Supplement 7 to the 11 series of amendments with regard to the items/functions/requirements as specified in the Table "Scope of assessment" of paragraph 2.2 with its numerous footnotes which indicate, e.g.

- deviations from ECE-R13 or
- tests which are not yet carried out but prescribed by ECE-R13 (in particular see footnote 2).

Deviations from ECE-R13 in general are specified in this report in particular in paragraphs 2.2, 2.4, 4.1.1 (Special additional requirements for service braking systems with electric control transmission) 4.1.3 and 6).

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TÜV NORD Mobilität GmbH & Co. KG
Institute for Vehicle Technology and Mobility (IFM)
Technical Service for Braking Systems

Accredited according to DIN EN ISO/IEC 17025:
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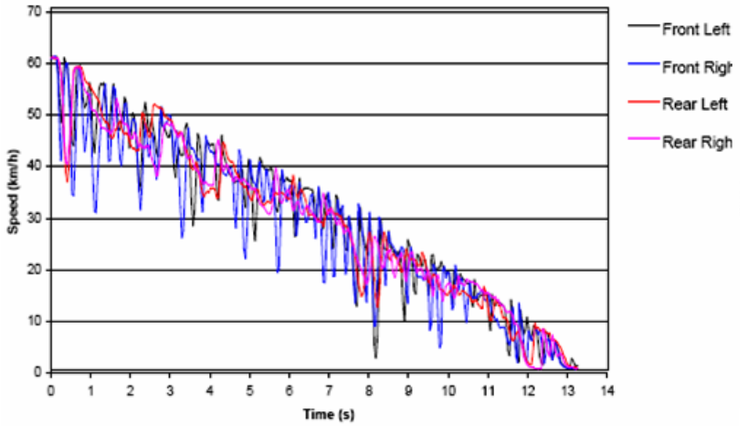
IFM TÜV NORD Mobilität KBA-P00004-96 DIN EN ISO/IEC 17025, 17020

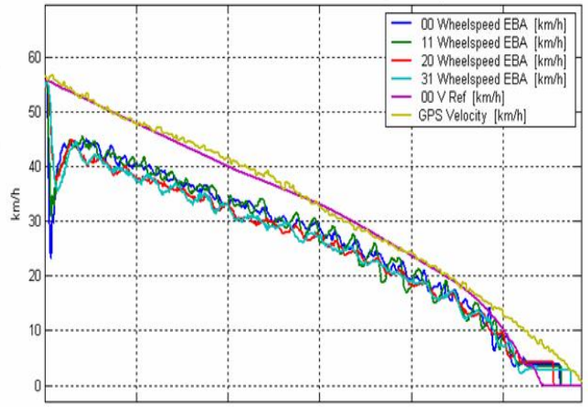
Brake by Wire on Heavy Truck
Braking and stability performance

- By braking on the peak level of the μ - slip curve maximum utilization of road / tyre friction can be reached.
- Shorter braking distance compared to conventional systems.

Conventional system.



HAVEit EMB system



- Initial stability tests shows good potential in the system for further ESC development.
- Quick response in brake force control when shifting between different road surface conditions.

Brake by Wire on Heavy Truck
Conclusion

- A fail safe Brake by Wire system for heavy trucks has been successfully developed.
- Technical review of the system together with TÜV Nord performed concerning ECE-R13.
- Improved braking performance compared to conventional systems.
- Good co-operation between vehicle manufacturer, supplier, scientific and specialist representatives in the project.

Thank you for your kind attention !