

Panel 2 – Innovative Energy Efficient Operation

GEKKO

Guide to Energy Efficient Driving *Greenspeed*

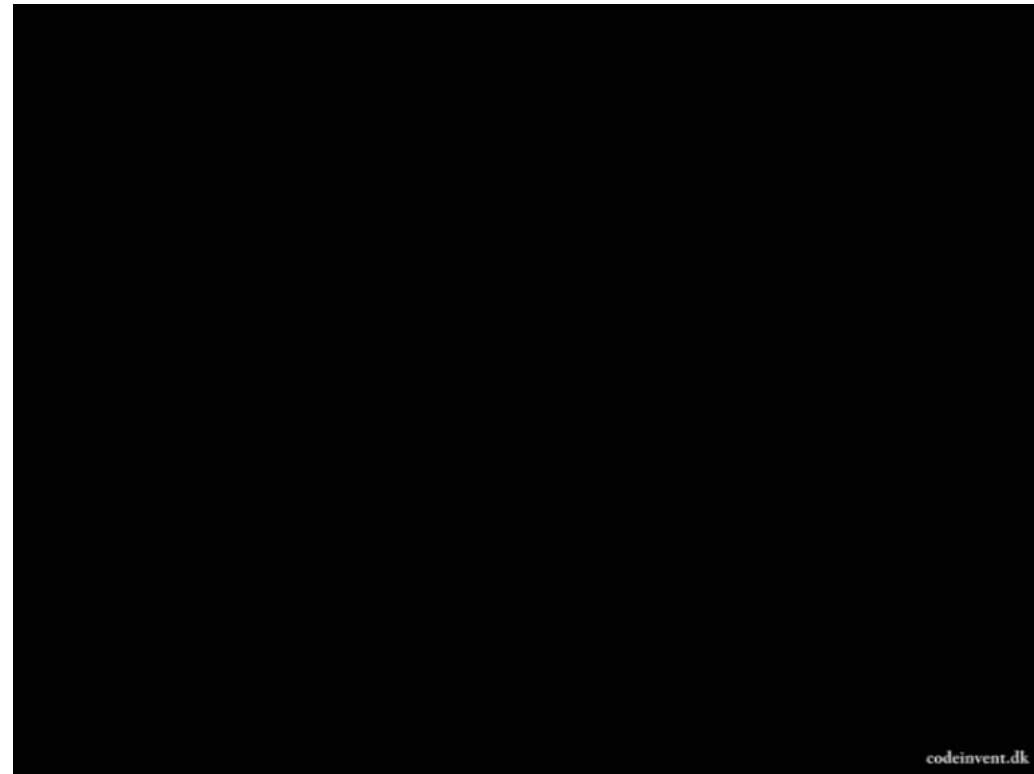
Peter Buchwald

DSB (Danish State Railways)

Scope & Objectives

Gekko contributes to a better environment by continuously delivering the most efficient way of driving.

Gekko makes the drivers working day more manageable.





Activities performed & Status

○ DATA REQUIREMENTS:

○ Infrastructure

- Track location, Altitude or gradient, Stations)

○ Timetable

- All stations and passagepoints, Arrival/Departure, Expected Track

○ Speed Limits

- Permanent limits, Temporary limits



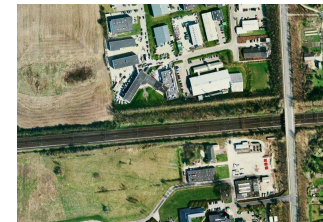


Data Requirement (continued)

- **Train Characteristics**
- **Length and weight, Maximum Speed, Resistances, Acceleration/braking**

- **Position**
- **GPS receiver, Tachometer, ERTMS**

- **Track Usage**
- **Updated Track usage, Transmitted real-time**





Punctuality

- GEKKO's first priority is to keep the timetable. If the train is delayed GEKKO will guide the driver to run on schedule, of course by energy efficient means. The train will always arrive on time, when possible, with minimal energy consumption.



Tjenestekortplan Dst K-09

IC 165
DSB
Kbh. Luthavn - Lindholm

Korer: CPH - OD
Togart: CPH - OD MF
Høst knytt: CPH - KH 180

IC 168
DSB
Lindholm - Kbh. Luthavn

Korer: OD - RO
Togart: OD - CPH MF
Høst knytt: OD - KH 180
KØ - CPH 160

IC 165	Ank	Atg	CPH	IC 168	Ank	Atg	OD
Kbh. Luthavn	-	17:50	TAT	Cdansa	22:20	22:28	ØD
Farsby	-	43	ORE	Marslev	-	54	ØV
Cresled	17:45	40%	ØRV	Ulstedev	-	58	ØV
København	-	47%	ØRV	Hjbjerg	-	04	JU
København H	53	18:00	ØRV	Hybjerg	23:03	09%	ØRV
Vålby	-	05%	ØRV	Sprogø	-	09%	ØRV
Helskov	-	-	ØRV	-	-	-	ØRV
Forn	-	-	ØRV	-	-	-	ØRV



Safety

- GEKKO handles all information required to do the mathematical calculations necessary to arrive on time, such as position, timetable and speed limitations. This means that the driver can be more focused on safety related aspects.





Energy Savings

- The most efficient way of driving is continuously calculated according to the current situation and presented to the driver as a speed recommendation. The driving strategy is customized to the individual operator based on current driving style, types of rolling stock and topography to achieve the highest level of energy savings

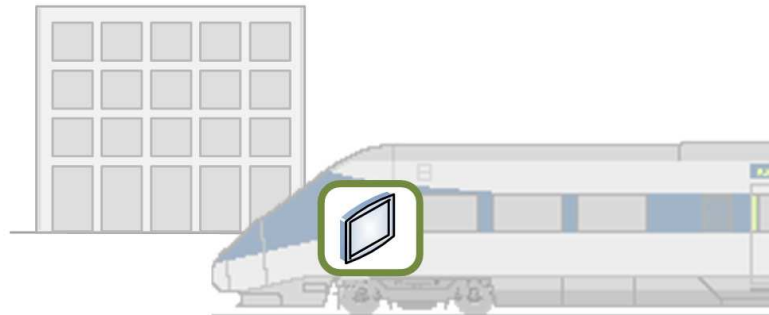




3 Levels..

Portable

- The system is limited to only the GEKKO unit and it has no connections to other systems. The system is 100% standalone, very easy to implement and requires no additional hardware. The data is manually delivered to the GEKKO unit as a simple file containing all relevant information
- Tablet PC, PDA or similar, Positioning by integrated GPS receiver
Manual entering of rolling stock specifications

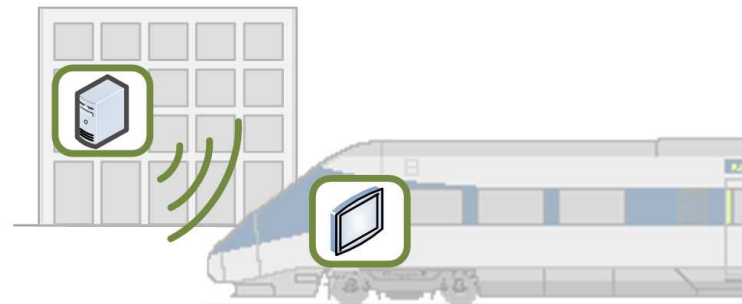




3 Levels..

Dynamic

- The data is delivered over the air on request from the GEKKO unit. The server is connected to data source systems on land to provide easy and centrally managed data maintenance. Updates to data (e.g. timetable) can be automatically transmitted to the train to instantly reflect the changes
- Tablet PC, PDA, PC with touch screen or similar, Land-side server with integration to data sources. Positioning by integrated GPS receiver
Communication via integrated modem (GPRS/3G)
Manual entering/confirmation of rolling stock

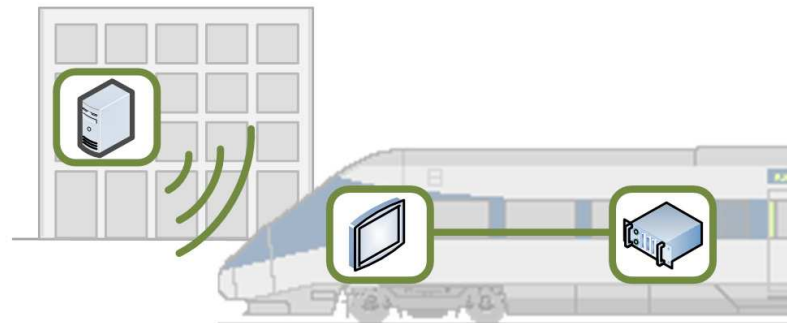




Intelligent

3 Levels..

- The GEKKO unit is connected to existing systems on the train, which provide information about real-time data such as position, current track and signals as well as detailed information about train characteristics and actual status.
A data delivery system connected to an integrated network provides access to real-time data and a communication channel.
- Build in PC with touch screen or similar.
Land-side server with integration to data sources.
Integrated data delivery system connected to existing systems, GPS receiver and modem (3G/GPRS/GSM-R/WLAN)
Positioning by shared GPS receiver and tachometer and/or ERTMS balises
Can be integrated with ERTMS/ETCS





Results achieved and implementation

- **Saving 15 % on Traction Energy**
- A detailed report has been produced in DSB to determine the potential energy savings by introducing GEKKO in Denmark.
- By conducting a series of tests and analyzing the results, the report states that DSB will save up to 15% on the traction energy while improving punctuality. Based on these results DSB has decided to implement the system (level 3) in all rolling stock by 2011.
- The efficiency of the speed algorithm is essential to a valuable result. Therefore the algorithm is continuously monitored and improved. The potential savings depend very much on the chosen driving strategy and surroundings.



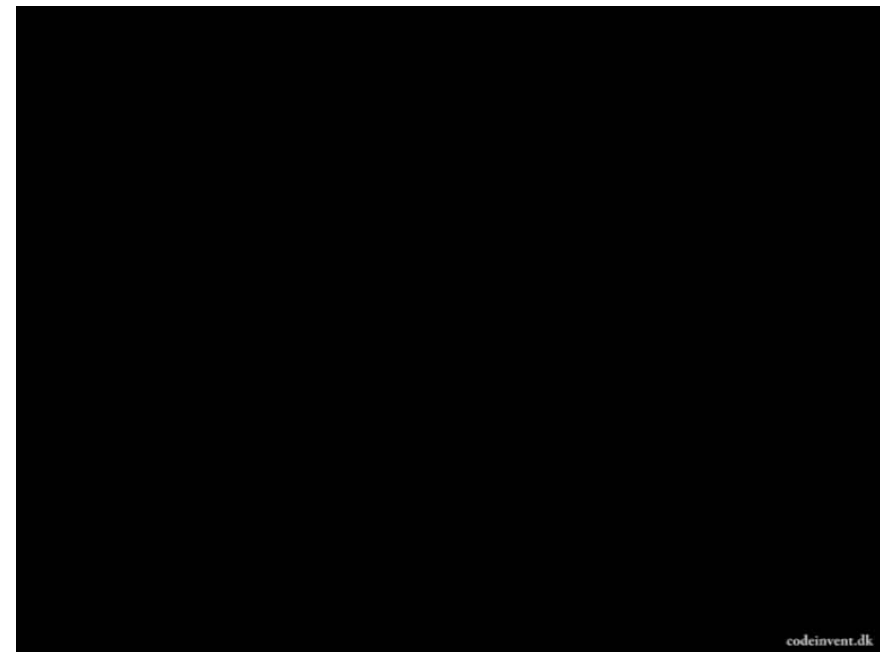
Implementation



- The left-hand side shows current information such as position, radio channel and track usage. The bar shows a red and green arrow which indicate the actual and recommended speed, it also contains a visual representation of current speed limits.
- The middle section is a graphical view of the track locations. The view scrolls according to the current position and the visual part depends on the current speed.
- The right-hand side shows information about future events. In the top is a description of the next station showing arrival/departure time and track usage as well as an indication of the expected arrival time in case the train is delayed. The bottom shows relevant changes in near future events such as speed limits and passage points.

Next Steps & Outlook

- The user interface is developed in close cooperation with the drivers to ensure ownership and guarantee wide acceptance.
- Tools for analysing and maintaining data are also continuously developed as demands and requests arise.
- GEKKO receives rescheduled timetables and adjusts the recommendations to reflect the changes. The decision for rescheduling will be made by the traffic manager using a decision support tool to optimize floating traffic.





Status

- Level 3 is currently being developed and is scheduled to be implemented in all trains in DSB by 2011.

Greenspeed

