Professional workshop „Satellite navigation & communications on railways“
organized by GUF - Galileo User forum,
the Czech Republic's Ministry of Transport initiative

Galileo impact assessment on railways, expectations of users

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6th October 2008, Messe Dresden, Germany

Transport process

- Transportation represents a complex process
- Many participating stakeholders: transport process providers and customers/end users
- Each group has its own demands for the transport
  - customers determine the progression of transport
  - transport providers lay down the requirements for the railway system

Railway system requirements

- **The customers as end users of the transport consider the following parameters as the most important:**

1) cost of the carriage
2) time period needed for the carriage of the consignment
3) or the time required for the transfer of a passenger from the point A to the point B (with a guarantee of relevant connecting lines in case of more public transport modes)

Railway system requirements

4) accuracy – adherence to the time of delivery agreed
5) safety – protection from damage of goods carried or protection from injury of passengers; the protection against criminal acts is still more frequently being stressed recently
6) information on the position of the consignment carried – impact on technological

Railway system requirements

time periods of the production process

7) information on passenger transport - delays, connecting lines - the application of satellite navigation may be also used here

Railway system requirements

- **Transport providers are laying stress on:**

1) the costs of the system offered – acceptability and justification of the cost given by the utility of the application or of the system
2) reliability – the system disposes of minimum operational stoppages and detects a stoppage or anomaly in cases of its occurrence; the stoppages have to be removed

Railway system requirements

within a minimum time-limit

3) availability – (*economical view*) in the case of the railway transport a permissible time-limit is involved within which the disturbance may affect the relevant application without impairing its operability

4) safety – in the case of a disturbance the system remains in safe condition

Railway system requirements

5) maintenance – as simple as possible; the diagnostics of the system is a frequent requirement informing about the location of a break-down and identifying non-operable modules
6) life cycle – as long as possible
7) integrity – the capability of a system to rapidly inform the user (service organization) about the loss of the integrity or about its automated detection

Railway system requirements

8) accuracy of the positioning – application will have different requirements for the safety in relation to satellite navigation

- the application of the satellite navigation on railways is to be broken up into two groups:
  - fail-safe and
  - non-safe applications

Non-safe applications

- fleet management
- traction energy management
- railway vehicle control involving automated driving speed regulation, automated target shooting and running of the train

Fail-safe applications

- safe operation of the train
- the provision of a safe passage through the station
- the prevention of a frontal crash of trains or a clash of a subsequent train with the rear end of the preceding train as well as securing the crossings by block systems (level crossing of a road with the railway)

Potential contributions

- compromise between requirements for the cost of application, its integrity as well as its maintenance simplicity
- analyses were made concerning the transport process implementation costs

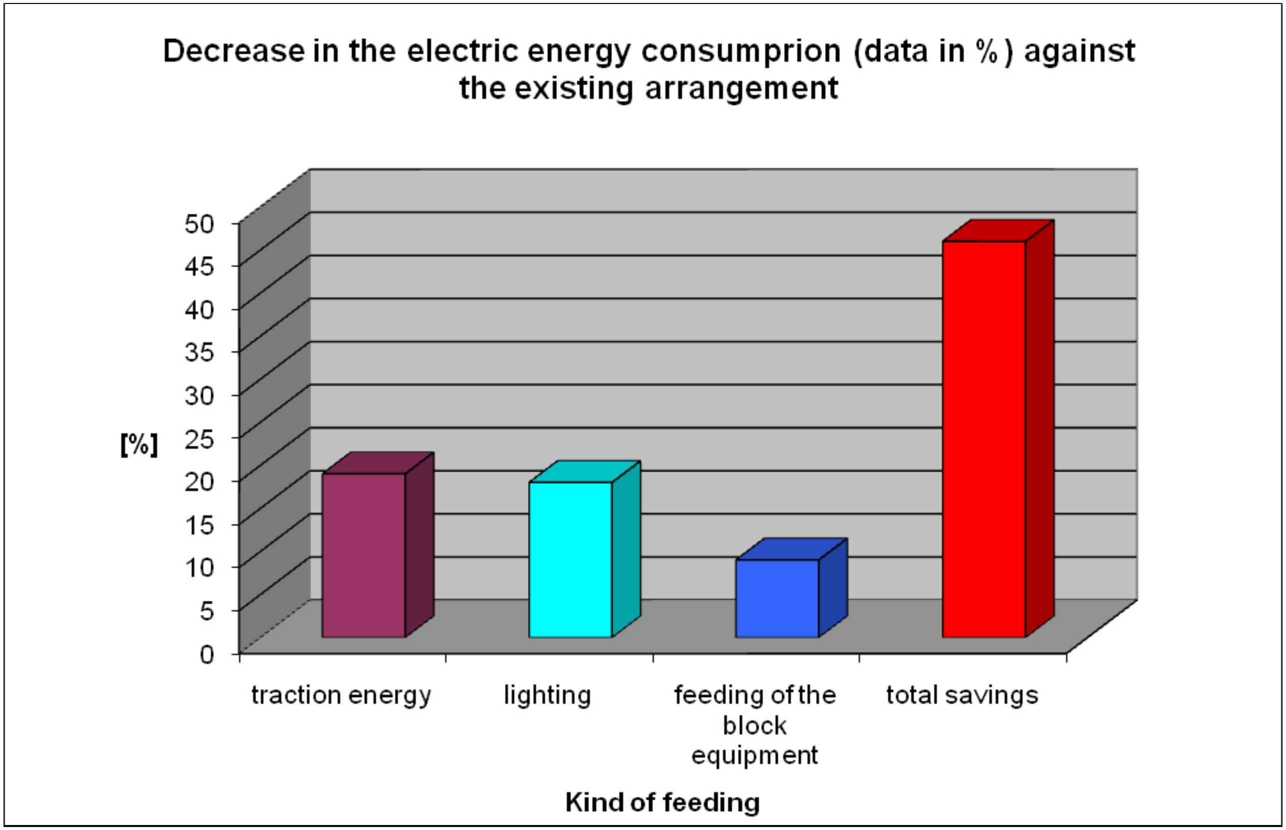
  → the satellite navigation in the railway transport has its potential contributions

Potential contributions

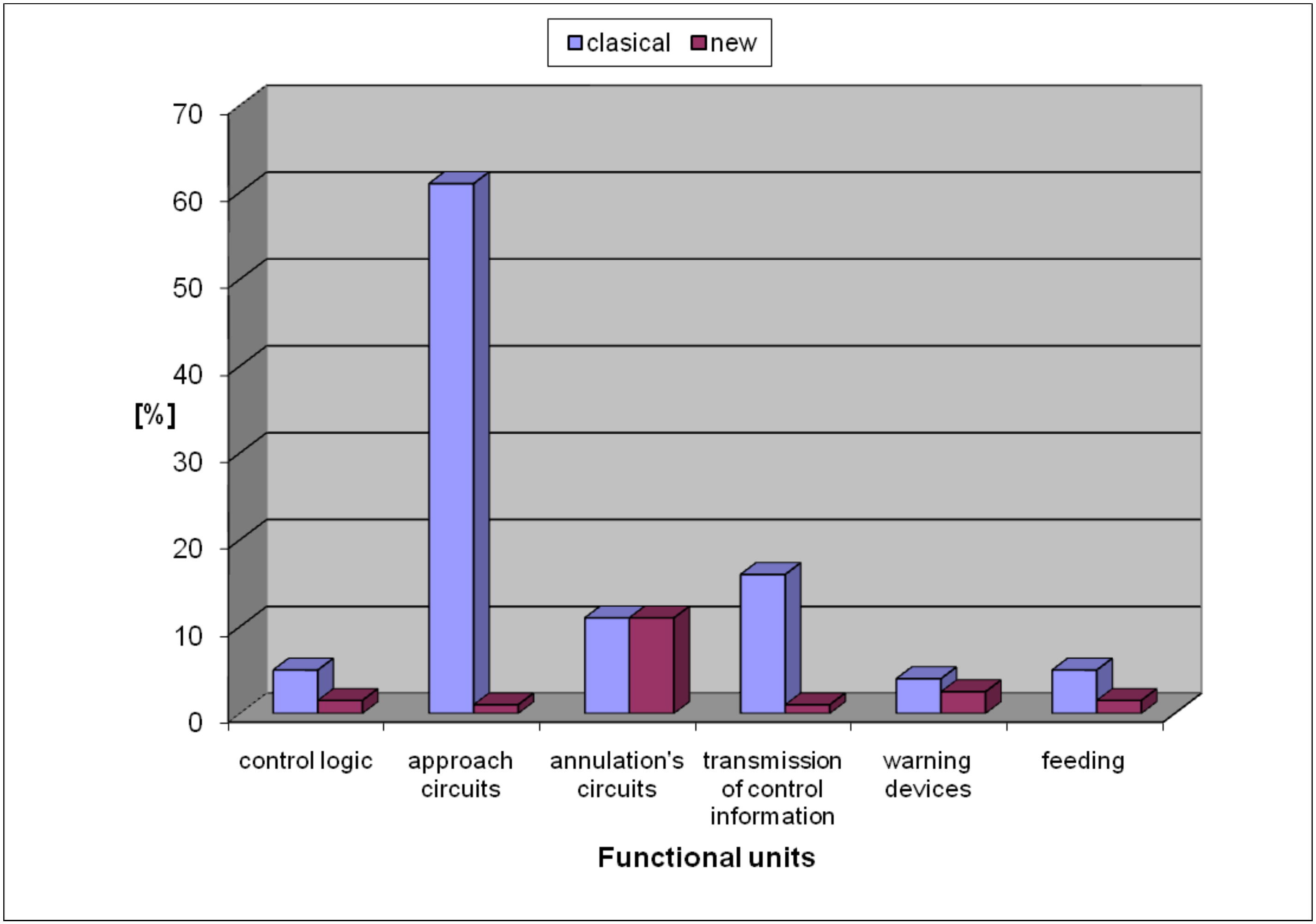
→ the most important benefits being the use of information about the location of the means of transport

→ the use of positioning technology is usually accompanied by associated telematics applications and systems, however, under the condition of synchronization of the system parameters or relevant information systems

Model track
Savings - synchronization of telematics system parameters/relevant information systems



Costs per 10 pieces of a block system on crossings on a model track



Some results of the analysis of economic contributions

- traction energy savings: evaluation of the difference between driving of a train following the engine driver’s decision, optimum running of the train by means of automated driving speed regulation, automated target shooting and command of the train
- electric energy savings on railway energy systems: model railway network section in the range of 250 km

Some results of the analysis of economic contributions

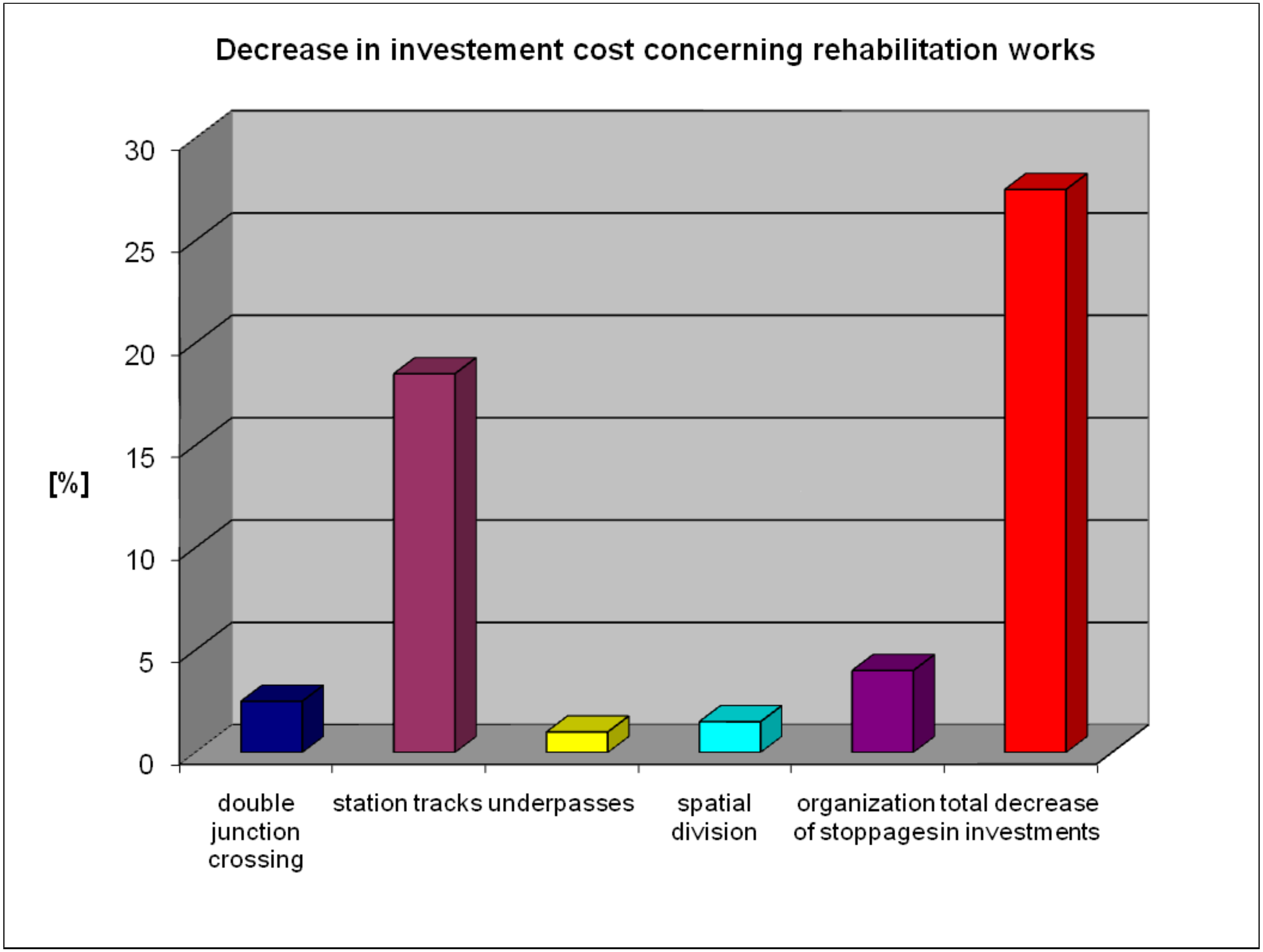
- savings on railway infrastructure elements (equipment)
- output represents savings of the required infrastructure extent (rehabilitation works) of a model line (20 km, 2 stations and 3 sections between stations)
- in the case of satellite localization concerning newly built systems (of reconstructed lines) following elements will fall off:

Some results of the analysis of economic contributions

- existing elements for the identification of free capacity of a track
- existing elements detecting the passage of a train through a certain point
- certain elements of tracks will fall of or will be simplified like, for example, the signals
- Savings in the process of laying cables:
  - substantial reduction of electric energy

Some results of the analysis of economic contributions

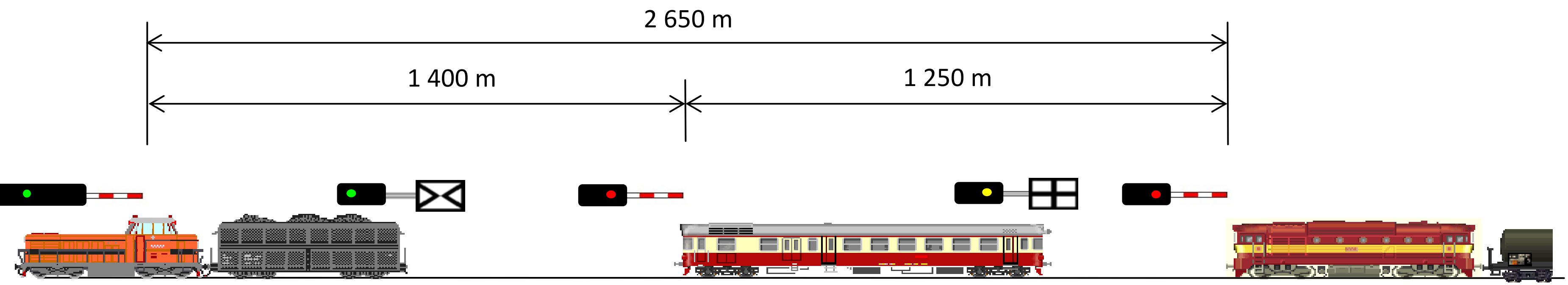
- smaller dimension for technological equipment
- the savings will have an impact also on part of the high-tension equipment and again the feeding cables or the transformer will be given smaller dimension.


Decrease in investement cost concerning rehabilitation works
30
25
20
15
10
5
0
[%]
double junction crossing
station tracks
underpasses
spatial division
organization of stoppages
total decrease in investments

Some results of the analysis of economic contributions

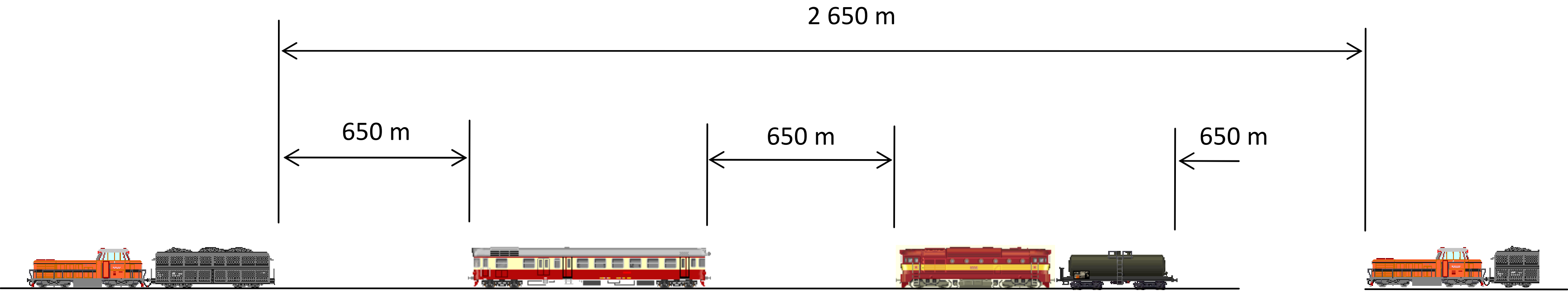
- new organization of the traffic between individual stations so far as the line is divided into spatial blocks.
- under standard conditions only a single train may be demarcated within a spatial block
- virtual spatial blocks will be used if a satellite navigation is involved

Spatial blocks



- trains are moving on a track in a speed of 120 km/h
- the brake within a distance of 650 m present regulations, main signals are installed on a track along with caution signals with the braking distance of 1 000m
- scope of vision impairing adequate visibility and therefore the signals are being installed on appropriate points
- result - two spatial blocks will arise on a 2 650 m long section
- three successive trains may emerge on a track

Virtual spatial blocks



- no signals are necessary when satellite navigation is
- successive trains are receiving and processing information on the speed of the preceding train
- they can safely stop before the preceding train
- they will keep a 650 m distance
- six trains may occur on the same track

The contributions of the satellite navigation for railway lines

- increase in the permeability of a line by 30 - 60 %
- traction savings in running of a locomotive or a unit by 30 - 80 %
- increase in the cruising speed by up to 20 %
- savings concerning the construction of a new block system by up to 80 %

The contributions of the satellite navigation for railway lines

- savings concerning feeding equipment by up to 80 % (apart from block systems at crossings)
- elimination of mistakes caused by human factor will result in the increase in the traffic safety (notably on lines where the traffic is ensured only by telephone communication between train traffic controllers)

The contributions of satellite navigations at railway stations

- increase in the permeability of railway lines at neighbouring railway stations
- savings related to the construction of a new station block system by up to 30 %
- savings concerning the feeding of relevant equipment
- savings related to the maintenance by 50 - 60 %

Investment or operating costs of the implementation of the satellite navigation

- own localization equipment: to be completed by additional equipment according to requirements for accuracy, safety, reliability and availability
- devices for the transmission of information: these devices need to be transferred to the centre

Investment or operating costs of the implementation of the satellite navigation

- devices for the processing of information: the value of the devices is to be increased and accordingly the establishment of a processing centre will be necessary
- available expertise: operating costs of systems using satellite navigation will be lower by 10 – 20 % compared with the existing technological solution

Trend of the railway block equipment

- provision of the systems interoperability
- efficiency: new system has to bring about new options as regards traction energy savings, and it has to ensure more reliable functions having substantially lower investment as well as operating costs compared with the classic system

Trend of the railway block equipment

- the shift to a new block system (migration phase) will entail an option of introducing the new system with respect to individual levels and stages, namely completely independent of the function of the existing block system
- compatibility and safe inter-relation between safe and non-safe systems: the new type of the block system will have to be compatible with other systems within the non-safe part

Discussion topics

- What is still missing for (any safety and security oriented) industries to invest more for developing Galileo based safety related (security) applications?
- Is introduction of rail block system based on satellite navigation into the field of safety-related products really cost effective?

Thank You !