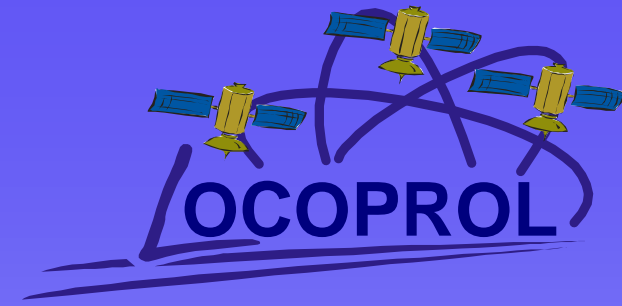# Project presentation
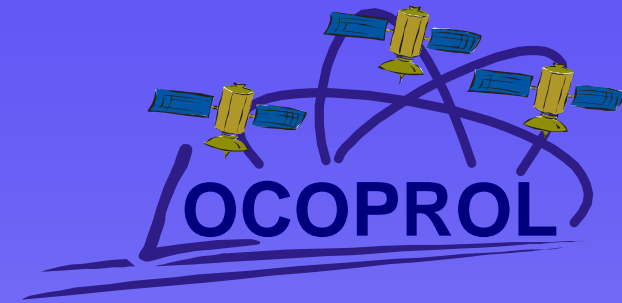
Low-Density Traffic Lines*

- Single track, few trains/day
  - High safety requirements
  - High installation and maintenance costs

- Worldwide market
  - > 300 000 km *LDTLs

- Customer requirements
  - Increase line capacity
  - Reduce trackside equipment
  - Limit on-board sensors
  - Increase train autonomy
  - Cost-effective & safe solution

Project objectives

■ Develop an
  – innovative
  – low-cost
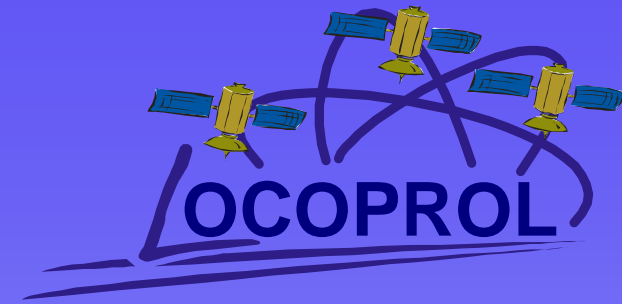 – fail-safe
  – satellite based
  train positioning system

■ Study and prove its applicability in LDTLs

■ Study its application to ERTMS/ETCS*

■ Study and prove its application for workers protection

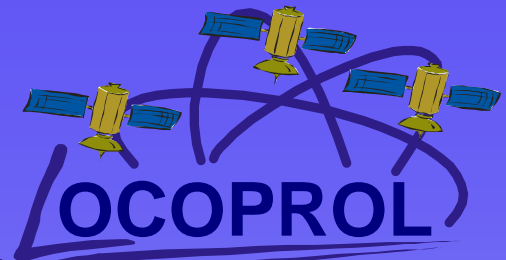*European Rail Traffic Management System / European Train Control System
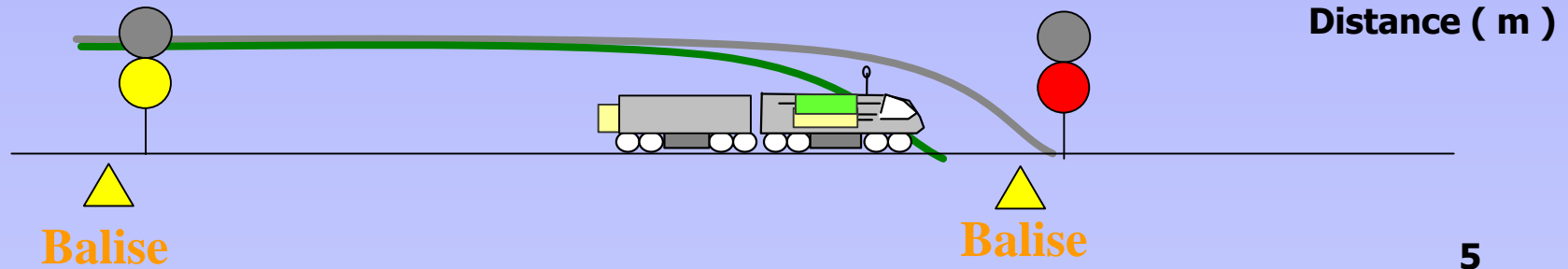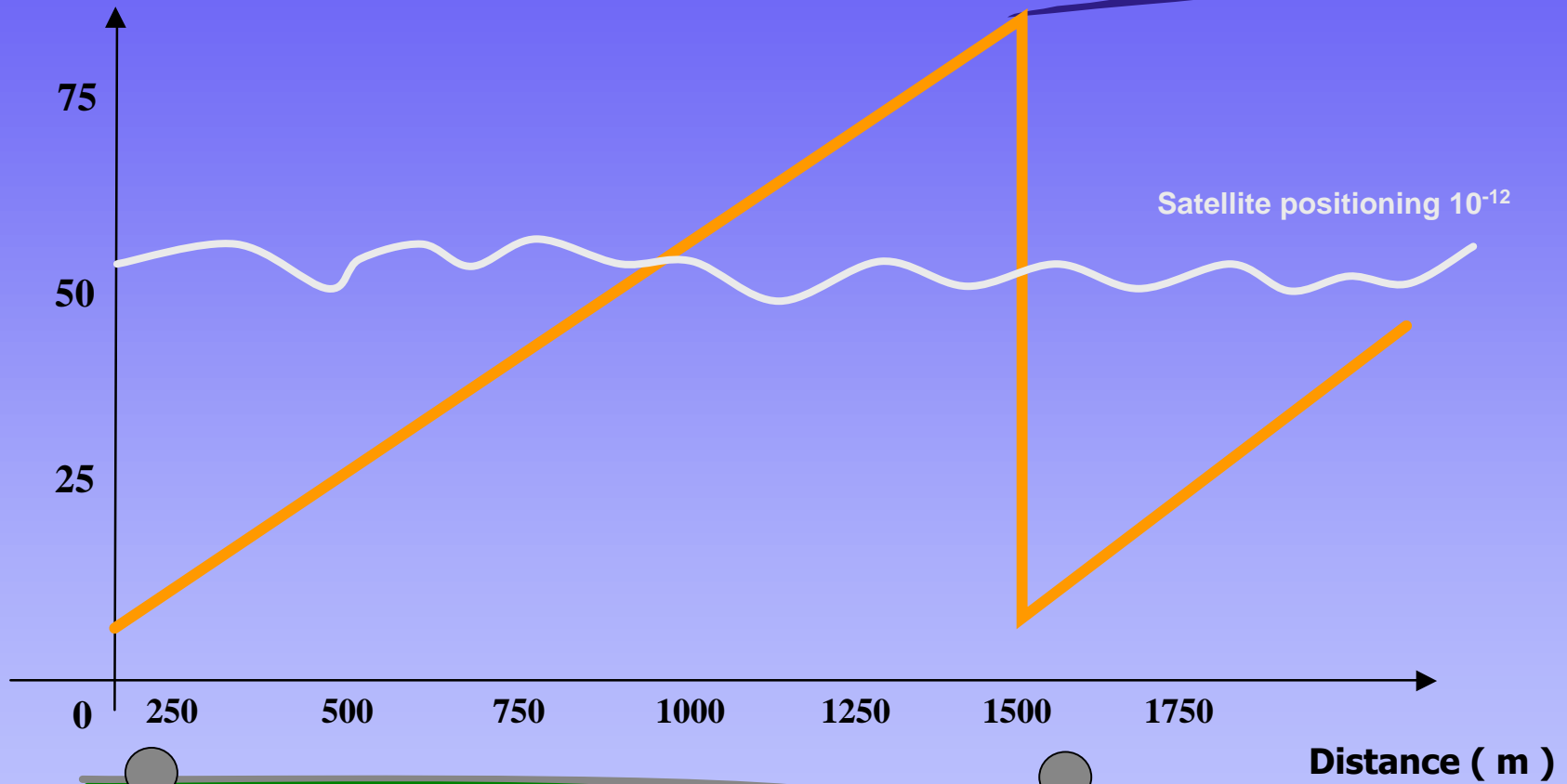
Application characteristics

☹ High <u>Safety </u>level is required:
 ⇒ Probability of wrong train position must be lower
 than 10^{-10} to 10^{-12} per hour

☹ High <u>Availability of measurements</u> is required:
 ⇒ Several satellites must be visible at any time

☺ It's a guided transport :
 ⇒ 3D problem can be reduced to <u>1D problem</u>

☺ Positioning <u>in line-based mode</u>:
 ⇒ Relaxed position accuracy, track separation not needed
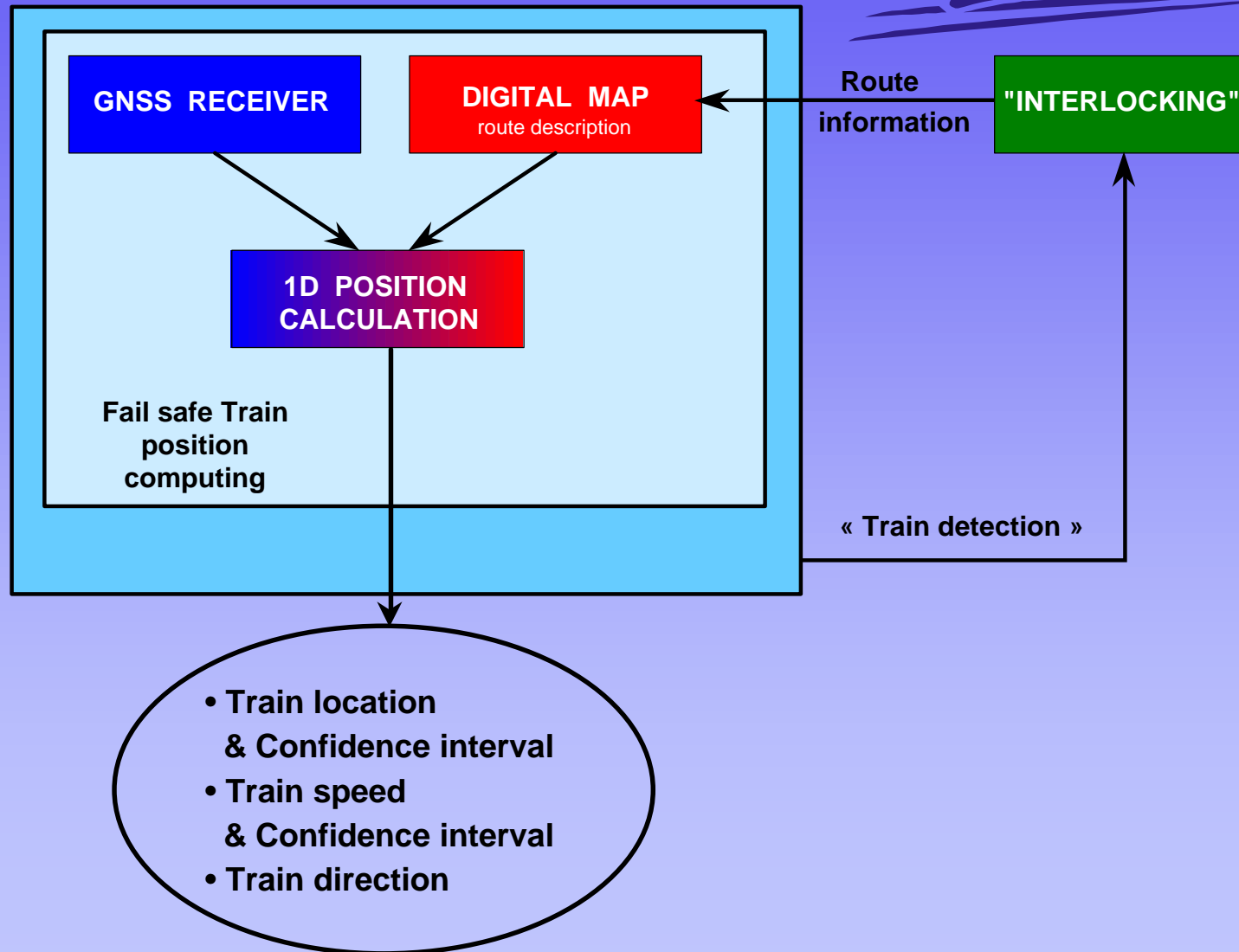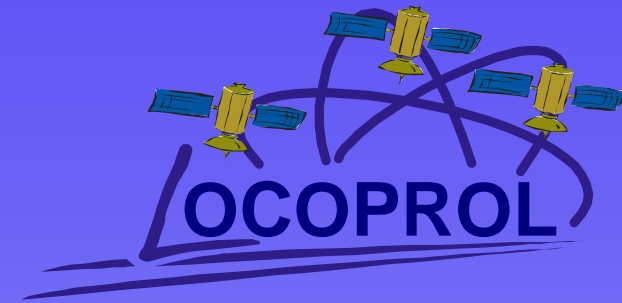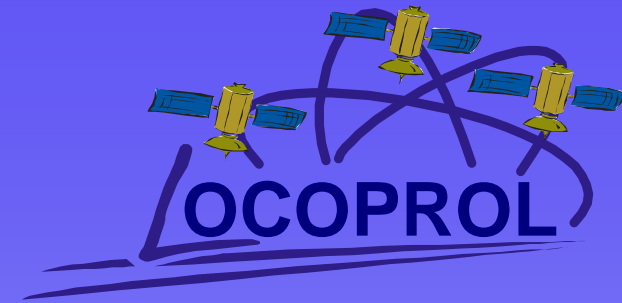
Positioning accuracy

Confidence interval (m)

75

50

25

Satellite positioning 10^{-12}

0   250   500   750   1000   1250   1500   1750

Distance (m)

Balise   **Balise**

5

Positioning method

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```
┌─────────────────────────────────────────────────┐
│  ┌───────────────────────────────────────────┐  │
│  │  ┌──────────────────┐  ┌────────────────┐ │  │
│  │  │  GNSS  RECEIVER  │  │  DIGITAL  MAP  │ │  │
│  │  │                  │  │ route description│ │  │
│  │  └──────────────────┘  └────────────────┘ │  │
│  │                                            │  │
│  │         ┌──────────────────┐               │  │
│  │         │  1D  POSITION    │               │  │
│  │         │  CALCULATION     │               │  │
│  │         └──────────────────┘               │  │
│  │                                            │  │
│  │   Fail safe Train                          │  │
│  │       position                             │  │
│  │      computing                             │  │
│  └───────────────────────────────────────────┘  │
└─────────────────────────────────────────────────┘
```

Route information → "INTERLOCKING"

« Train detection »

- **Train location**
   & Confidence interval
- **Train speed**
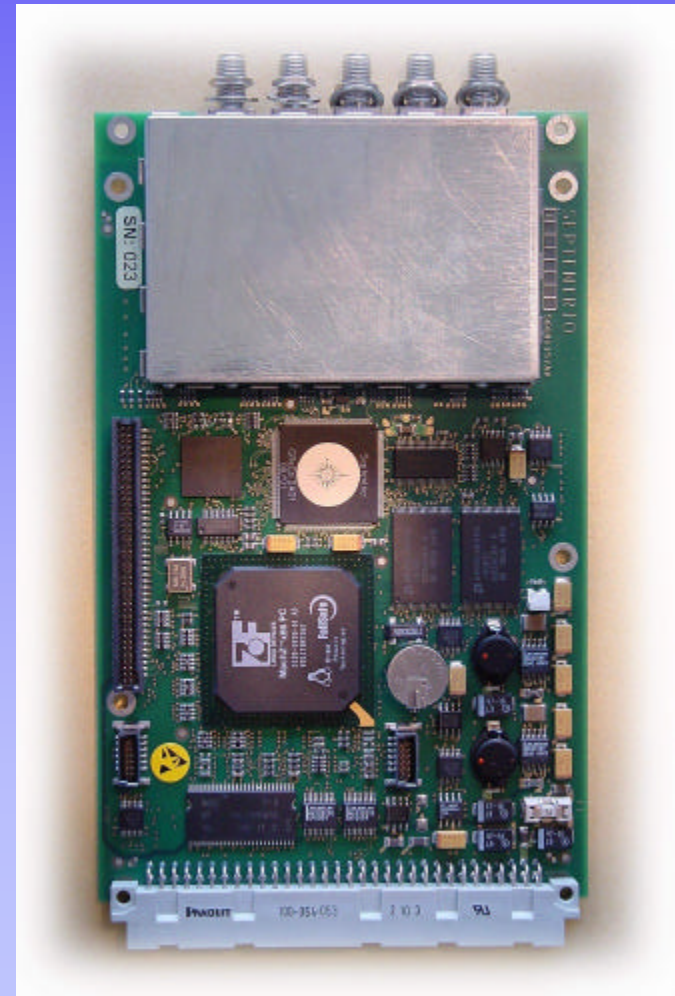   **& Confidence interval**
- **Train direction**
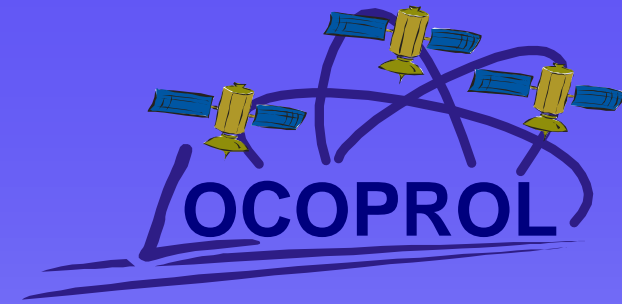
PolaRx2 GNSS receiver

- dual-frequency GNSS receiver
- 48 HW channels
- GPS/GLONASS/SBAS
- C/A + P code tracking
- ready for C/A on L2
- attitude determination
- 1PPS in/out
- 10 MHz reference in/out
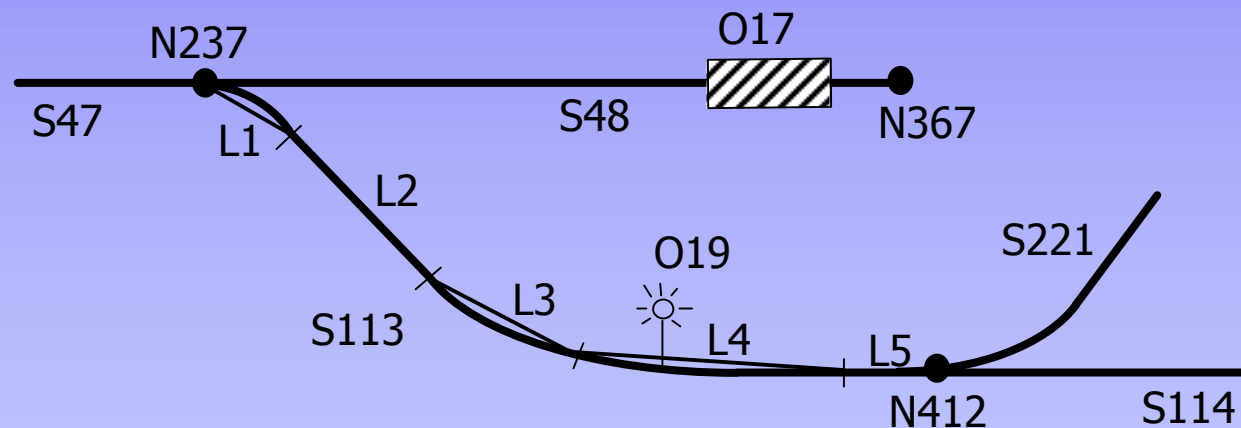- Eurocard sized
- compatible connectors

Digital map example

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- ## Sections (e.g S113)
  - Straight lines (e.g. L3)
  - Point objects (e.g. O19)
  - Extended objects (e.g. O17)

O17

N237

S47

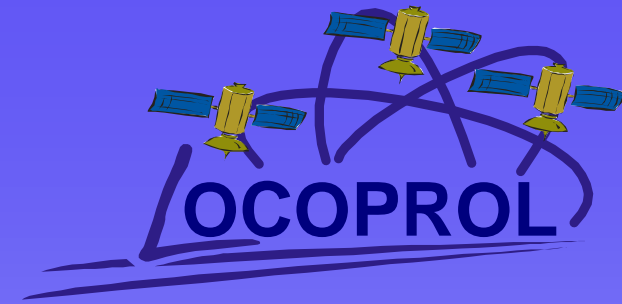L1

S48

N367

L2

S113

O19

L3

S221

L4

L5

N412

S114
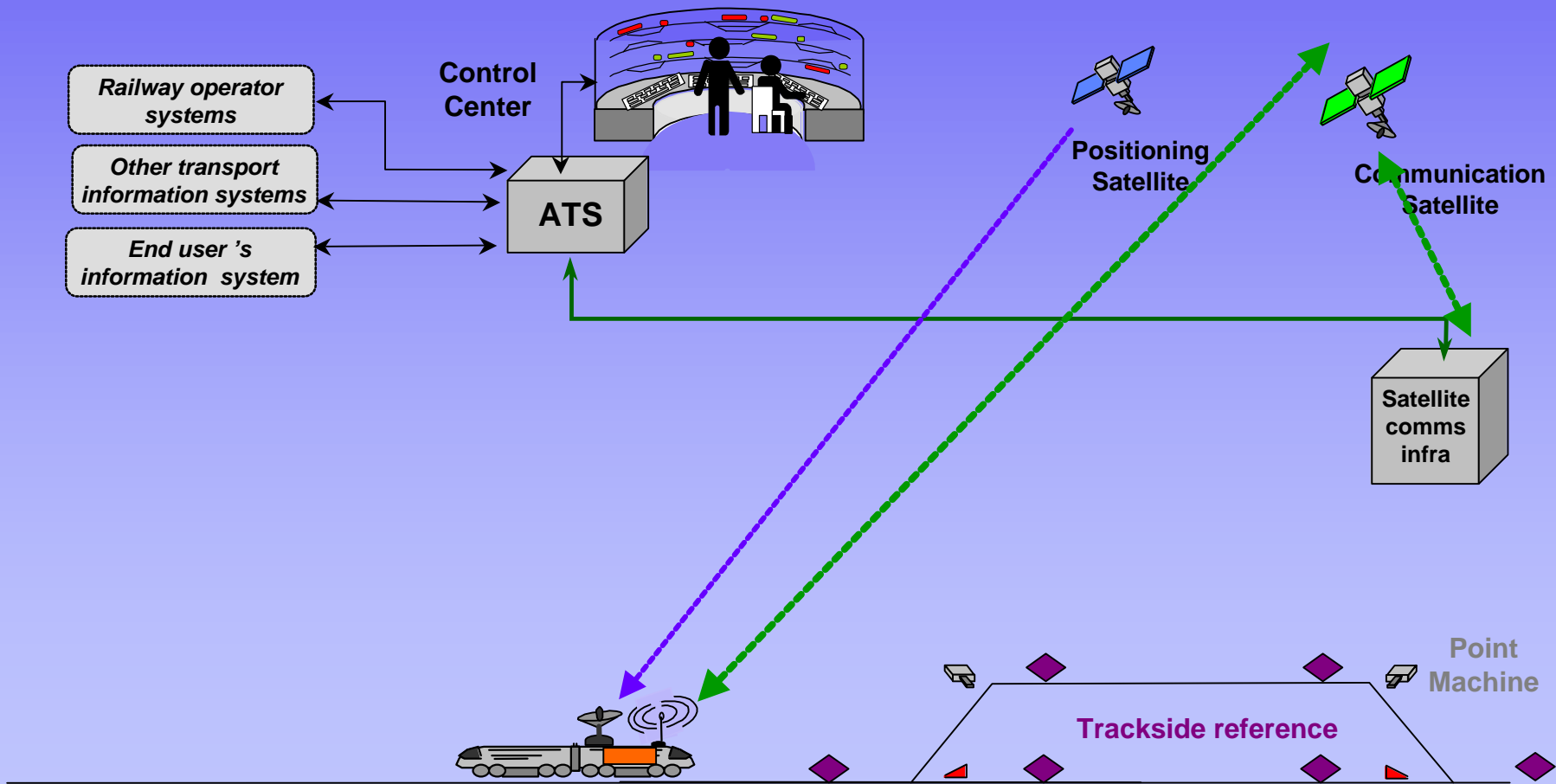
- ## Nodes (e.g. N237)
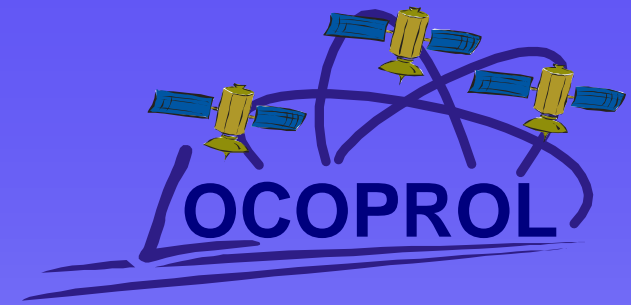 - Coordinates in WGS84
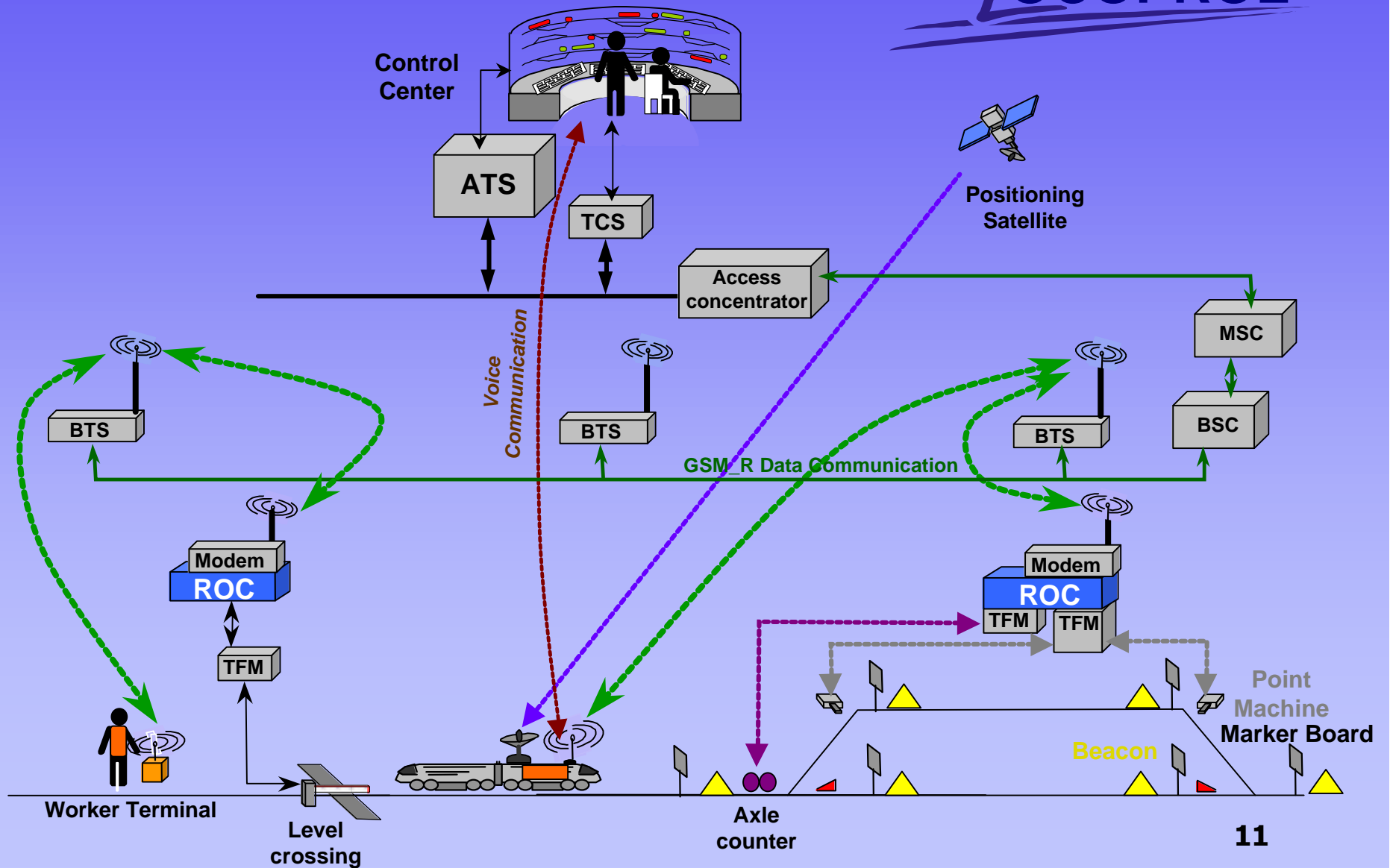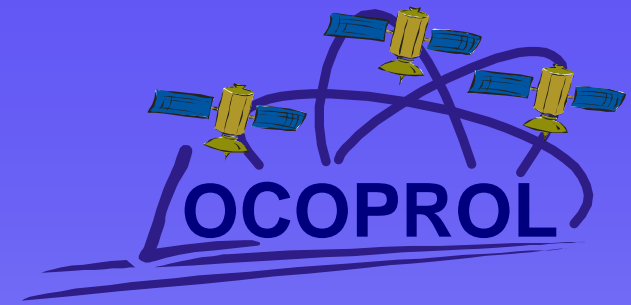
System tests objectives

- **Belgian test track:**
  - Satellite positioning validation
  - Satellite communication evaluation

- **French test track:**
  - Signalling system application
  - Workers protection
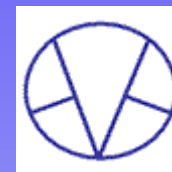
Positioning tests (Belgium)
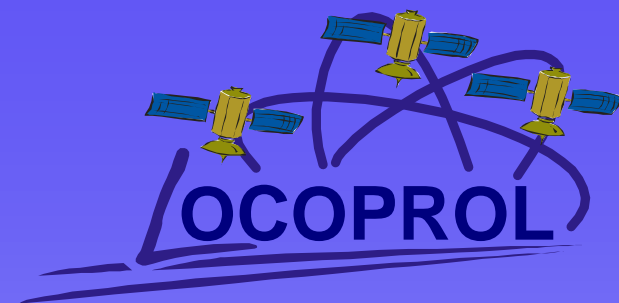
OCOPROL

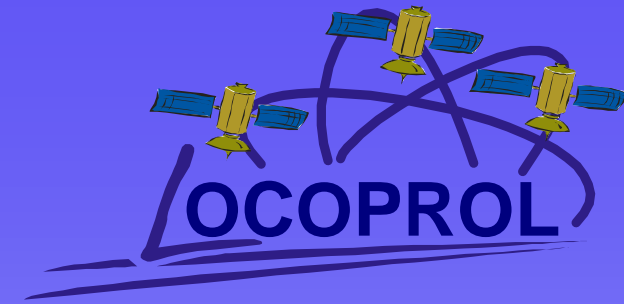*Railway operator systems*

Other transport information systems

End user 's information system

Control Center

ATS

Positioning Satellite

Communication Satellite

Satellite comms infra

Point Machine

Trackside reference

10

Signalling tests (France)

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Control Center

ATS

TCS

Access concentrator

Positioning Satellite

MSC

BSC

BTS

BTS

BTS

Voice Communication

GSM_R Data Communication

Modem

ROC

TFM

Modem

ROC

TFM   TFM

Point Machine

Marker Board

Beacon

Worker Terminal

Level crossing

Axle counter

11

Project consortium

Project consortium

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■ Composition of consortium in terms of skills:

Railway Operation 9%

Telecommuncations 5%

Software Development 13%

Supervision and Control Systems 14%

Equipment Manufacturing 14%

Railway Safety Critical System Design 14%

Railway System Certification 14%

Satellite Navigation 17%
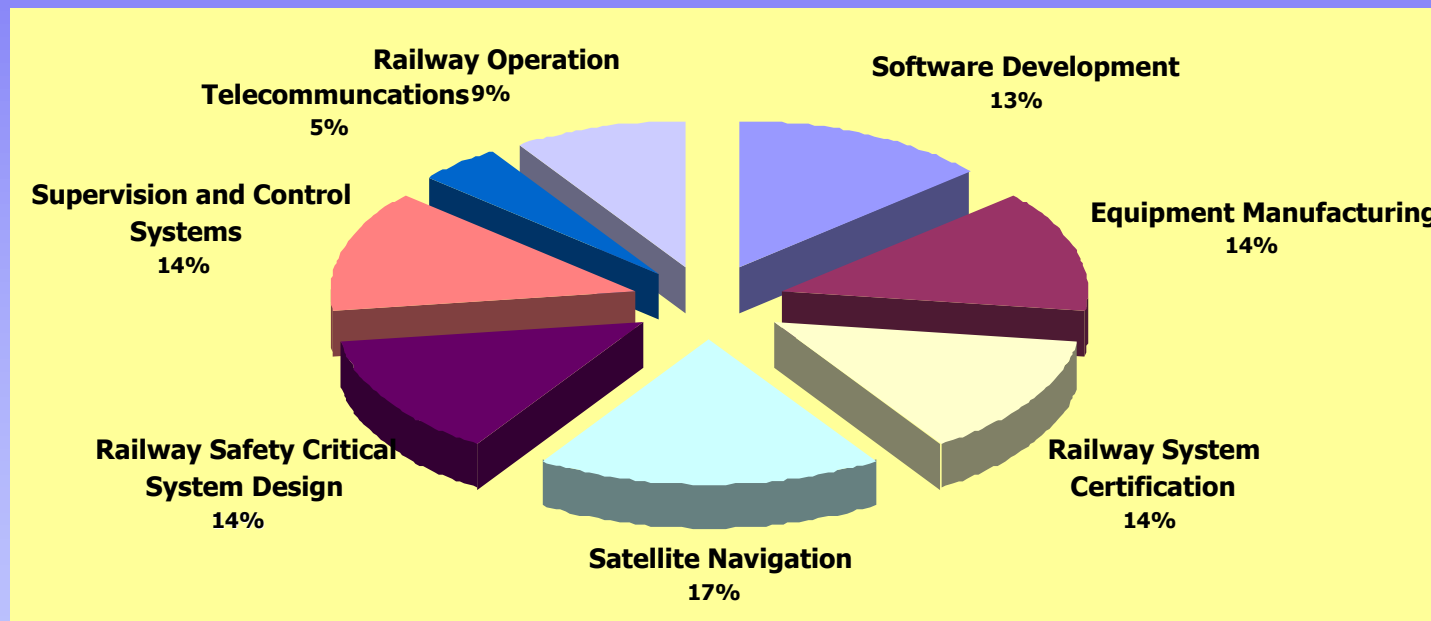
Project data
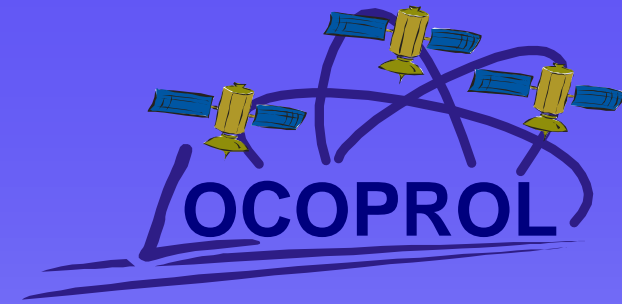
■ **LOCOPROL / EC DG INFSO:**
- IST/5th Framework Program funding
- Budget about 8 Mio. €
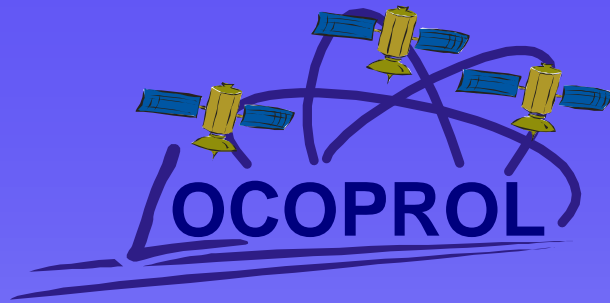- Start date 1-Aug-2001
- Duration 36 months

■ **LOCOLOC / ESA:**
- Focusing on satellite based train speed and acceleration measurement, and web services
- Budget about 1 Mio. €
- Start date 15-Mar-2002
- Duration 26 months

Project planning

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Name	01		2002				2003				2004		
	Qtr 3	Qtr 4	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1	Qtr 2	Qtr 3
WP 1 Project Management													
WP 2 Definition of User's needs													
WP 3 System specifications													
WP 3.1 External interfaces													
WP 3.2 System requirements													
WP 3.3 System architecture													
WP 3.4 Internal interfaces													
WP 3.5 Final System Specifications													
WP 4 System Development													
WP 4.1 Build System Modules													
WP 4.2 Implementation of Integrated System in d													
WP 4.2.1 Test site 1													
WP 4.2.2 Test site 2													
WP 5 System Safety Validation													
WP 6 Evaluation													
WP 7 Dissemination & Promotion of Project results													
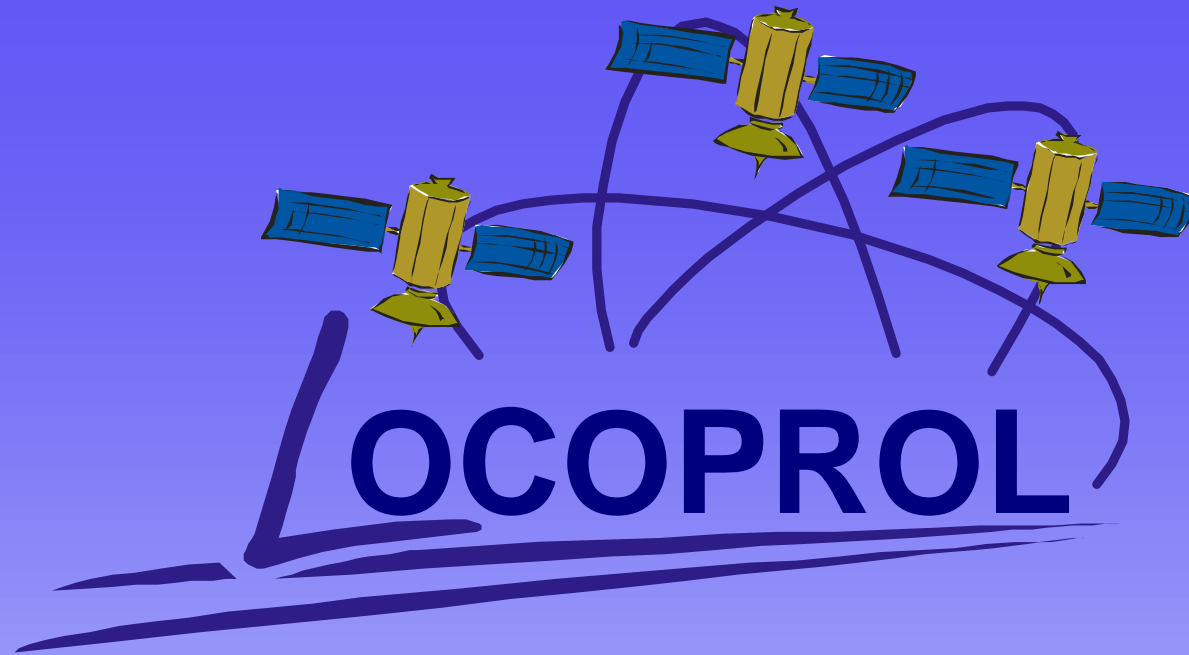
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Thank you for your attention

Visit also

WWW.LOCOPROL.ORG