Implementing ITS for BRT: considerations and recommendations

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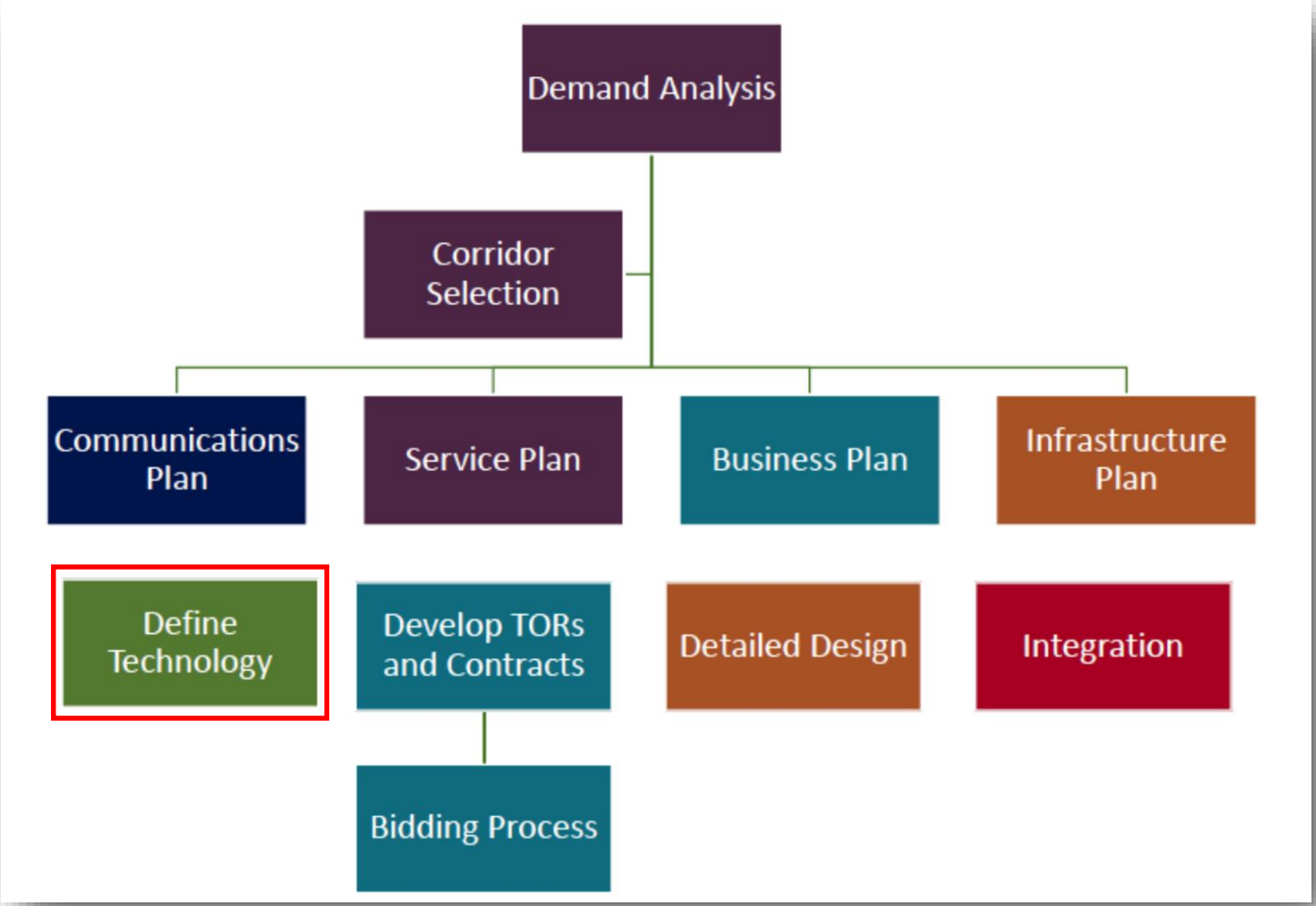
MemEx

Overall objective of the webinar



What this webinar is going to address today

Contents of the webinar

- ITS market: approach from provider/demand side
- ITS supporting BRT operation: wide range of solutions
- BMS/AVL (Fleet Monitoring) system and e-ticketing
- Approach to ITS design and key choices
- Relevance of the feasibility study
- Process complexity: contract, implementation and operation
- Some conclusions / remarks

The actors in PT service chain

PT AUTHORITY | **PT Service** | **PT OPERATOR**

Planning → **Scheduling** → **Operation**

Service KPI assessment

Reporting

Improve reliability
Improve accessibility
Information

PASSENGERS

Service Integration

Data analysis and mining

Service Interoperability

ITS

SYSTEM PROVIDER/OFFER

ITS market: system provider/offer side

- Lack of understanding/in-depth analysis of PTA/PTO needs
- Poor "problem solving" approach
- Offer of many products without complete awareness to local requirements customization
- Underestimation of costs and timing of the realization
- Difficulty in integration of third-party systems, etc.
- Poor coordination of sub-contractors

PTO/PTA wrong perception

OVERESTIMATING THE ROLE AND BENEFITS OF **ITS**:

"… ITS can immediately **support new services** for end-users and stakeholder"

"… ITS will **increase performances, decreasing**, **resources/investments resulting in cost savings**

"… ITS **allows plug&play** solution for data/services integration"

"… fast to realise and easy to manage with "light" organization and operation"

- Expected **ITS performance** and **benefits** sometime **are partially achieved**
- **Time** for implementation is often **longer** than planned and **costs higher**
- **ITS need an appropriate feasibility study** accompanied by the necessary organizational and operational measures

ITS for BRT

Many SOLUTIONS and CONSOLIDATED PRODUCTS

- Fleet monitoring and management systems (BMS/AVL….)
- Fare Collection System and Integrated Payment
- Customers information systems pre/on trips on various channels (panels, audio, SMS, web portal and smartphone)
- Surveillance Systems, Safety and Security solutions
- Priority Systems
- Back-office / Management Systems

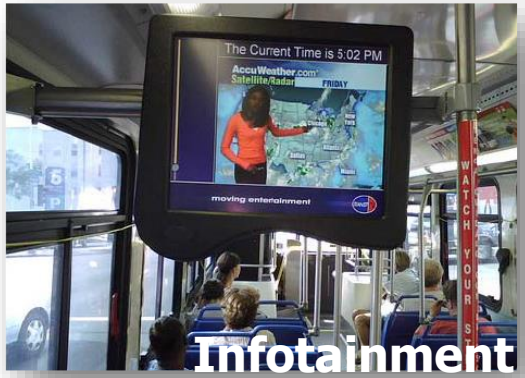
ONE SYSTEM DOESN'T FIT ALL SERVICES AND REFERENCE CONTEXTS

FUNCTIONALITIES TO BE ADAPTED TO LOCAL OBJECTIVES AND OPERATIONAL PROCEDURES

Fleet Monitoring= AVL←-->AVM ←> BMS

Fare Collection Systems

On-road / on-board infosystem



Infotainment

Rio de Janiero

Jonkoping

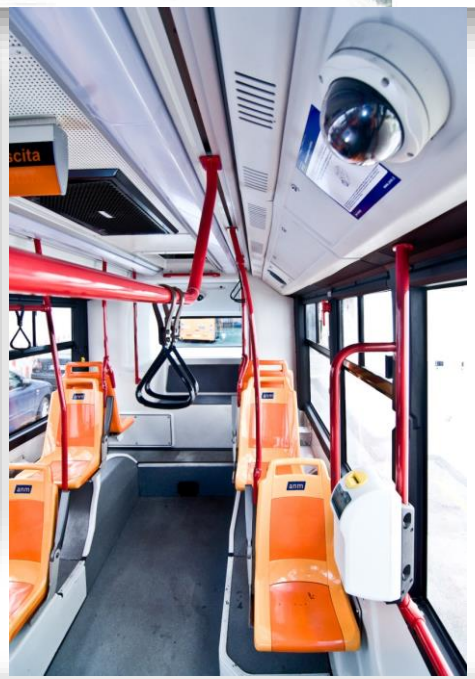
Next stop / Line direction

Rouen

System for improving security and comfort

CCTV

Video-Monitoring Control Centre in Rio de Janeiro



Fastract bus : plug and WIFI

Bus Priority systems

Nantes

Johannesburg

Design principles

AVL and e-Ticketing even more crucial for effectiveness of BRT Quality →Reliability/Regularity/Accessibility

ITS for BRT is seldom the first ITS deployed in the city

but …

they are sometimes deployed specifically for BRT with no relations with the others PT services

<u>Key considerations from technology point of view</u>:

- AVL, Fare Collection and User Information should be planned with **"network-oriented approach"**
- **"Unitary and shared"** Control among the **overall PT services and BRT operator**




Key role of AVL / Fleet Monitoring System

Controlling and acting on regularity, reliability, headway, … Service Quality and Performance

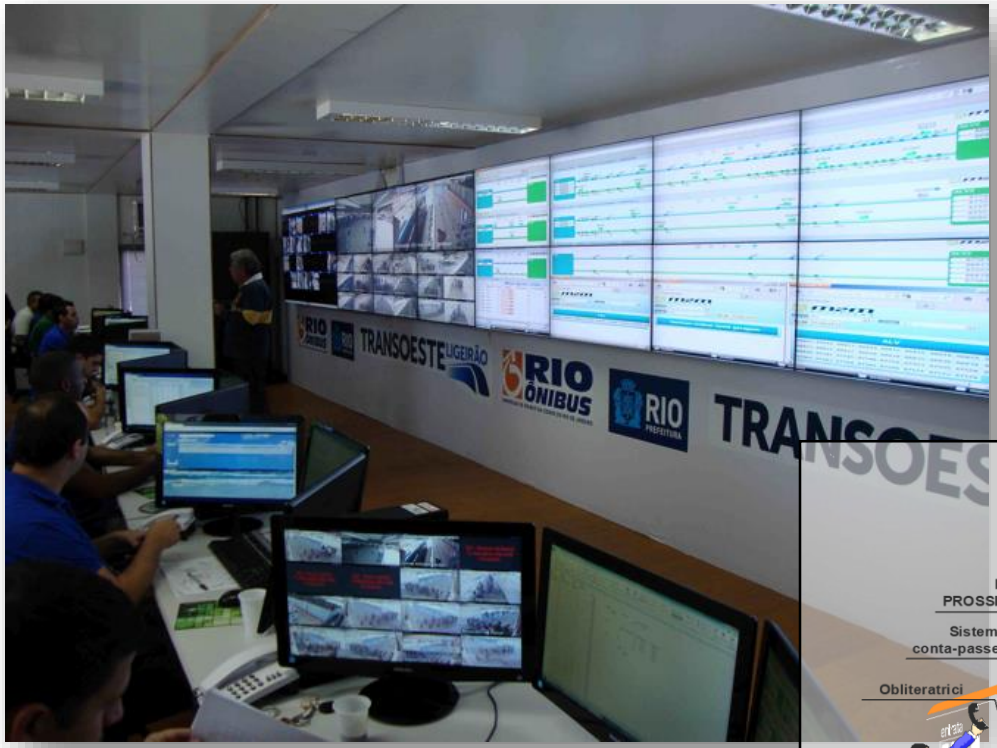
"Ancillary" to other systems specially for **e-Ticketing** User Information and Traffic Light Priority

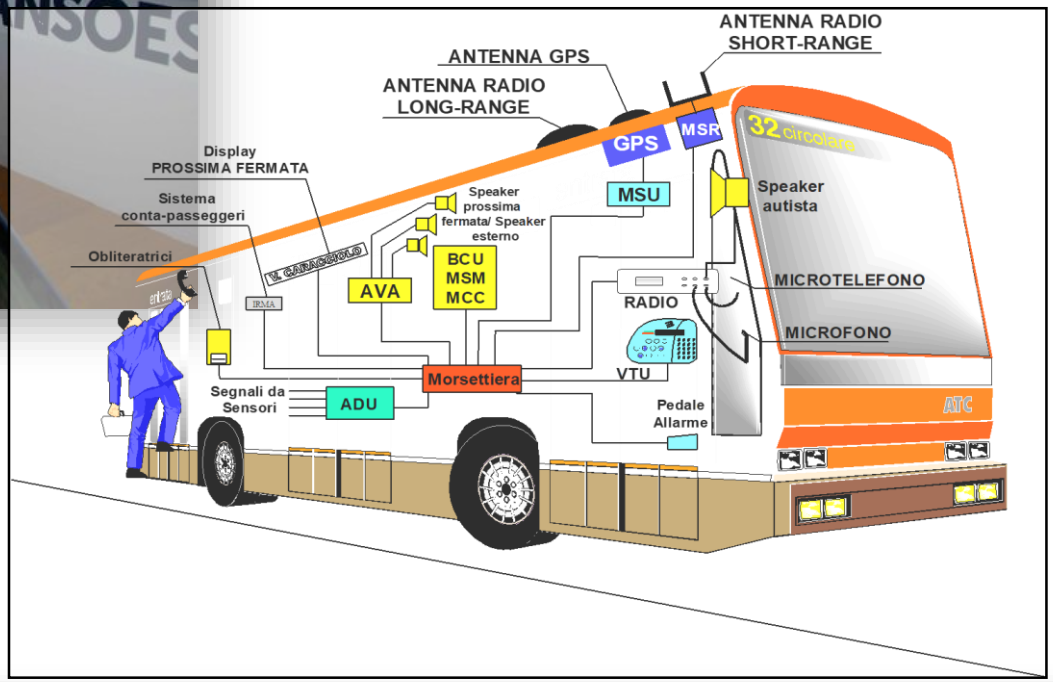
Fundamental for service contract monitoring allowing performances collection and reporting

Complexity of AVL system long deployment process

- **Design phase**
- **Contracting process**
- **System implementation**
- **Organization and operational impacts**

Design of AVL system specifications



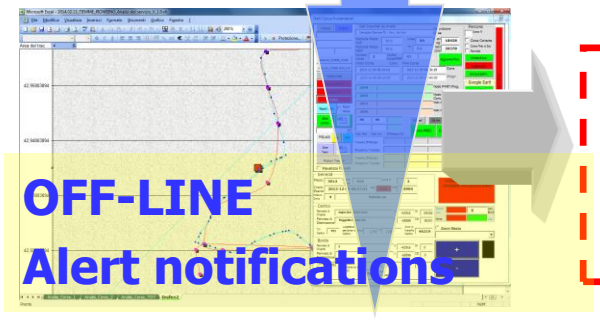


Different requirements → Different functionalities

- Fleet location and monitoring
- Service regulation
- Real-time Users info: Panels, Web, Apps, etc
- On-board safety and emergencies
- Data collection

- **CONTINUOS CONTROL (BRT CORRIDOR)**
- **TIME SHARING CONTROL (URBAN BUS LINE)**
- **CONTROL ON EVENTS (FEEDER)**

ORGANIZATION LEVEL



- Data consolidation and performances reporting
- Quality assurance and service validation
- Feedbacks vs planning

Imply different Organization Scenarios, Operation Procedures, Technology Choices, Costs

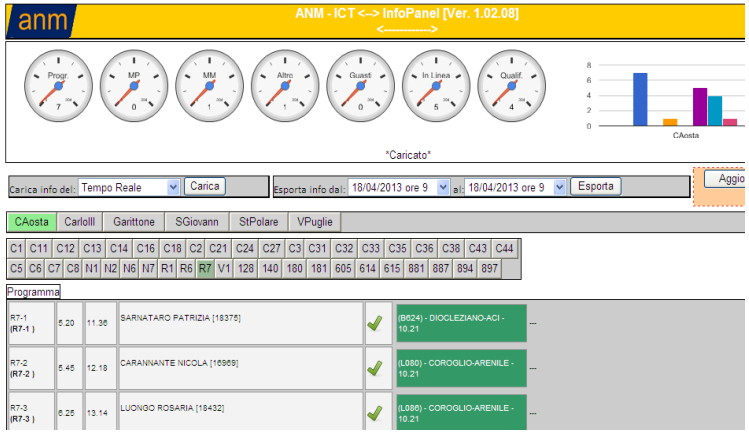
Key points for AVL design and functional options

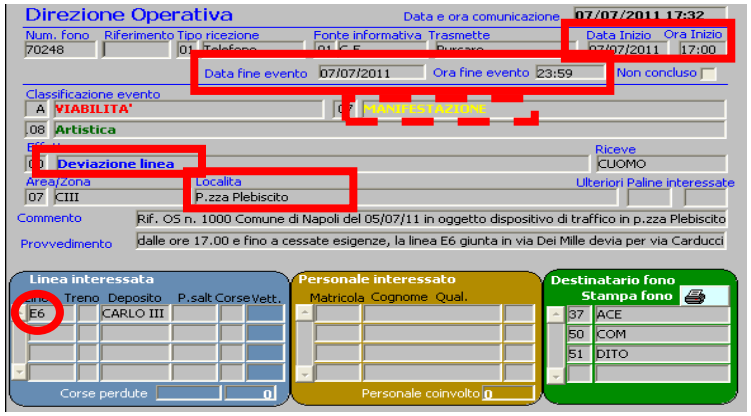
- **Import of scheduled service from planning sw:**
  - Definition of data format, exchange protocol and procedures
  - Tool/procedures to check the import is complete and successful
- **Service monitoring:**
  - Procedure for vehicle assignment with planned service (Central System, drivers, Control operators) and priority rules
  - Requirements for on-board localization (polling, by events, …)
- **Service regulation:**
  - Control Room/Events notifications
  - Management of irregular cases
- **Communication network**
  - BRT WiFi, long-range UMTS/G4/G5 as back up for BRT and primary for feeder, short range at depots
- **Reporting and data analytics**
  - For quality and KPI
  - For service contract obligations
  - For optimization of service planning

AVM design focus: the reporting functionality

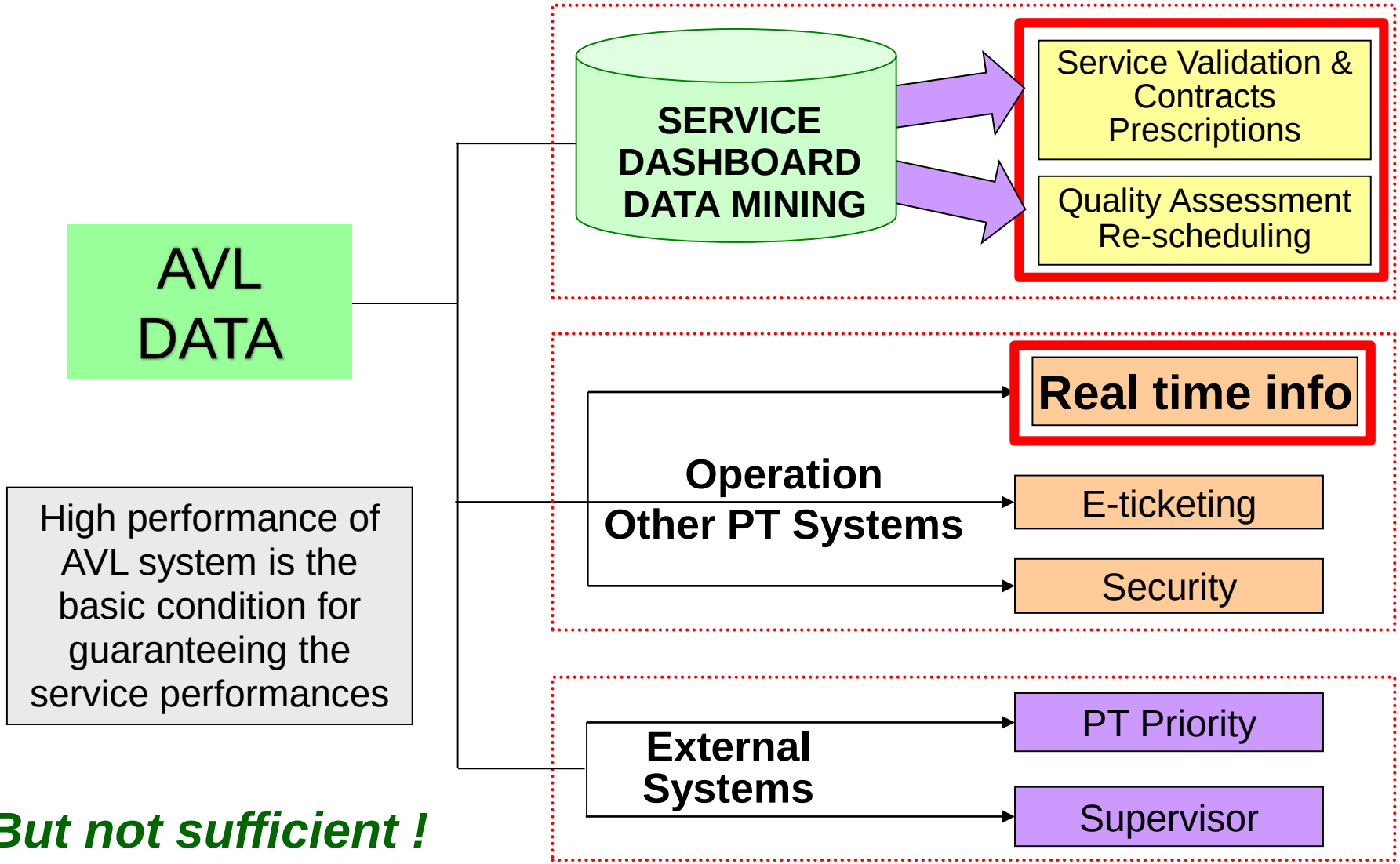
Assessment of service performance

- related to the objectives of the PT Operator to improve the provided services and optimise
  - Identification/classification of data typology (i.e. reliability, vehicle diagnostics, etc.)
  - Identification of performance indicators
  - Criteria for aggregation/filtering data (i.e. per route/line, hours, days, etc.)
  - Definition of statistics elaboration
  - Data export to other back-office applications
  - Data mining (integration with data produced by other systems)
- related to contractual obligations
  - Identification of performance indicators
  - Protocol, timing and modalities data exchange to PT Authorities
- related to systems performance





Relevance of data quality produced by AVL



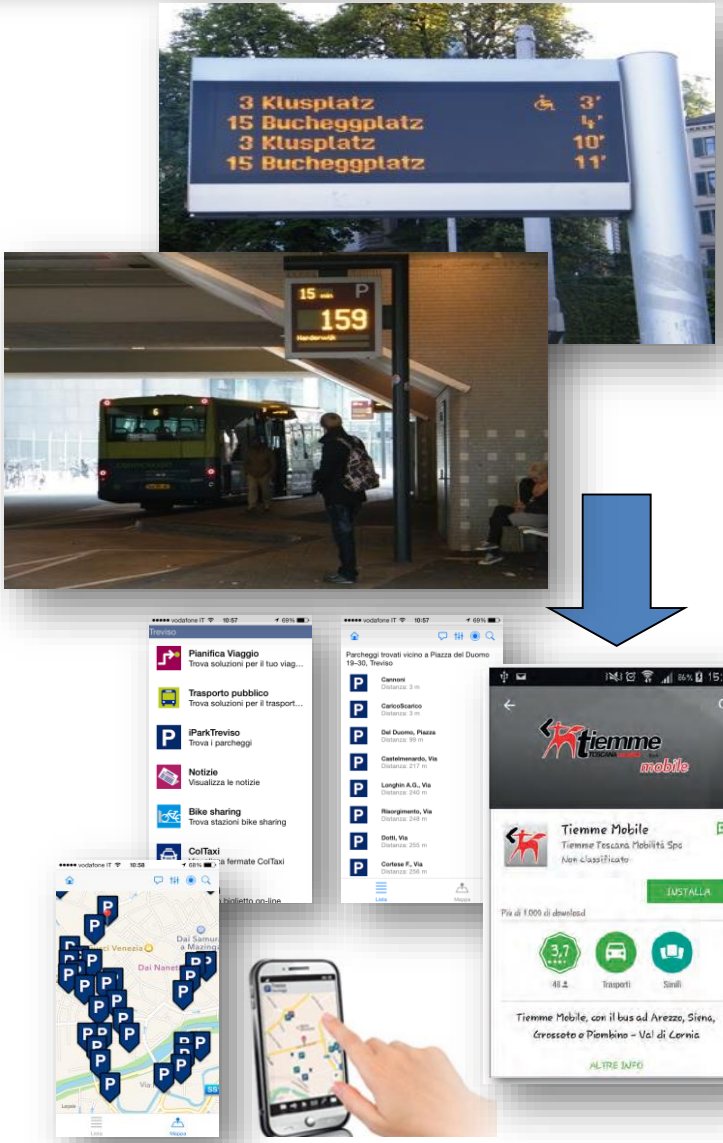
High performance of AVL system is the basic condition for guaranteeing the service performances

But not sufficient !

Quality of information and problems

Providing PT real-time info requires efficient and reliable AVL system…

… and highly performing organization and operational procedures



Technical Problems

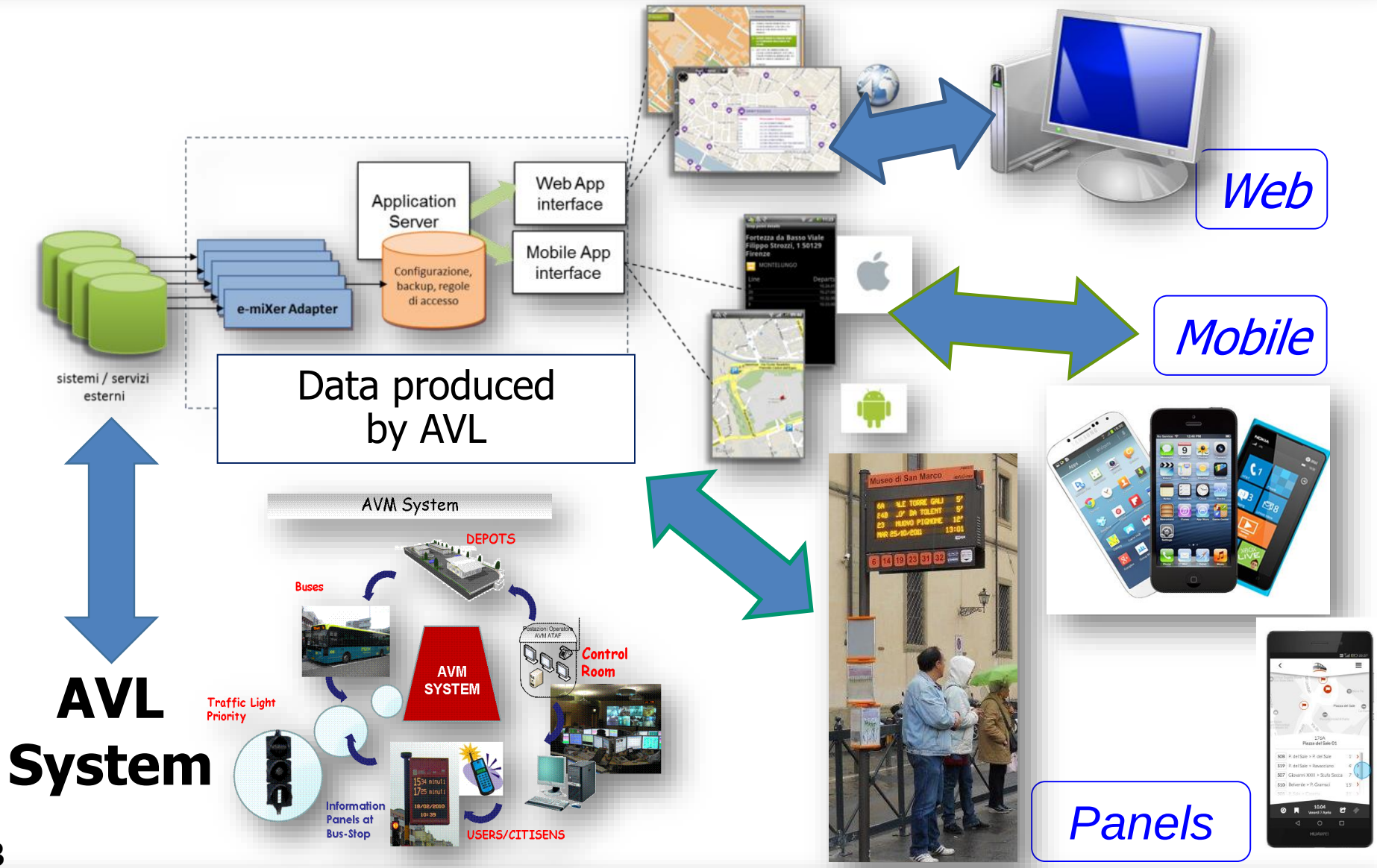
- Failure of on-board system running
- Failure in communication board-control centre
- Wrong bus location on the service
- ……..

Operational Problems

- Vehicle assignment
- Maintenance of on-board units
- Change of vehicle for failure
- Imprecise geo-coding of bus stops
- …

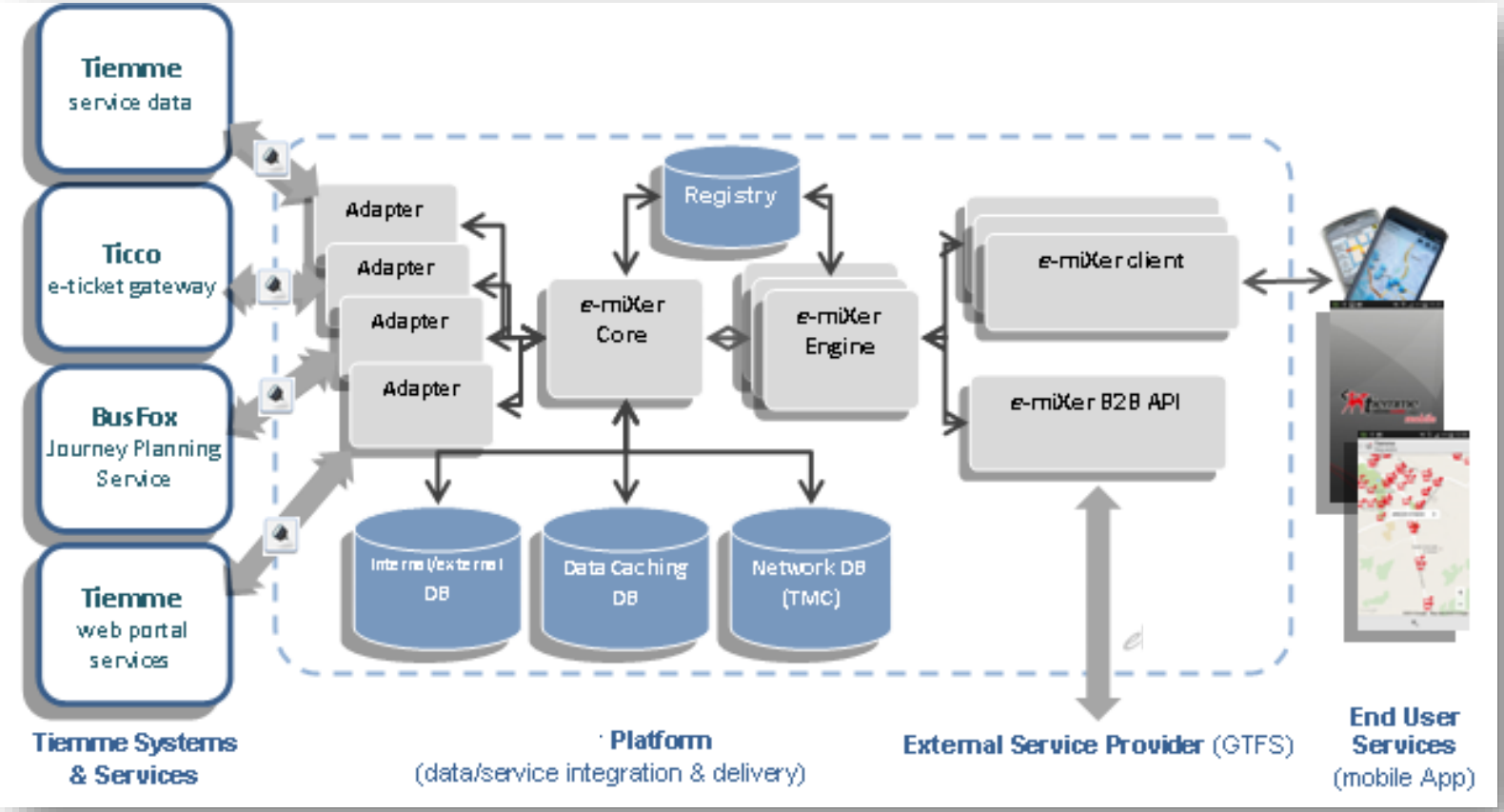
Design of Infosystem specifications

Infosystem


Application Server
Web App interface
Mobile App interface
Configurazione, backup, regole di accesso
e-miXer Adapter
sistemi / servizi esterni
Data produced by AVL
Web
Mobile
Panels
AVM System
DEPOTS
Buses
AVM SYSTEM
Control Room
Traffic Light Priority
Information Panels at Bus-Stop
USERS/CITISENS
AVL System

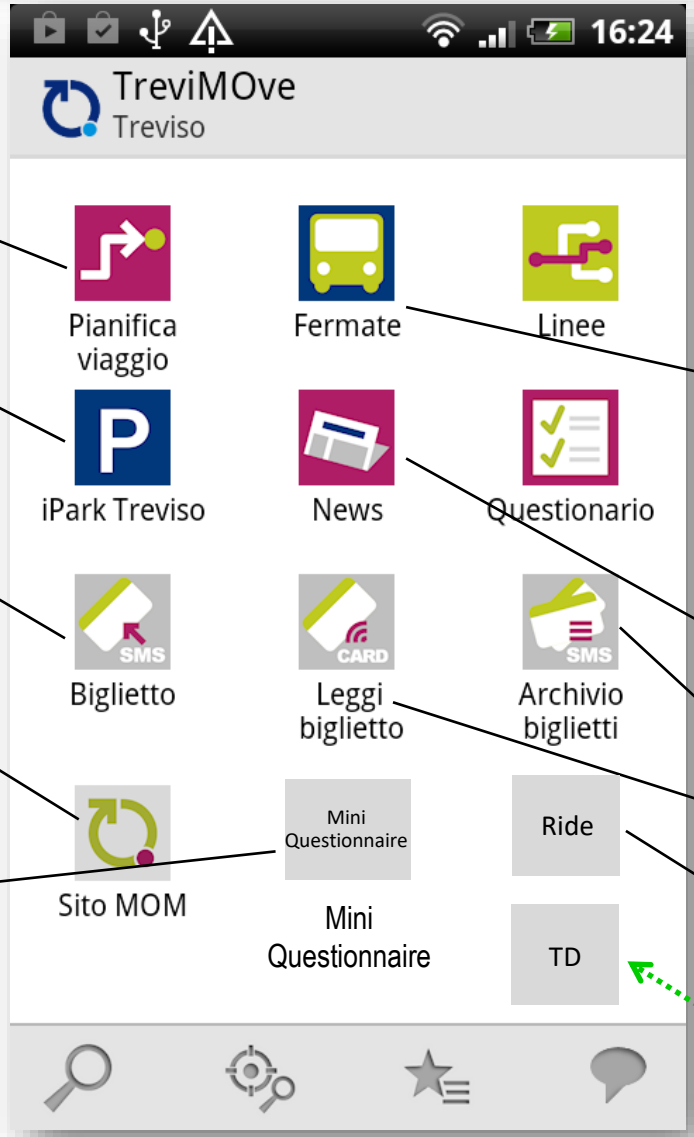
APP from PT Operator point of view

DATA



SERVICES

APP from PT Operator point of view



Trip planner

Parking info

Ticket purchase by SMS

Link to web site

Mini Questonnaire

SUMP Measures Evaluation

PT lines info

Bus stops info (real time/planned)

User feedbacks

News

Read of Ticket

Ride services

Travel diary

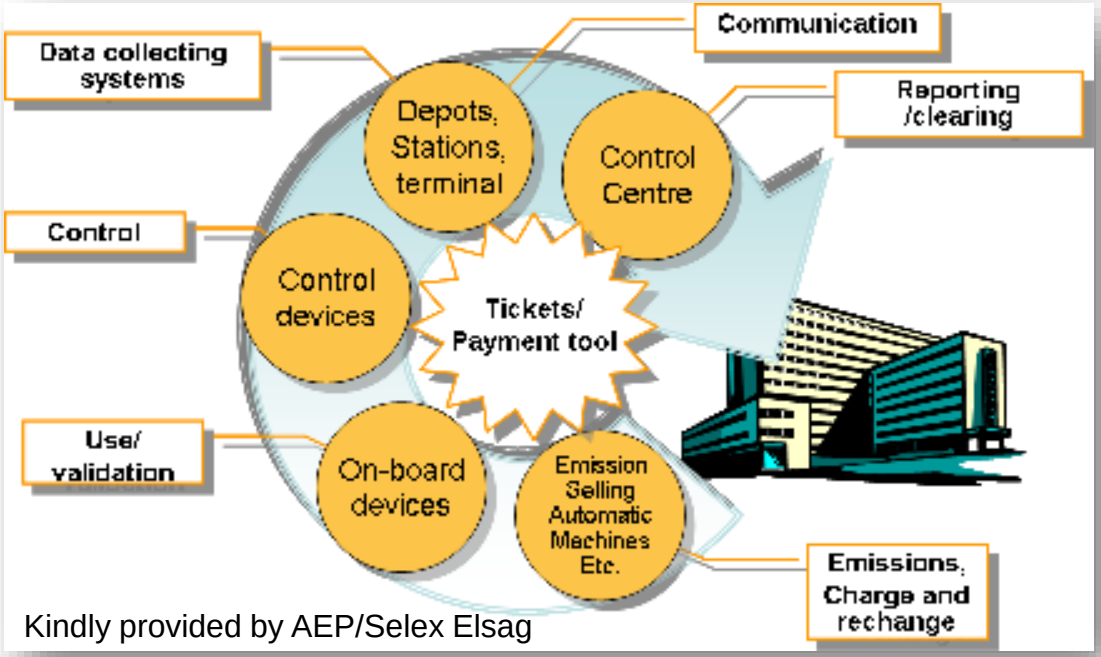
Design of e-ticketing

Focus on interoperability among different Operators

FCS: components and operational scenarios

- Smart card emission
- Selling points
- Validation
- Tickets control
- System monitoring and management
- Data collection, statistics and analysis
- Clearing

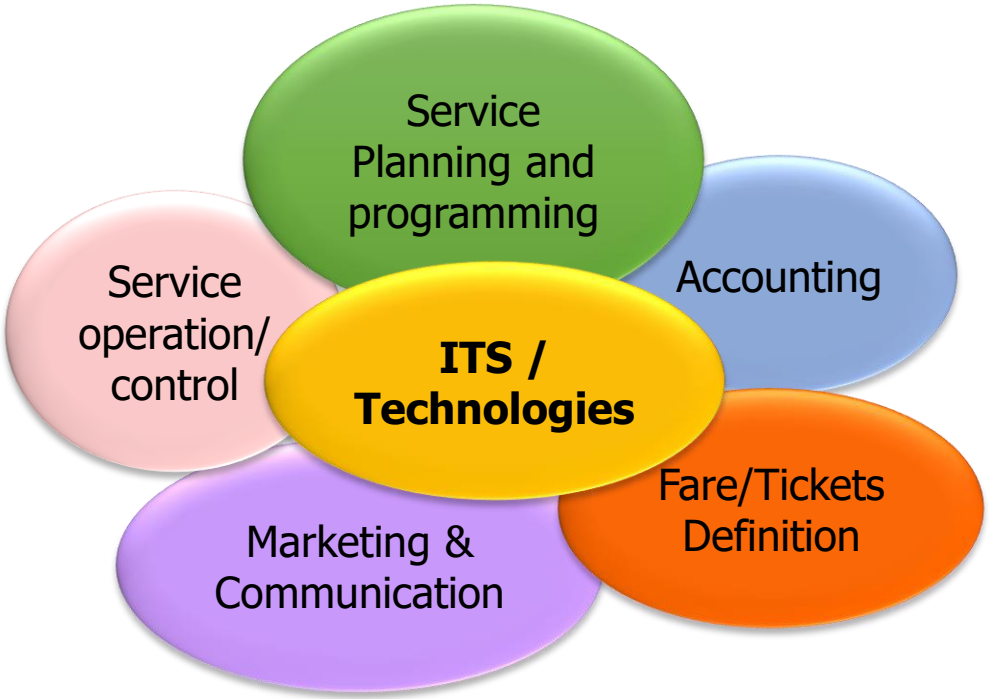
- Different organization and operational procedures among the operators
- Different systems to be integrated:
  - Accounting sw
  - Maintenance sw
  - etc.



Kindly provided by AEP/Selex Elsag

Again… more than technology

FCS system is more than choosing and specifying technologies (ITS)

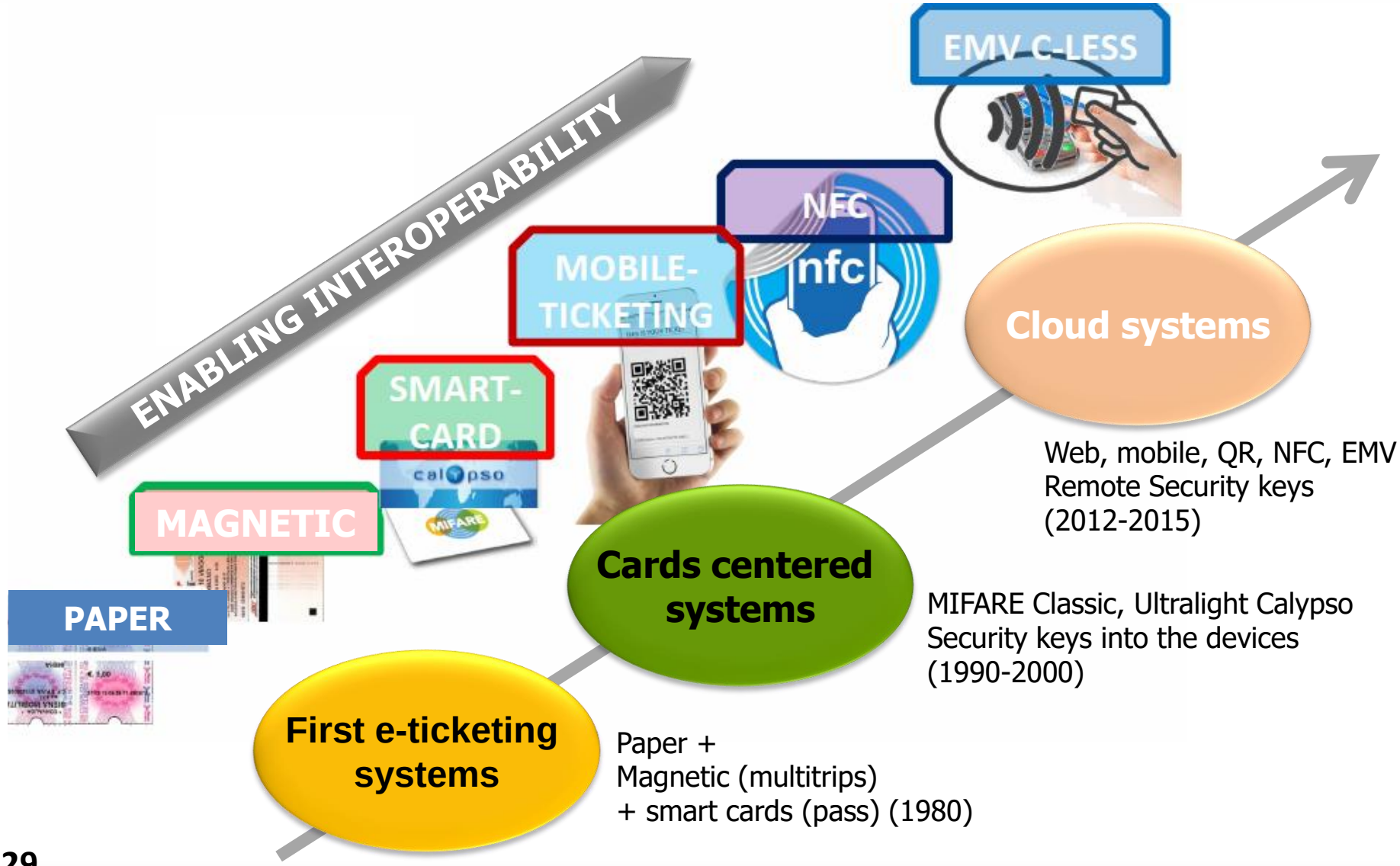


design phase plays a key role !

ACTIONS INVOLVED:

- Revision of fare and tickets
- Definition of discounts, promotional fares/flexible prices, "new" targeted profiles
- Data for cross-related analysis with other system (O/D, improvement of PT offer, optimization of on-board control)
- Integration with AVL, background data sources and accounting procedures
- Design of promotional campaign, restructuring of marketing initiatives
- ITS maintenance
  - on-board
  - depots/terminal
  - communication network
- …

FCS: the evolution over time



Spotlight on key points of the design

- Common ticket database to manage multiple vending channel
- Integration with accounting system
- Security managed by third party and outside the code (security keys). **Not in hands of IT provider**

In particular for interoperable systems:

- Definition of commercial rules/agreements among Operators
- Definition of processing rules
- Definition of "private" or "hared" data level
- Definition of access rights for reported data and statistics
- Definition of clearing rules and procedures

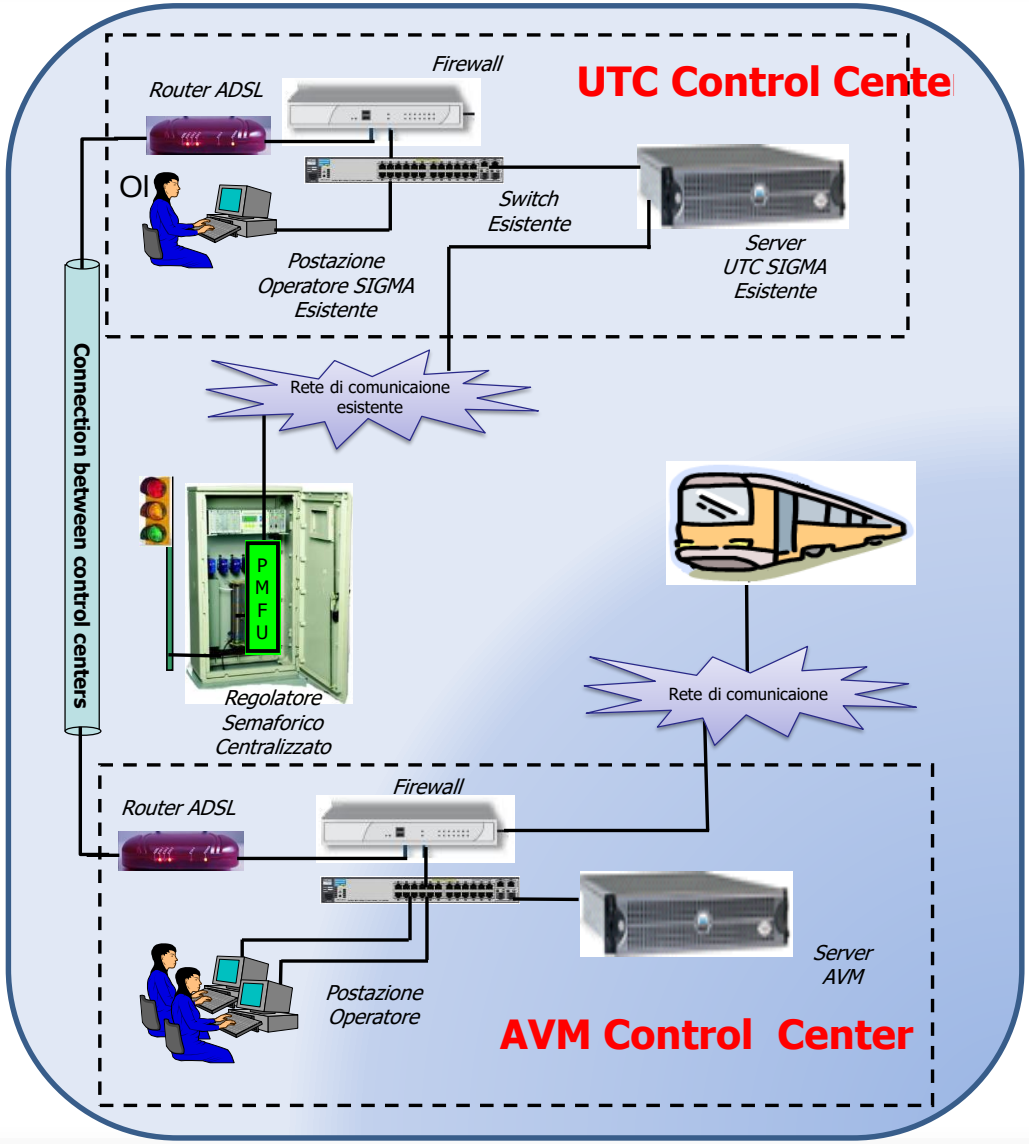
Integration with other city systems – Towards MaaS

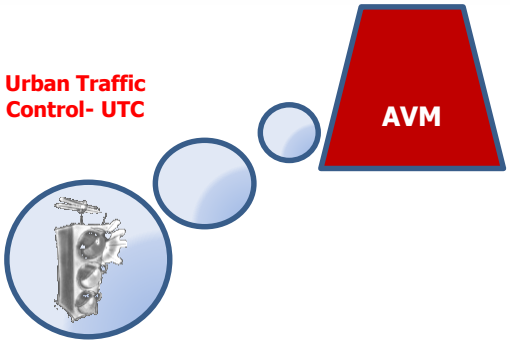
Priority system

Key elements:

- Architecture
  - centralized/de-centralized/Mixed solution
- Priority strategies:
  - unconditional/conditional (based on vehicle status)
- Technological solution:
  - physical devices installed on the road
  - direct communication between vehicle and traffic light
  - communication between AVM and UTC Central systems

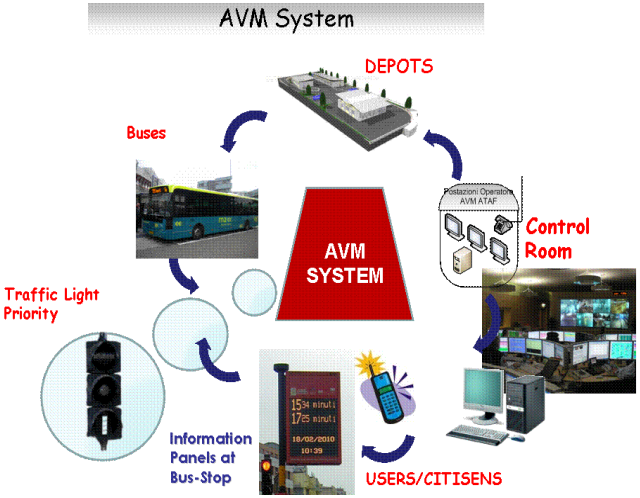
Traffic Light and AVM system





- **Direct Connection**
- **Priority Policy**
- **Data Flow between Centers:**
  - Bus identification number
  - Junction Identification number
  - Line
  - Bus state (in orario/in anticipo/in ritardo)
  - Priority for each lines
  - Timing of priority request to UTC by AVL

AVL (and PT- ITS) role in MaaS



- AVL, e-Ticketing, User information are **the base systems** for **any MaaS initiatives**
- **The Transit data are relevant for any modes integration**
- The role of PTO **is fundamental** in terms of open data, system responsible and services provider
- **MaaS must involve strongly the PT Operators/Agencies**

Feasibility Study

A good practice: a detailed ITS feasibility is necessary

- **Objectives** to be achieved
- **Needs** of relevant actors, their role and responsoibilities
- System's **functionalities and use cases**
- **Architecture, technical requirements**
- Appropriate **management and maintenance procedures, Organization structure, resources**, responsibilities.
- Business Model, *estimated costs* for investment, maintenance and operation

Pre-condition procurement process

Costs vs Benefits

Feasibility, Procurement and Contracting

Investment, Maintenance, System evolution

Internal costs for system implementation, operation, staff training and management: control room, depots, reporting, info devices, planning

Create and maintain data flow among ITS and external systems, integrating databases and

Improve the quality of the service and the customer satisfaction

Attract new customers

Increased efficiency in internal procedures

Reduction of staff (it depends case by case)

More transparence in contract management and more efficient planning

To be evaluated vs framework conditions and services scenario

Contracting

Approaching the procurement process

- Technical criteria more relevant than the price
- Do not underestimate the resources and time required to manage the procurement
- A must: build the required coordination/links among the involved dept/staff

Contracting model and object of the procurement

- ITS contracted as "supply" or "service (SaaS)" ? Different operational scenarios and costs impacts

- In both cases, it is recommended to detail the supporting services the Contractor should guarantee, in terms of:
  - Activities (maintenance, on-site presence, trainings, etc.)
  - SLA, expected outputs, etc.
  - Resources to be guaranteed (maintenance staff, tickets distribution, cash collection, etc.)

Contract realization plan

- Define a "step-by-step" realization:

1st step:

- "Prototype" of the system with "reduced dimensions" but "full set of functionalities" (i.e. one corridor, etc.)
- "Prototype" of the system to be under operation (avoid "lab tests")

Following steps:

- Extension of the "prototype" towards the full required system

- Verification of "all" system functionalities from the early beginning
- Facilitate the monitoring of the implementation and the application of penalties
- Smooth launch of operation and reduced operational impacts (to be more easily controlled)
- Smoother introduction of operational procedures with opporutnity to tune them
- Define time of each phase with a realistic approach

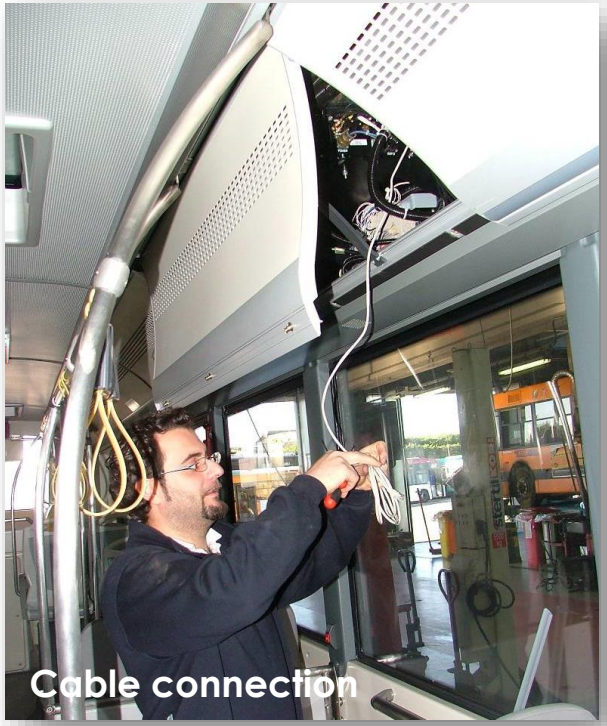
Penalties and Contract termination

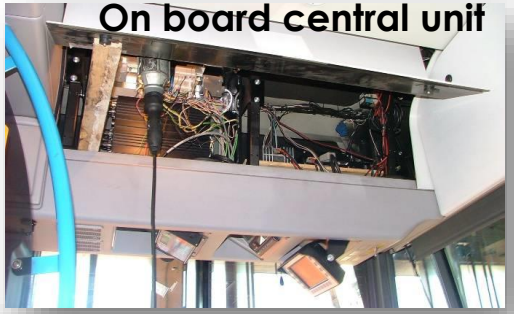
- Payments can be related to each implementation step and to properly defined achievements
- Achievements should be measurable in terms of outputs and performance indicators (target values)
- Penalties based on:
  - Delay in achieving target outputs/performance
  - Lack of compliance of the outputs/real values of performances indicators compared to target values defined in the technical specifications

…… up to Contract Termination

Implementation & Operation

On Board system installation and maintenance …


Cable connection


On board central unit

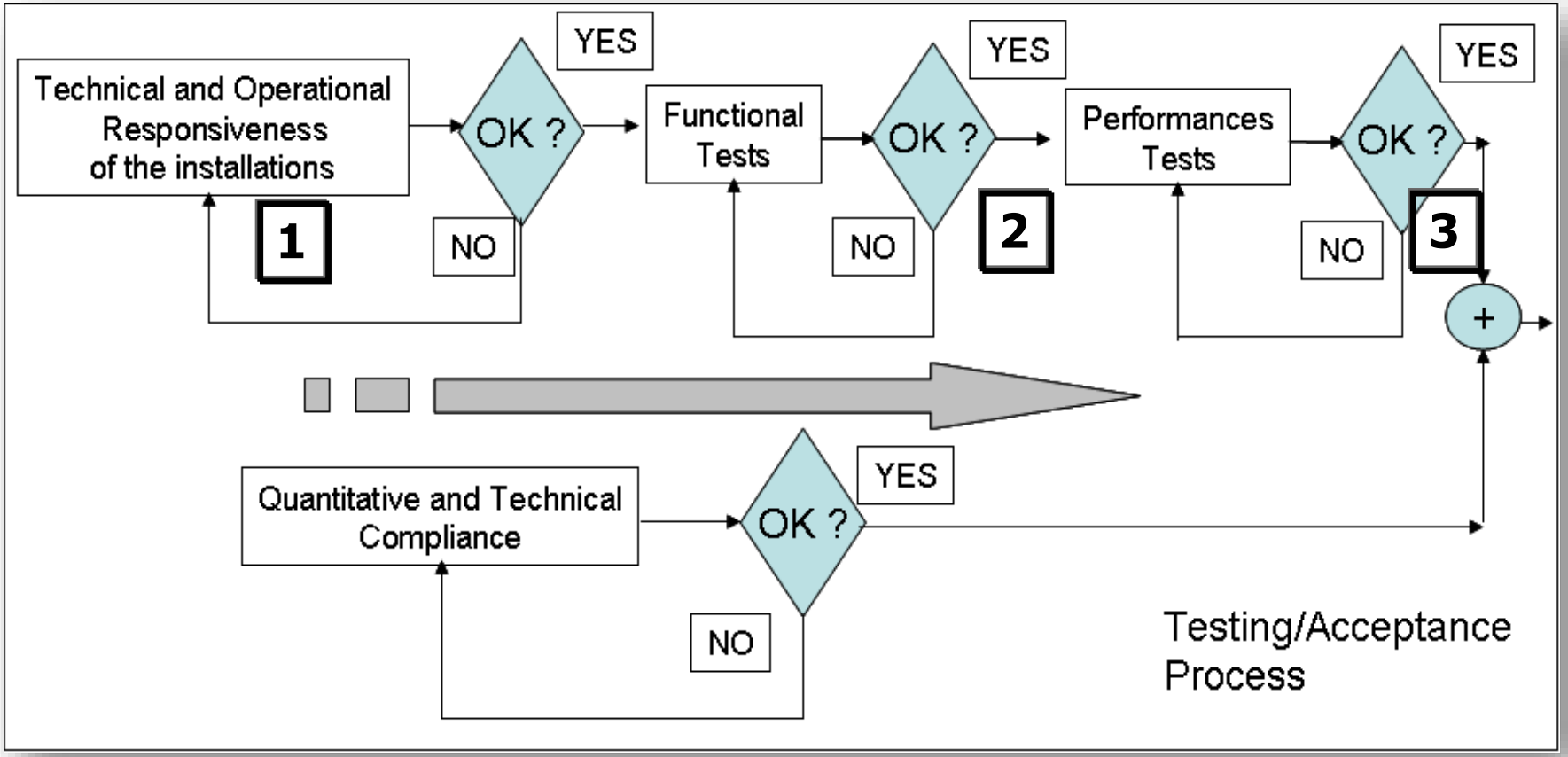

Live voice microphone


Panel

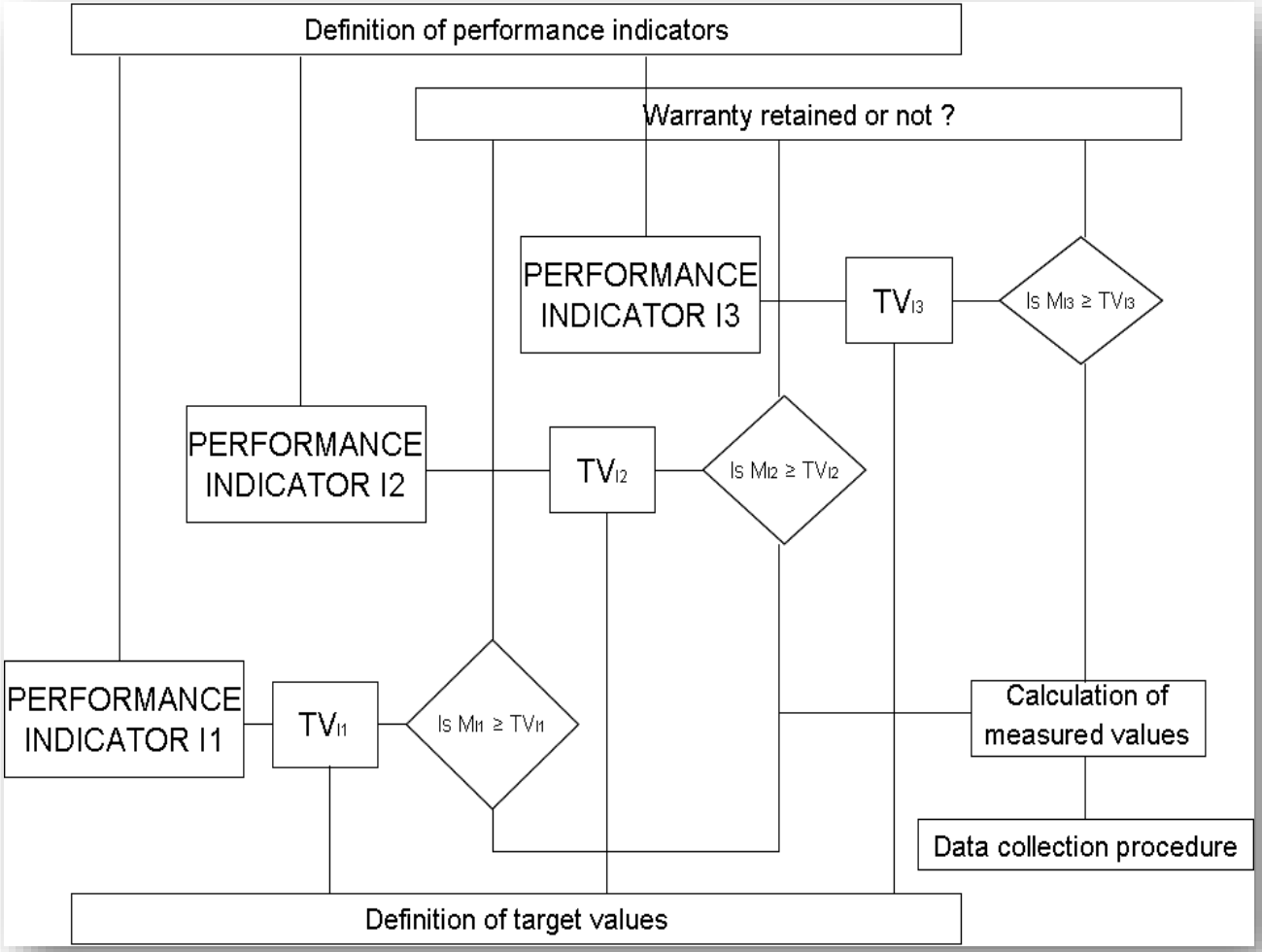
Next Stop announcement


Driver Terminal

Three stages process



Performance verification - KPI for AVL system



- Availability rate of control centre
- Availability rate of on-board device
- Rides monitoring rate
- Precision of time estimation at bus stop/terminal
- Location Accuracy
- On board event notification
- Availability of data communication
- .....

Conclusions

From decision takers: what we need

- **Clear identification** of the needs, requirements and targets
- **Awareness** of the system complexity and realization process
- **Sharing of experience, benchmarking of the current practices**, benefits, and problems encountered in similar contexts
- **Balancing the role of technology** respect the operation procedures and organization scenarios
- **Detailed feasibility analysis,** including definition of performance indicators and organizational/operational aspects
- Estimation of all the **cost categories**: investment, operation, support service for implementation, maintenance, etc
- Clear definition of **testing and commissioning procedures**
- Identification of needs in terms of know-how and competencies

Thanks for the attention

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