Exploiting IoT and Big-Data for Building Multi-service Capable Intelligent Transportation Systems

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Structure of the presentation

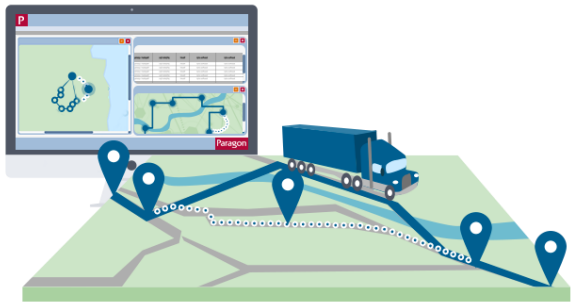
1. User requirements and objectives
2. Location tracking and in-car IoT networks
3. Next generation e-Call
4. Crowdsourcing and big-data
5. Concluding remarks

Background, objectives and related work

OBJECTIVES AND PRIOR WORK

Use-cases and User requirements

Drivers safety and assistance



Highway management

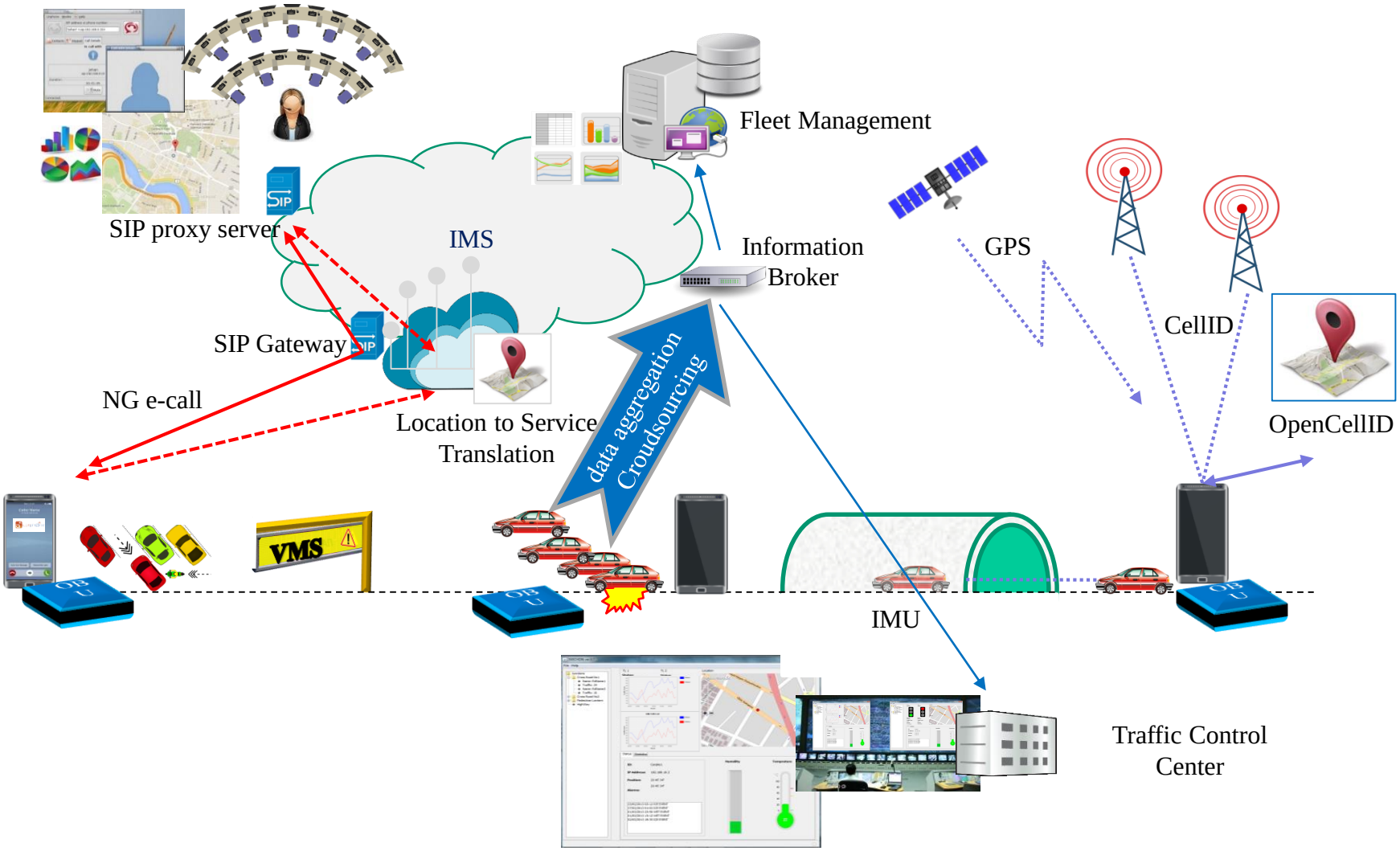
IoT

Fleet management

Big Data

- The Multiservice cApable iNtelligent TransportatIon Systems (MANTIS) project objectives:
  - Enable **geolocation of vehicles with reliable and continuous position detection**, regardless of environmental and network conditions.
  - Enable the **collection and dispatch of sensor data for recording primary operational parameters through appropriate Internet interfaces** and protocols.
  - Enable the automatic execution of **emergency calls via Internet communications (VoIP)** - even in cases of passengers' incapacity - by means of automatic call routing, to the appropriate/closest management and driver assistance centres, based on vehicle's location, accompanied with critical data from the on-board sensory instruments (NG-eCall).
  - Enable the collection and transmission of useful **data for tracking environmental and extraordinary conditions** by external infrastructure management centres (e.g. road operators, prefectures etc.) as well as by fleet management systems for corporate (M2M) applications, exploiting **crowdsourcing** techniques and intelligent big data analytics.
  - Enable interoperability and customised dispatch of data to the selected management centres.

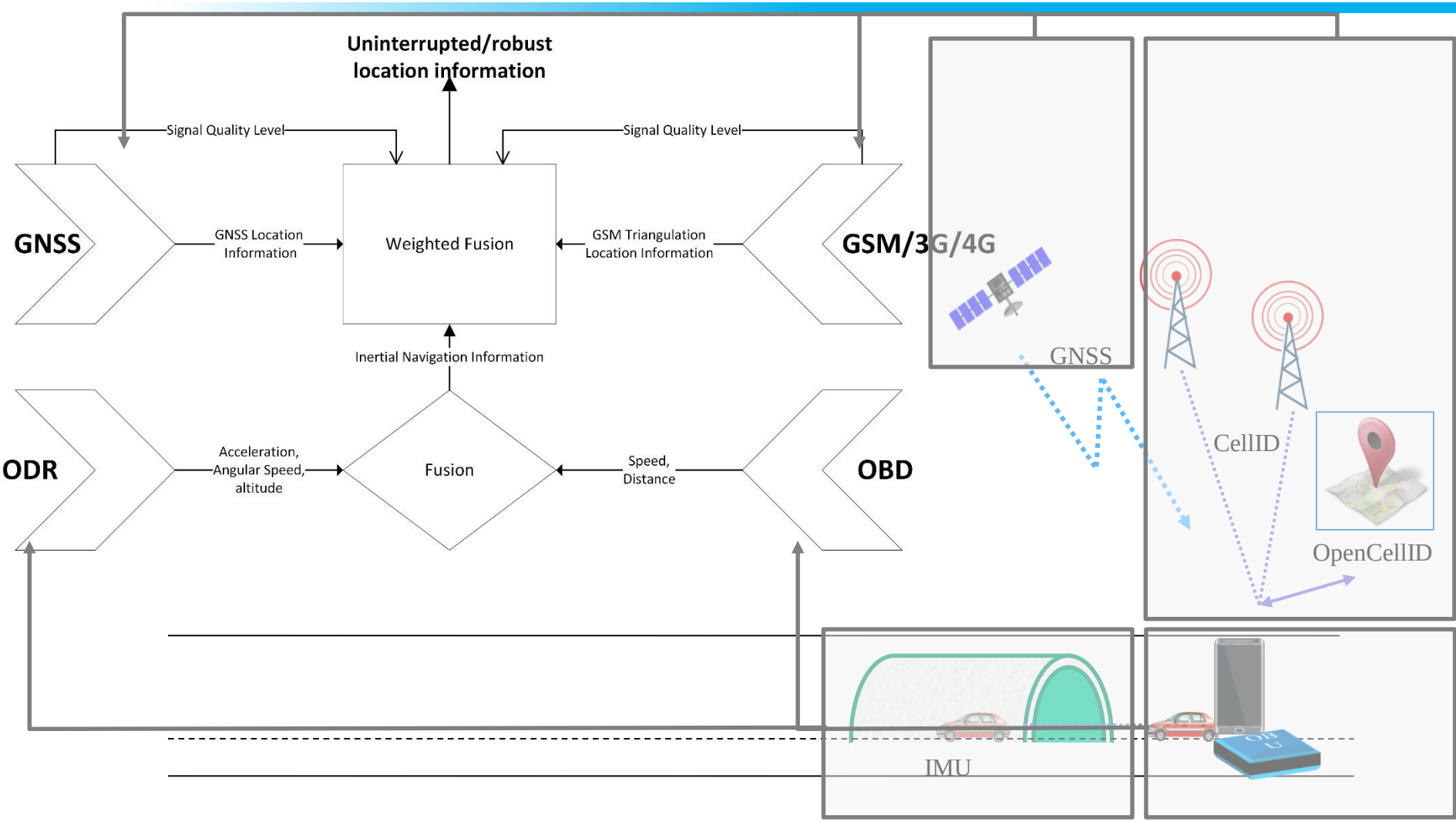
MANTIS architecture



Location tracking technologies and in-car IoT networks

LOCATION TRACKING & IN-CAR IOT

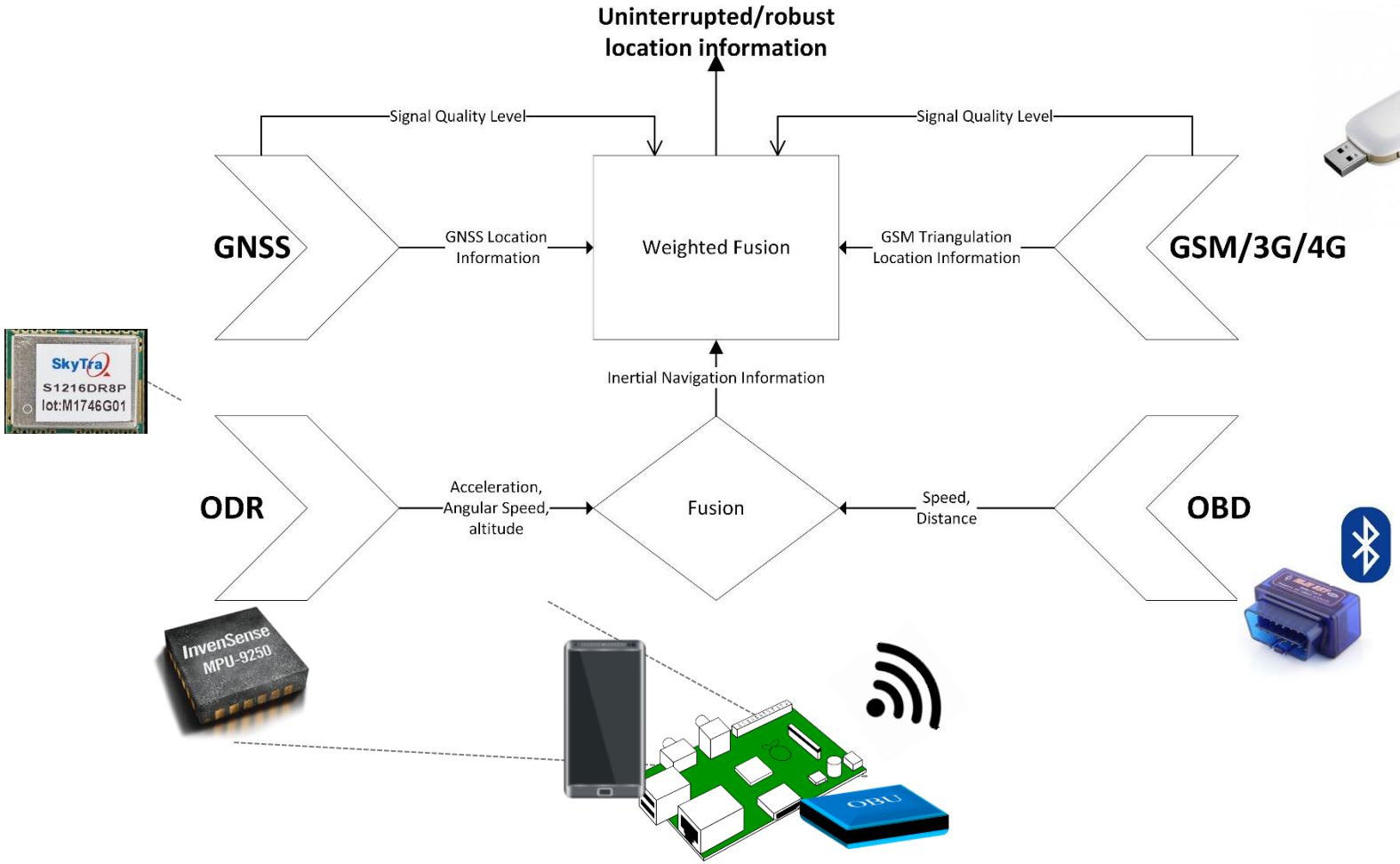
Location tracking



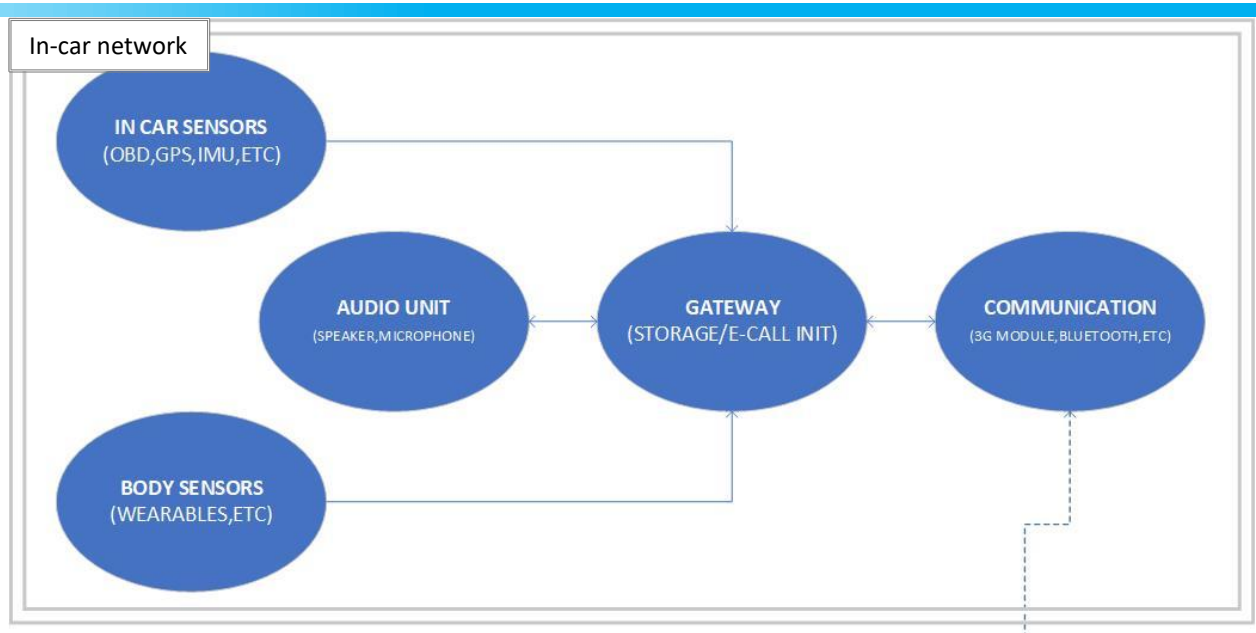
Location Tracking - Multistage dynamic sensor fusion

- Multi-Input: GNSS, Cellular Triangulation, Inertial Navigation, Vehicle Odometer
- Dynamic/Smart Location Information Combination
- Kalman Fusion-Filtering Based
  - ❖ A loosely coupled Stage (Inertial Navigation Synthesis)
  - ❖ A tightly coupled Stage (Triangulation based Synthesis)
    - ➢ Coupling augmented by Signal Quality Information (Dynamic Weighting)

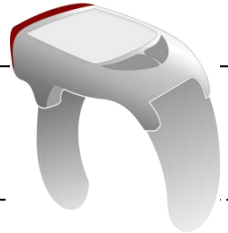
Location tracking – System design

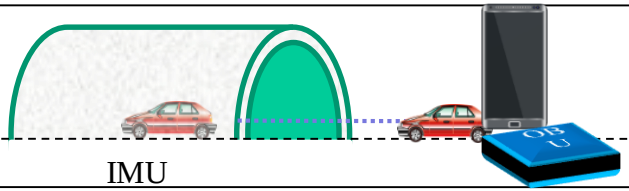


In-car network



Vehicle Sensors
e-Health Sensors





IMU

IoT data aggregation

Location tracking

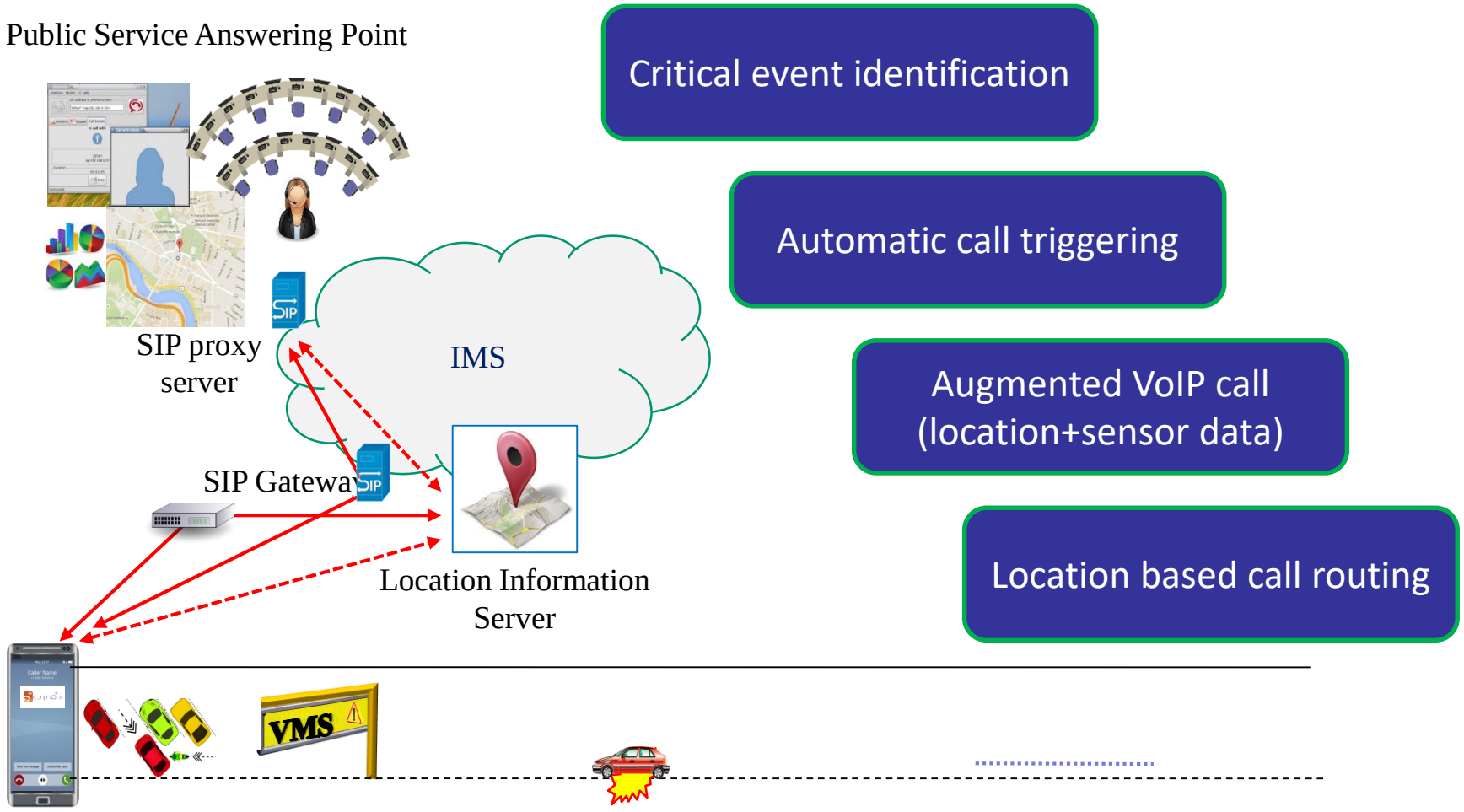
In-car Network

- Sink/Concentrator Model. A central device (GW) captures data from:
  - Car Onboard Diagnostic System (OBD)
  - Car Infotainment System
  - Driver & Passengers Wearable devices
  - Other Peripheral In-Car Devices
- In-Car communications are based on wireless technologies (Mostly Bluetooth)
- Edge Communications (In-car to Outside Services) based on 4G/5G technologies
- Concentrator Preprocesses and/or stores Data
  - Bandwidth reduction & Edge Networking redundancy
  - Context Modeling for In-Car real time services
- Security: PAN Based Networking (Network Limited to area inside of vehicle only)

Emergency communications and location-based VoIP call routing

NEXT GENERATION E-CALL

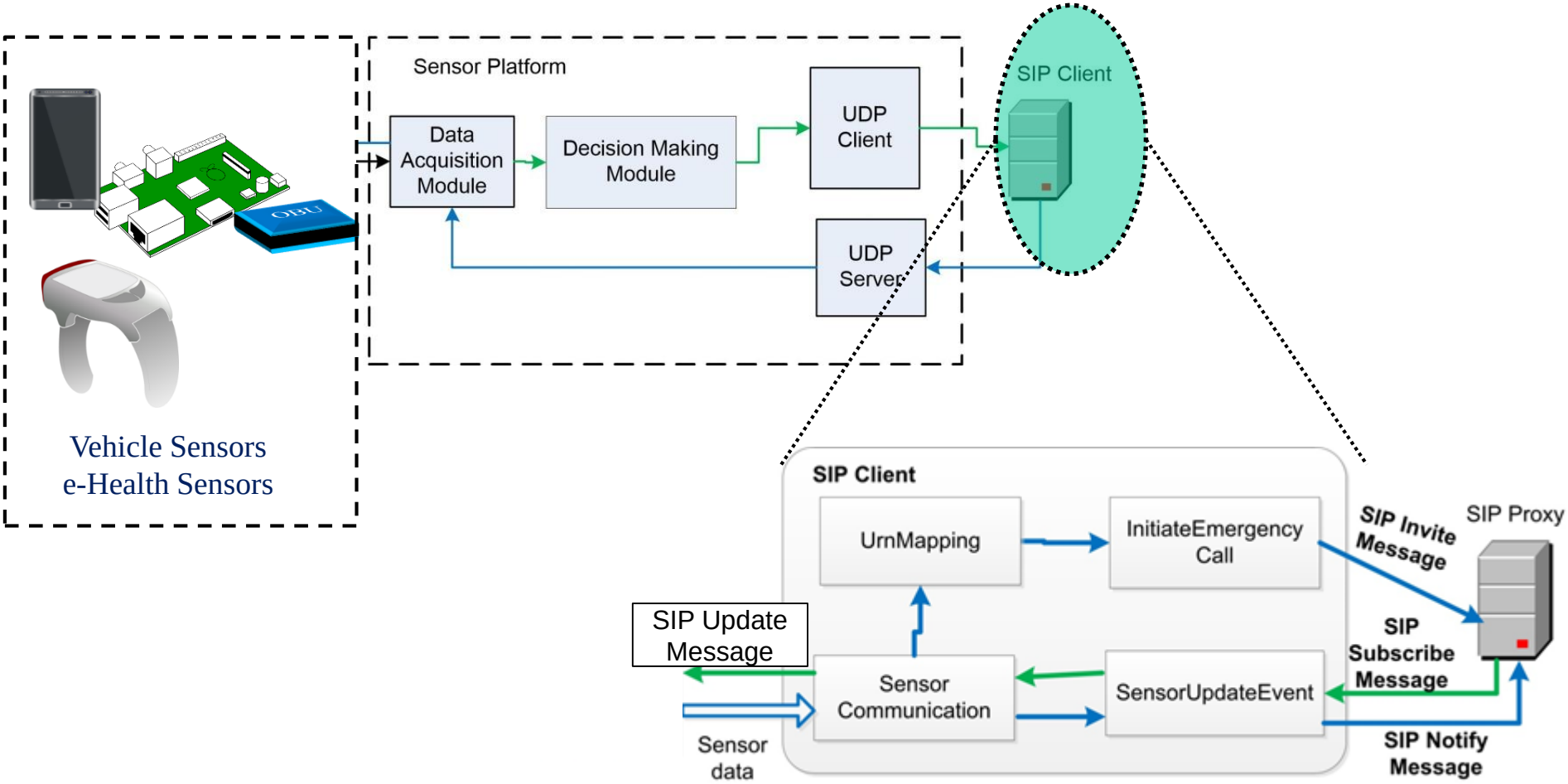
Driver assistance via NG-eCall



- Critical event identification
- Automatic call triggering
- Augmented VoIP call (location+sensor data)
- Location based call routing

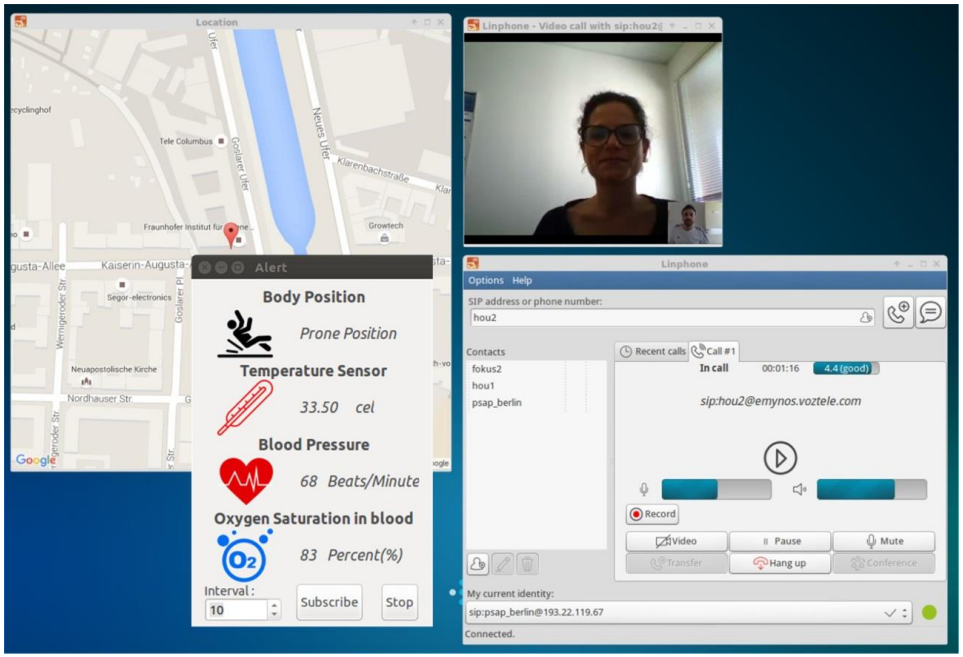
NG-eCall – vehicle side

In-car network

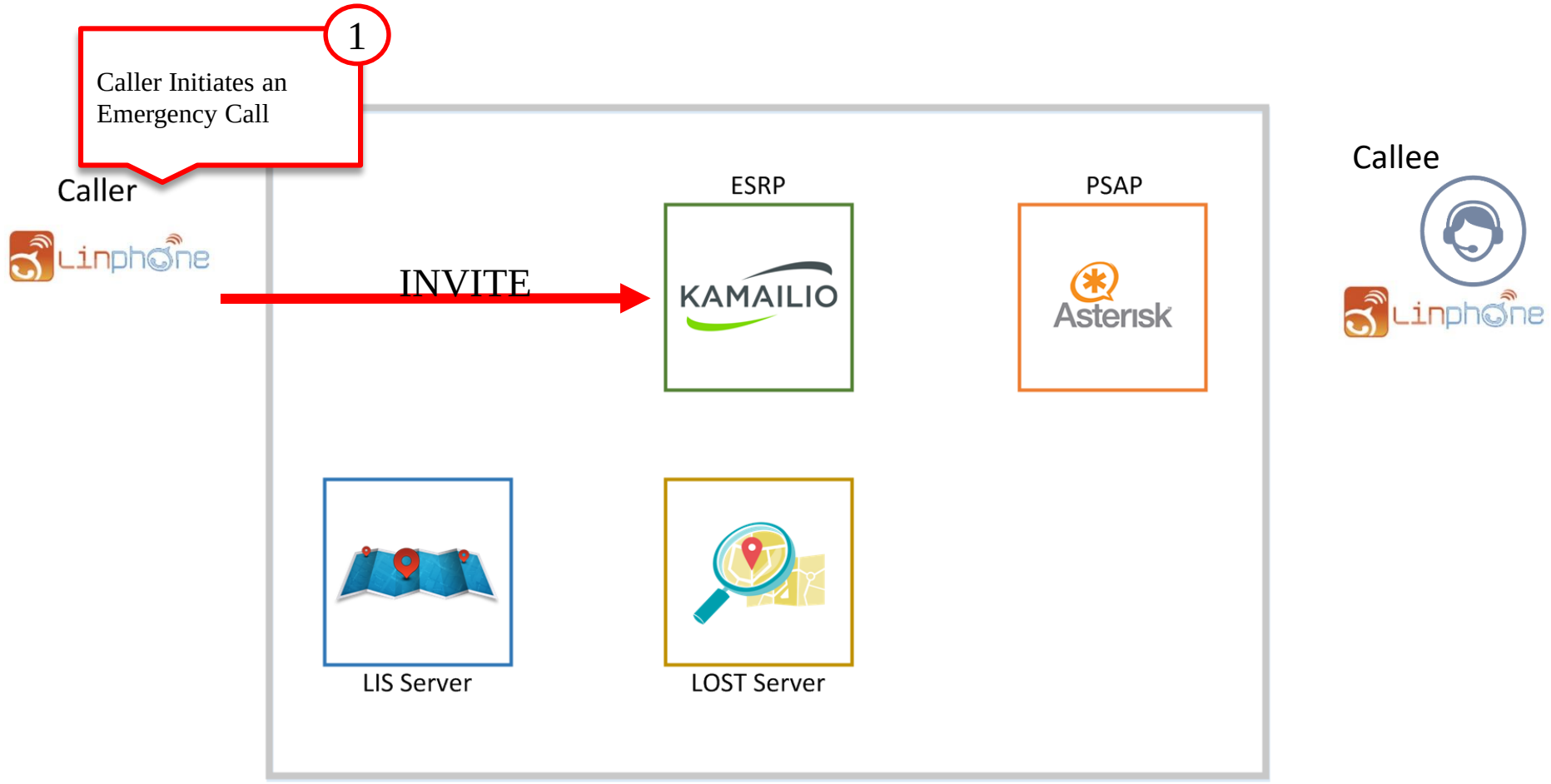


NG-ecall Implementation Status

- ✓ **Extensions to existing applications:**
  - Linphone (Caller/Callee Side)
  - Asterisk
- ✓ **Audio and video communication**
- ✓ **Extended „MSD“ (incl. sensor data)**
- ✓ **Real-time sensor data**



Location based VoIP routing



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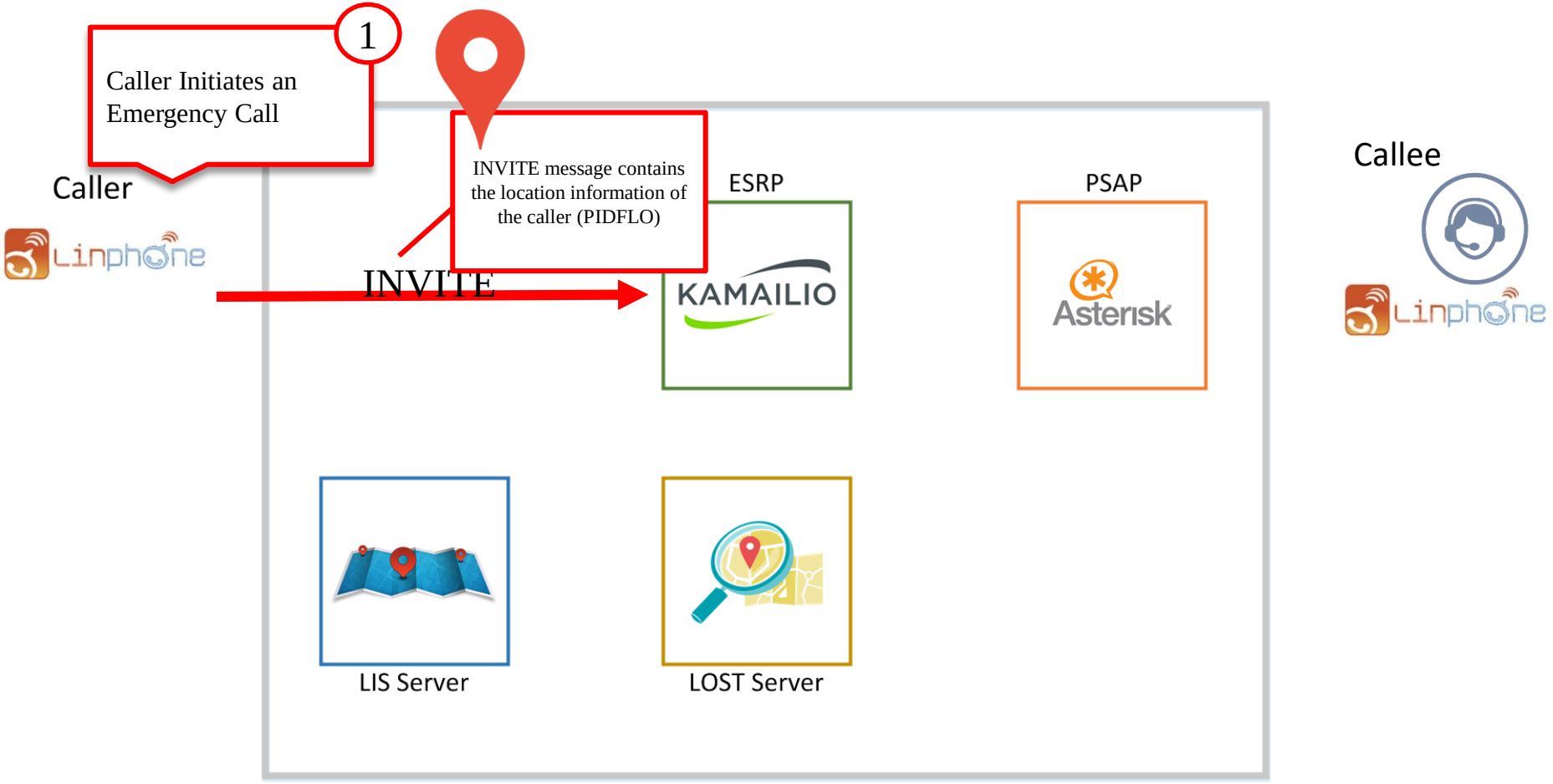

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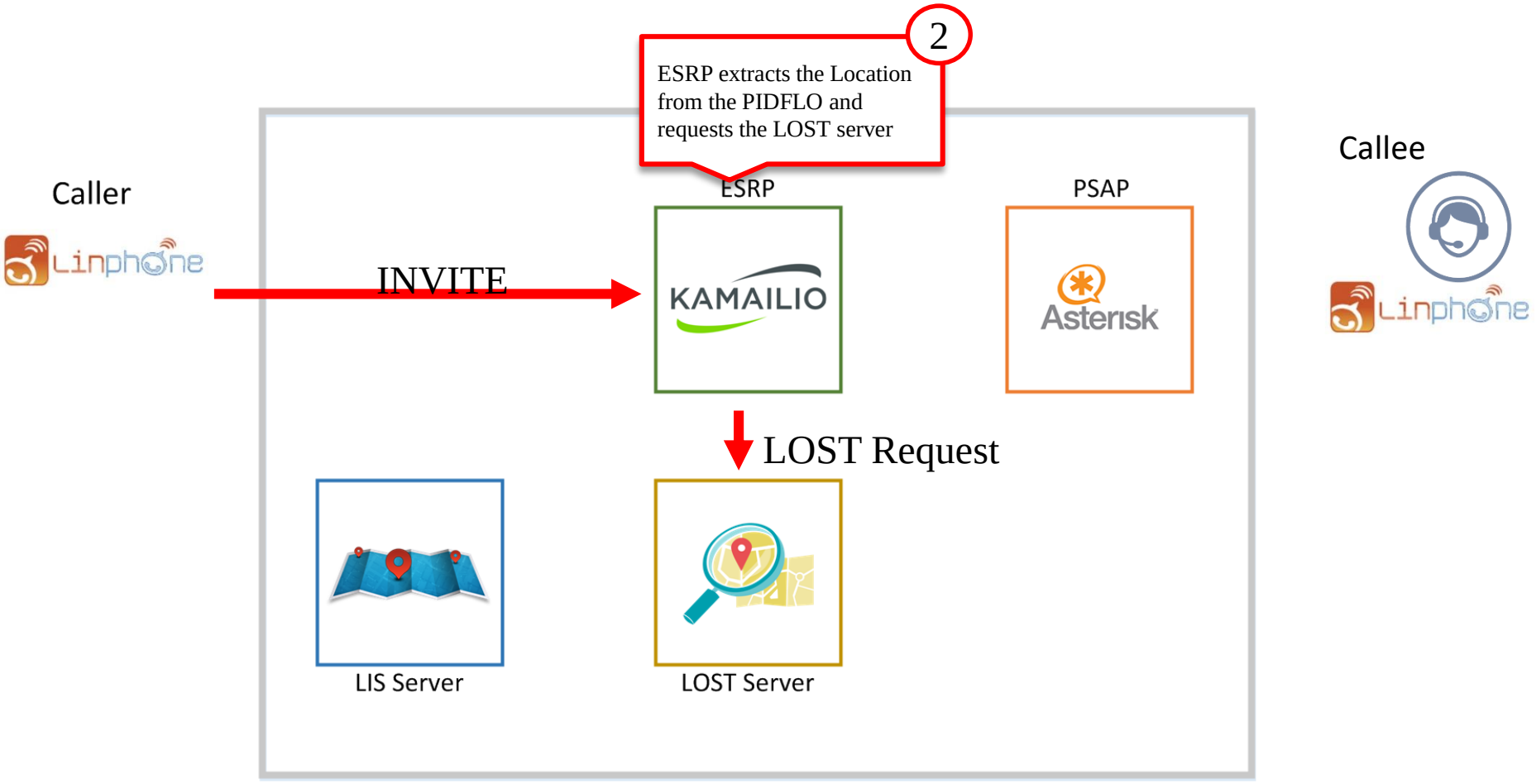
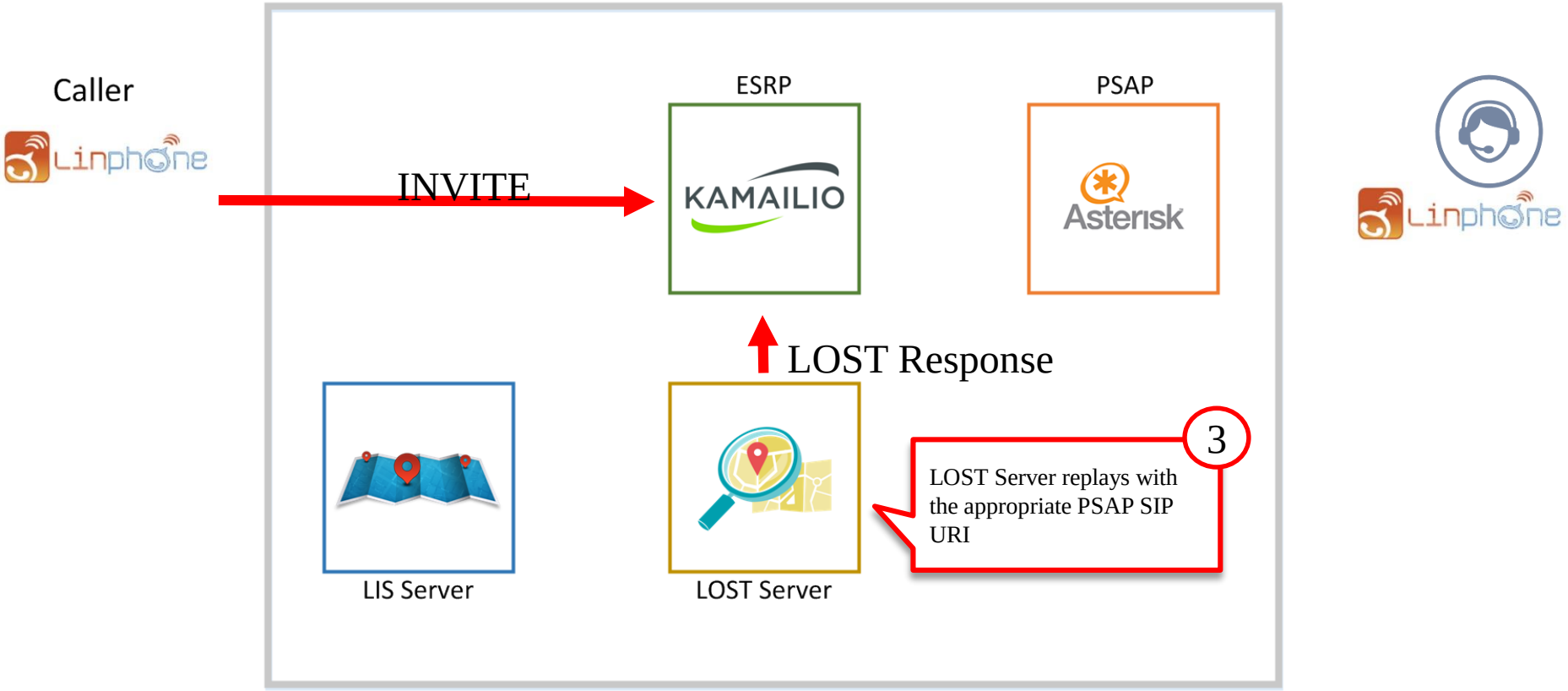


Location based VoIP routing



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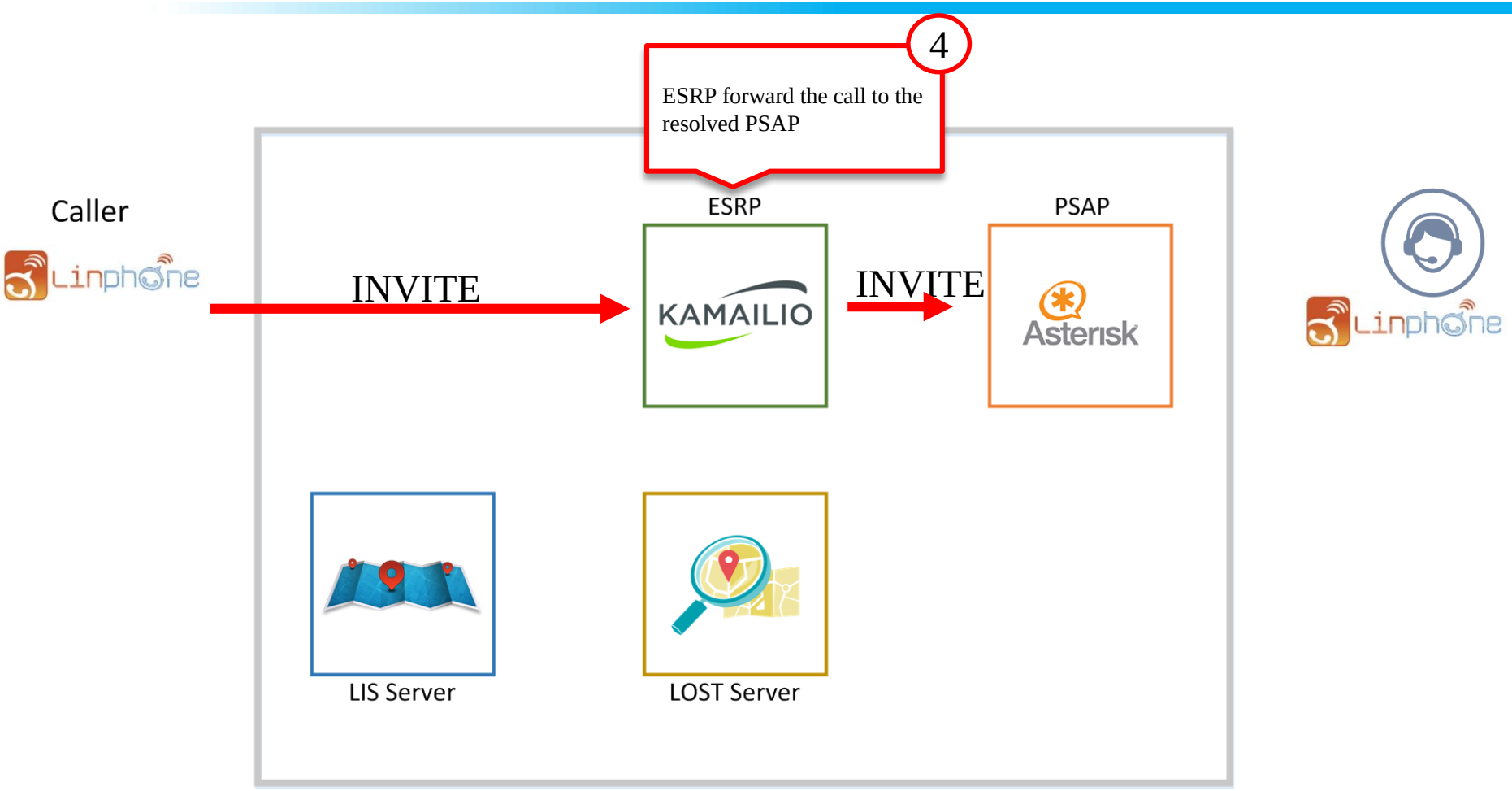
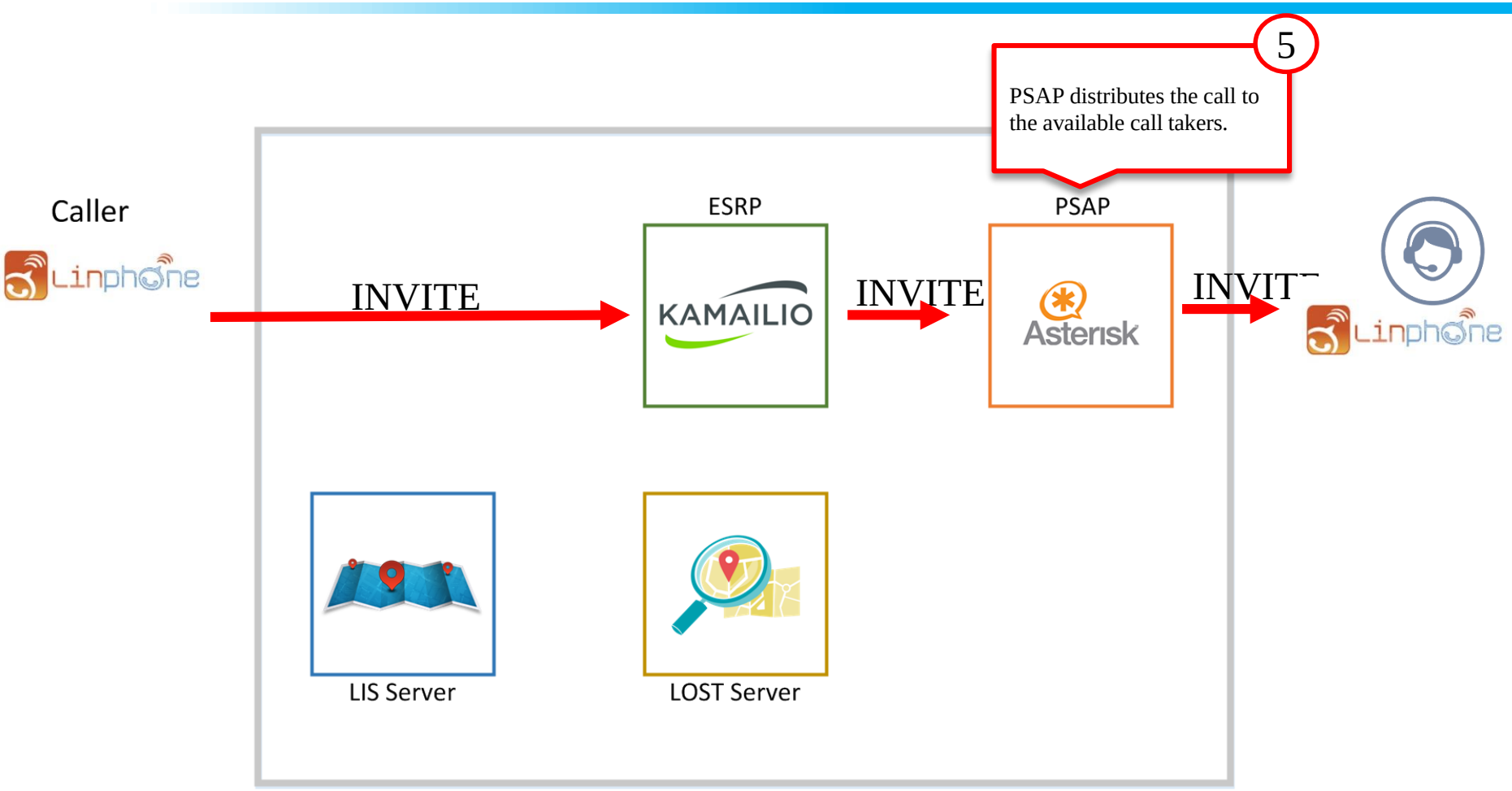


Location based VoIP routing



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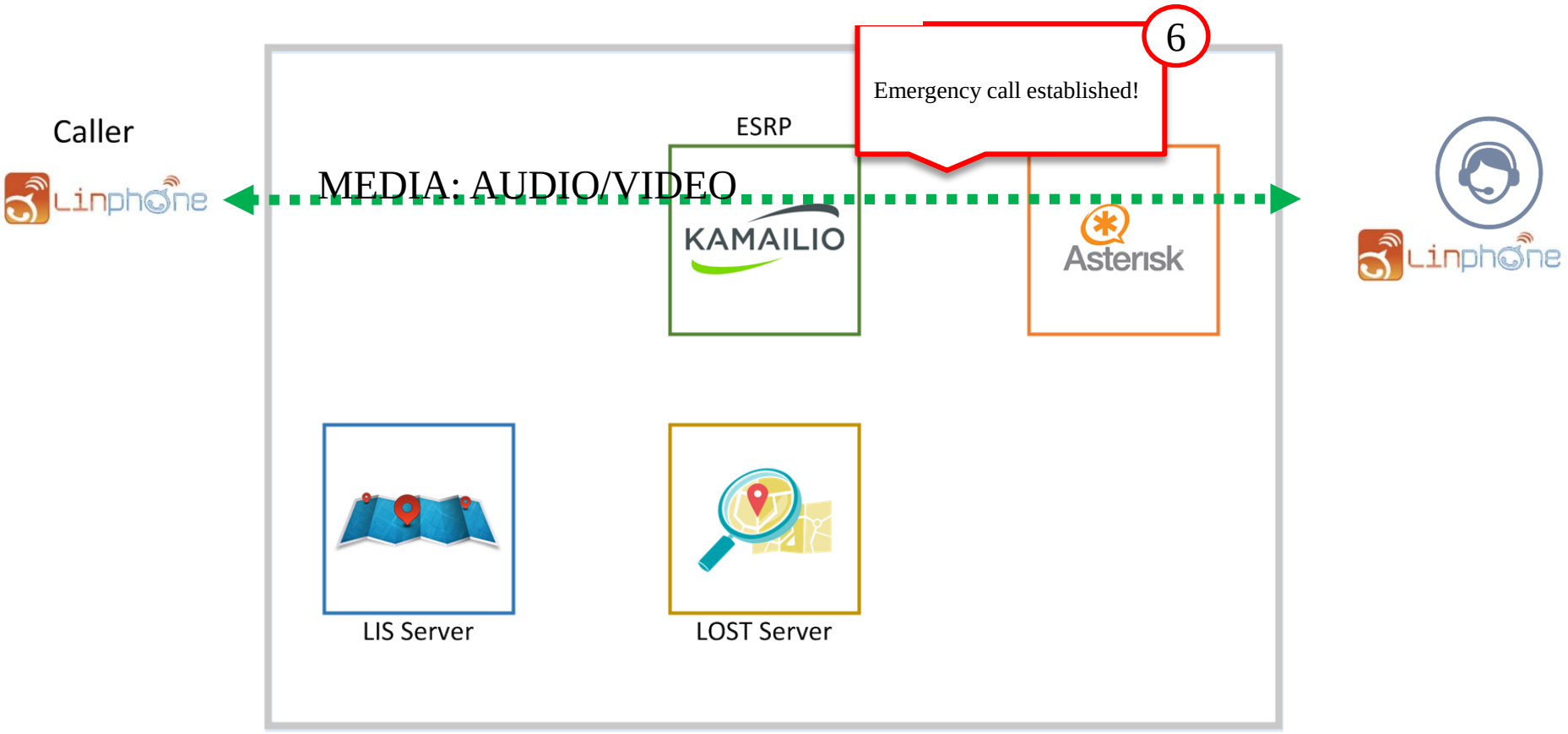
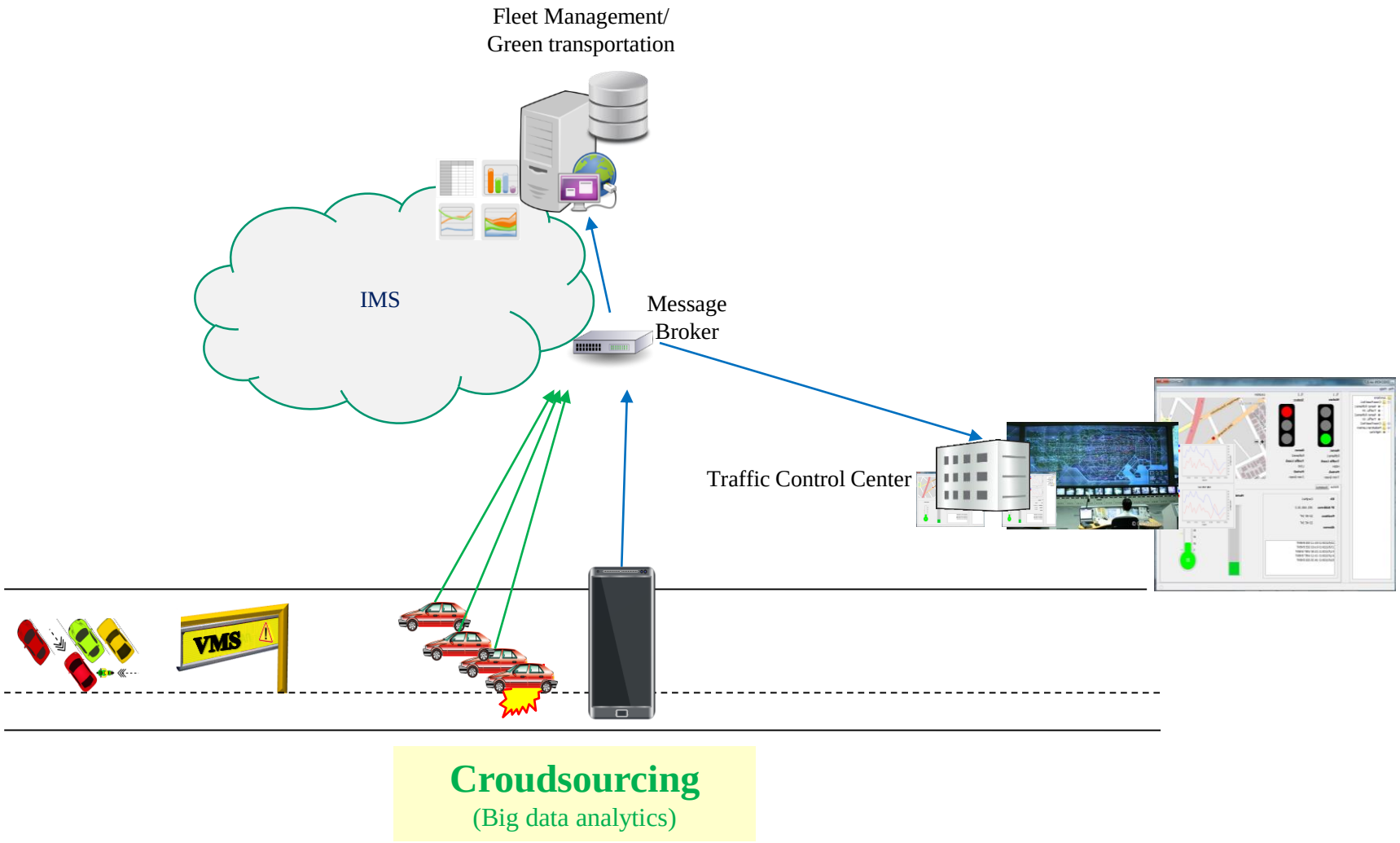


Crowdsourcing and big-data analytics

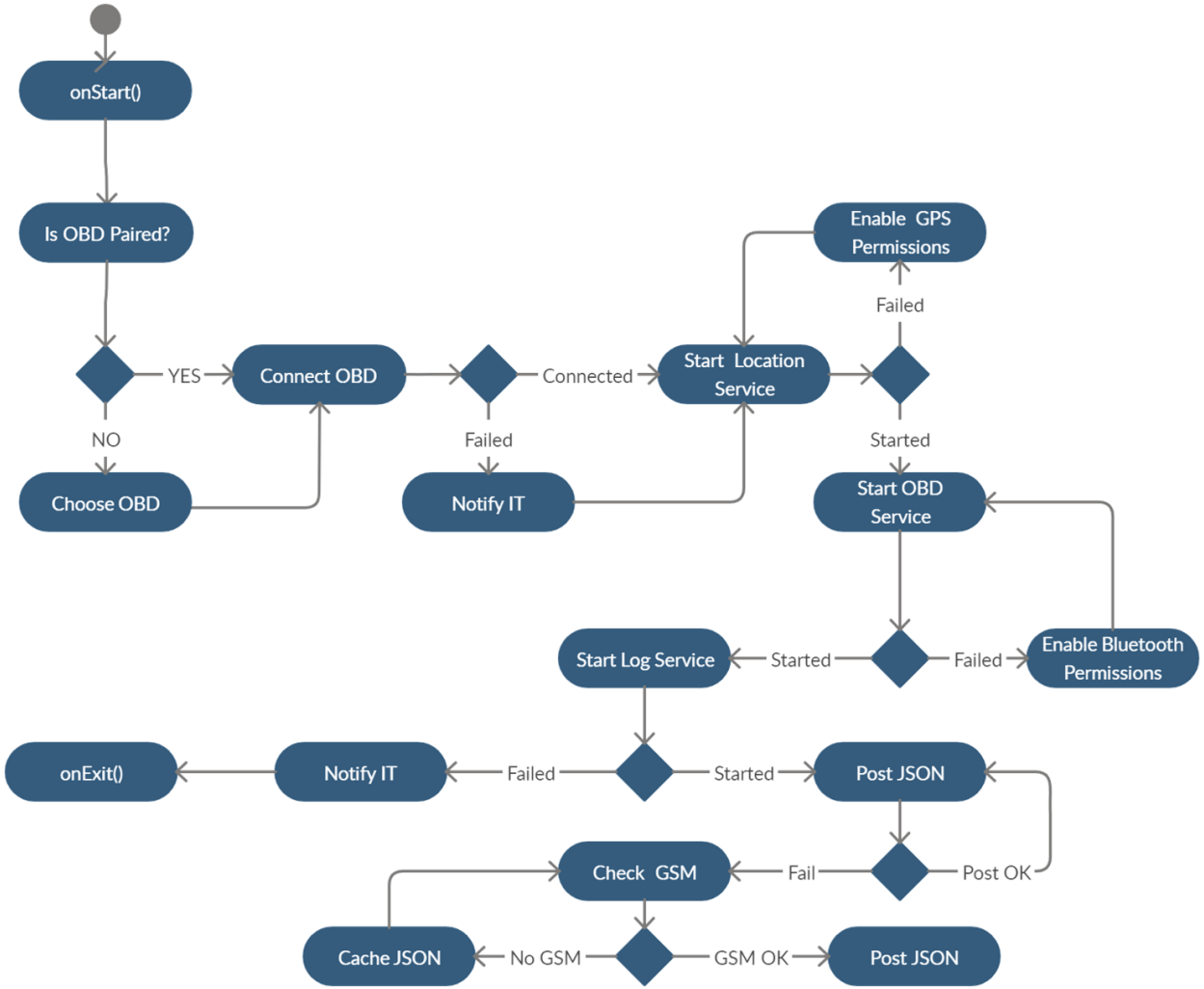
CROWDSOURCING AND BIG-DATA

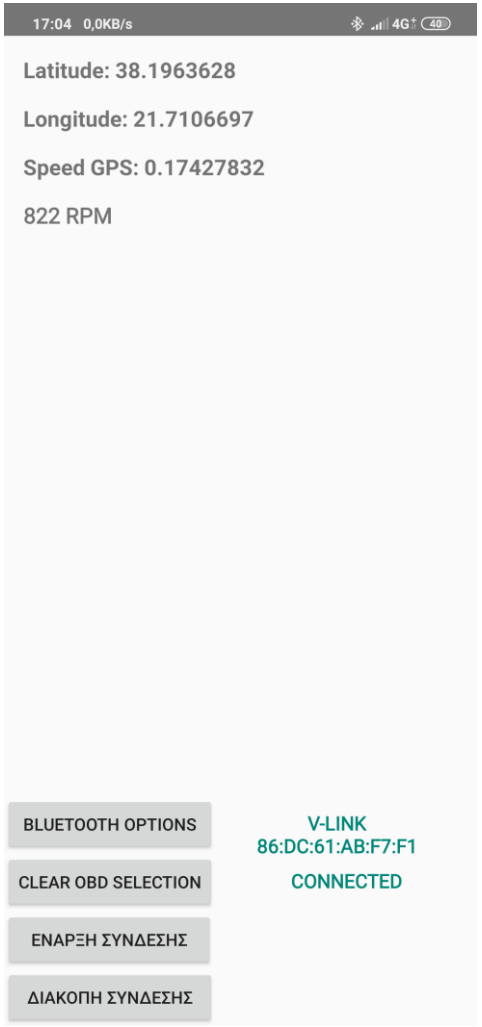
Crowdsourcing & Data analytics



Croudsourcing
(Big data analytics)

Prototype Android app





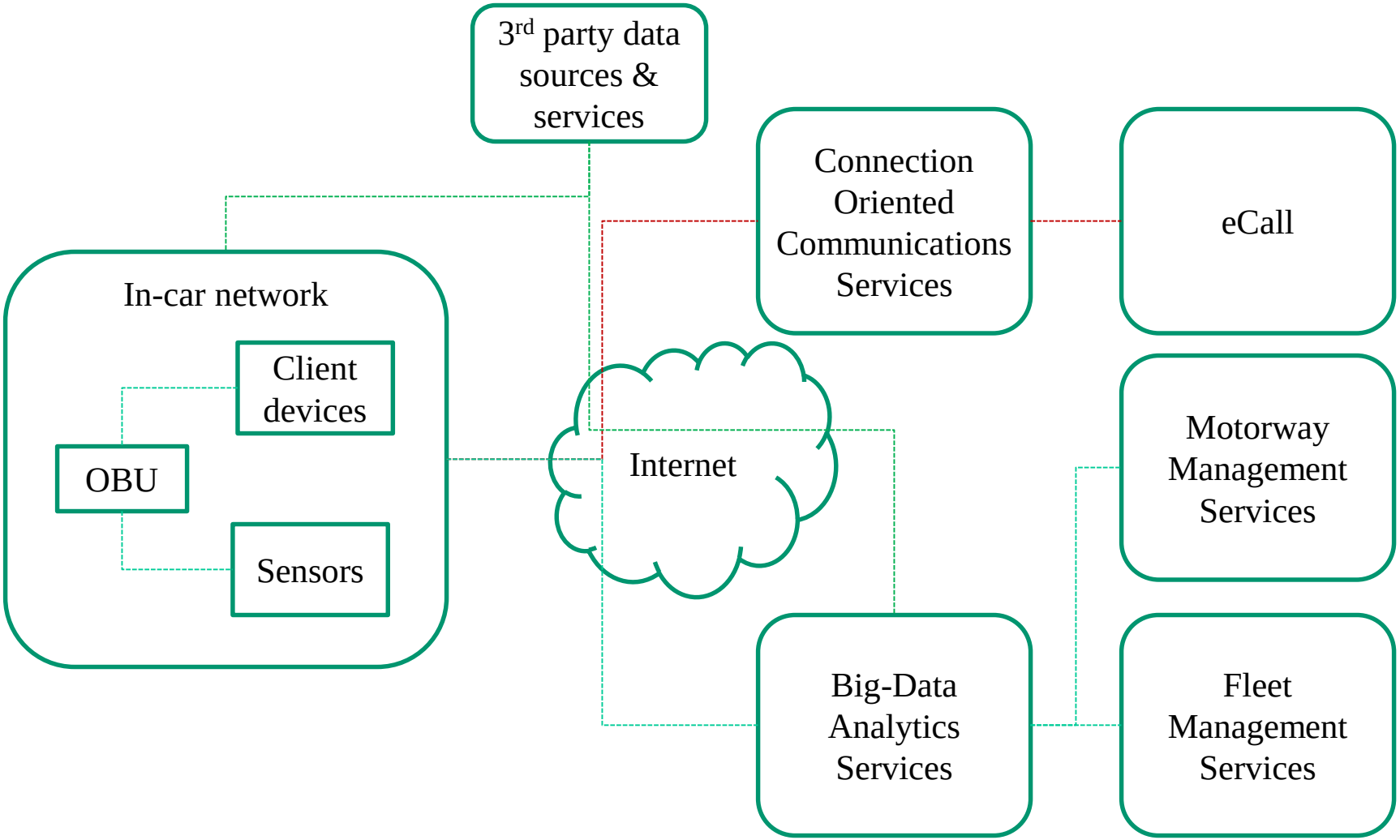
Big Data Platform

- Supports real time and near real time processing
- Collect data from heterogeneous data sources
- Consists of three basic modules:
  - Storage module (based on Apache Hadoop). The module will allow scalability with the addition of new clusters.
  - Analyzing module. Set of mappers and reducers for processing big data.
  - Monitoring module (based on Apache Storm). The module will allow event management by monitoring the streams of data and allowing for real time actions that cannot be performed in batch processing.

Crowdsourcing Solution

- The end user will be able to send events manually to the big data platform.
- The platform will process the events in real time, and it will notify all the users/subscribers that are near the area of the reported event.

Communication architecture



Conclusions

- MANTIS designs and develops a comprehensive framework for the development of heterogeneous applications
  - intelligent transport systems
  - driver assistance systems and services.
- The MANTIS framework will exploit technologies of rapidly growing sensor and vehicular networks and will pursue their integration with Internet technologies and cloud applications.
- MANTIS will develop innovative applications based on the communication between vehicles and cloud services exploiting
  - In-car IoT networks with enhanced location tracking and data processing functions
  - Augmented NG-call with sensor data and location-based routing
  - Crowdsourcing and big-data analytics for improved road transport services

Visit us at
https://mantis-project.gr

Questions….

Ευρωπαϊκή Ένωση
Ευρωπαϊκό Ταμείο
Περιφερειακής Ανάπτυξης

ΕΠΑνΕΚ 2014-2020
ΕΠΙΧΕΙΡΗΣΙΑΚΟ ΠΡΟΓΡΑΜΜΑ
ΑΝΤΑΓΩΝΙΣΤΙΚΟΤΗΤΑ
ΕΠΙΧΕΙΡΗΜΑΤΙΚΟΤΗΤΑ
ΚΑΙΝΟΤΟΜΙΑ

ΕΣΠΑ
2014-2020
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Με τη συγχρηματοδότηση της Ελλάδας και της Ευρωπαϊκής Ένωσης