Smart Rainfall System

Measure and localization of rainfall in real-time

low-cost innovative system based on existing TLC infrastructures

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Smart Rainfall System

Project Rationale

- Technological innovation:
  - Exploiting the propagation model of microwave signals to estimate the **amount** and **distribution** of **rainfall** at **river basin** level
  - Deployment of a **distributed system** of **measurement** and **localization** of precipitation in **real time**

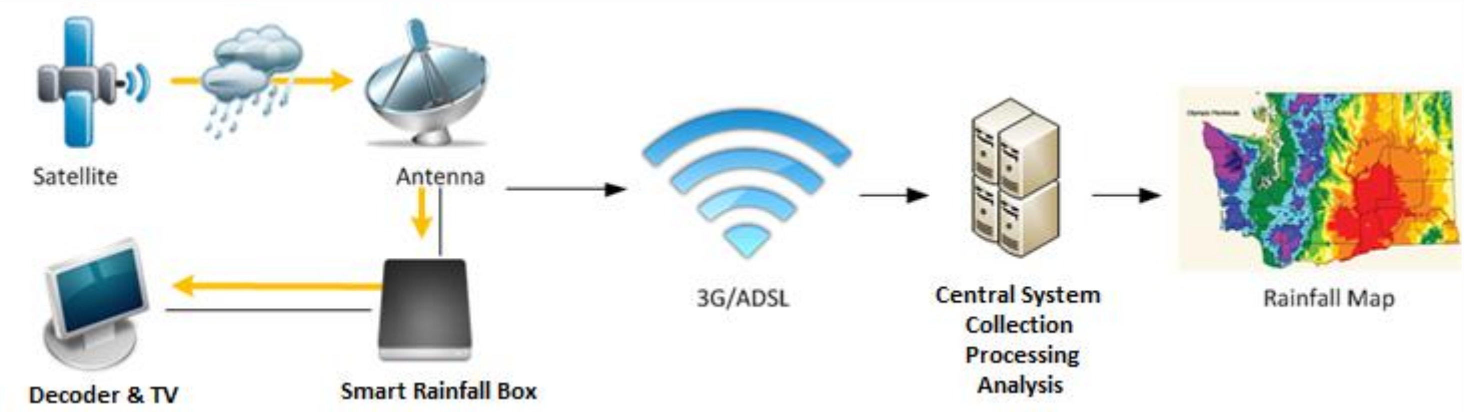
- Main purpose:
  - Allow a **timely evaluation** of the onset of weather-hydrological alarm conditions due to intense rainfall

- Recipients:
  - Entities responsible for forecasting, monitoring and surveillance of the weather-hydrological risk for **civil protection**

- Result:
  - **Reduction in the time** required by the management and dissemination of alarms in the territory
  - **Timely information** for a controlled evacuation

Features and Functionalities

- Features :
  - **Innovative** tool
  - Data acquisition and processing in **real time**
  - **Analysis on a local scale**, at the level of river basin
  - Using the **commercial TLC network** for the connection between sensors and the central system
  - Use of the **Internet** and **mobile channels** for the dissemination of results
- Functionalities:
  - Real-time measurement of **rainfall rate** (in mm/h) for each acquisition sensor.
  - Construction of **a map of the space-time distribution** of rainfall



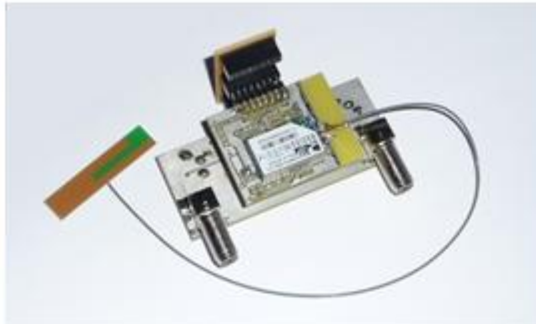
System Architecture

- Implemented with:
  - **Sensors distributed** in the areas to be monitored for the measurement of the precipitation
  - **Central system** for data integration, and the spatio-temporal identification of the event

- Uses a TLC infrastructure available on the territory:
  - **Parabolic antennas** for the reception of satellite DVB
  - **Commercial satellite** constellations
  - **Internet** access (3G, ADSL, FTTH)

- Only requires the **installation of the sensor** downstream of the dish:
  - Condominium or private **antennas**
  - Based on components **widely available** on the market
  - **Without any interference** with the satellite TV service

Sensor Prototype



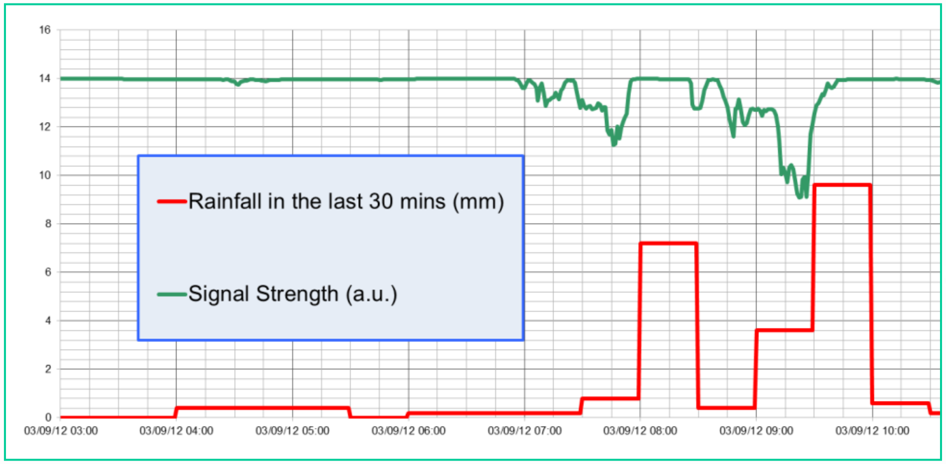
- Implementation of the **electromagnetic model**:
  - Algorithm for estimating precipitation according to interference with the satellite signal (dB of attenuation)

- Design and construction of a prototype of the **electronic sensor**:
  - Measure of the degradation of the satellite signal due to rain
  - Real time calculation of rainfall rate (in mm/h) according to the algorithm
  - Communication with the central system

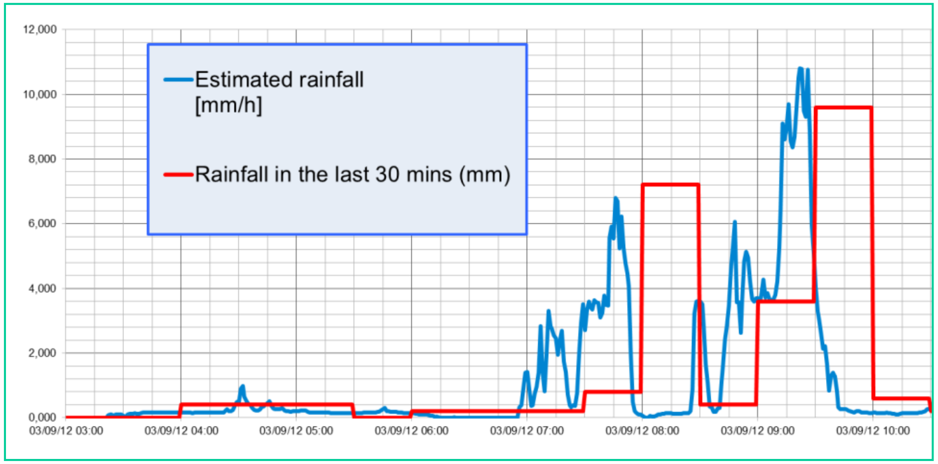
- Simplified realization of the SW of the **central system**:
  - Application for collecting and displaying data

Experimentation and Validation

- **Experimentation**:
  - Collecting sets of measures in the UNIGE laboratories in various weather conditions
- Prototype **validation**:
  - Through the comparison between the measurements of the Smart Rainfall system and those of a reference rain gauge, under different atmospheric conditions
- Conclusions:
  - The Smart Rainfall system, operating in real time, **anticipates** up to 30 mins the results of the rain gauge
  - The measurements of the two instruments are strongly **correlated**
  - The Smart Rainfall system even detects light rain (**tenths of mm/h**)



The example shown refers to the early hours of the 31-08-12
The peak of the pluviometer (red line) is of about 10 mm in 30 mins

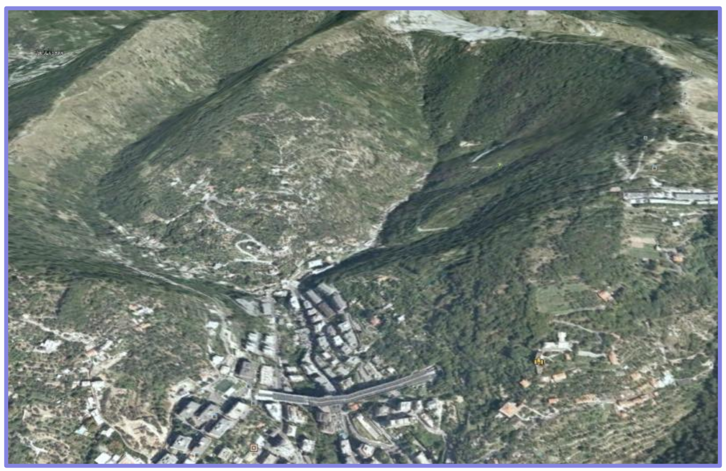


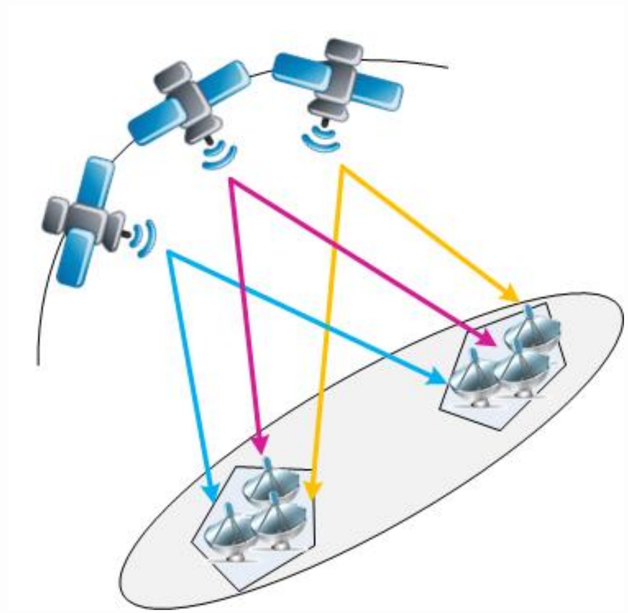
The integral of the extent of the Smart Rainfall system
is consistent with what obtained with the rain meter

Map of Precipitation

- **Geolocation** of GNSS **antennas** using off-the-shelf instrumentation
- **Integration** and **correlation** of **data** from peripheral sensors
- GIS processing to produce high-resolution **maps** of **precipitation**

⇒ **New input** for the models needed to estimate **risks** for the **environment**





Innovative Elements of the System

- Allows you to **densely monitor** the **territory**:
  - Uses **TLC infrastructure already available** in the area
  - Exploitation of readily **available components**
  - **Easy** and **quick installation** of the sensor

- **New support tool** for monitoring and controlling the weather and hydrological risk for **civil protection**:
  - Measures and transmits the data in **real time**
  - Evaluates the precipitation in the area of interest **at the level of the river basin**, and not on few locations (rain gauges), or over large areas (RADAR), such as the traditional instruments

- Allows the operator to **take emergency decisions in less time** than at present

- **Patentability** of the Smart Rainfall System

Thanks for Your Attention!

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