

## RTD Fact Sheet Template

TECHNICAL SPECIFICATION CISIUM UPGRADE RTD FACT SHEET*	
Reference Measure	8.3 BOL Cisium: New Traffic Control Centre
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### Context and Purpose

The Municipality is developing the new traffic centre that connects and integrates the ITS systems in the city in order to achieve optimal real time traffic management. The traffic control centre monitors a large proportion of traffic lights in the city and also influences traffic communications in the whole metropolitan area. This new system is already funded outside the CIVITAS Initiative and the activities are almost completed. In the CIVITAS Mimosa measure is performed (i) a fine tuning activity on traffic models and scenarios, (ii) an evaluation analysis and (iii) a dissemination campaign for road users. The RTD analysis consisted in a study aimed at defining Cisium functional models for the project completion, leaving to external suppliers only the developing phase. Output of the study is the functional document approved by the Municipality and the tender specification (tender for the Cisium upgrade).

### Description of RTD Activity

The RTD activity was a study completely realized within Bologna municipality aimed at collect and analyze all traffic data, analyze the algorithm for traffic congestion calculation derived by information provided by traffic lights and PT data, define performance index (system UTOPIA<sup>1</sup>) in order to re-project the CISIUM system and define the functional models.

During the RTD activity a new set of index was elaborated in order to evaluate the system (data provided by UTOPIA<sup>2</sup>). New indicators are:

1. delay index= average individual delay/traffic lights cycle duration. The indicator permits to distinguish when the delay is due to a single traffic light cycle from the case where it is accumulated from more than one cycle (and therefore the driver is obliged to several "stop and go");
2. filler index=average queue/max acceptable queue (where the max acceptable queue is a configuration movement parameter defined from topological UTOPIA base data);
3. congestion index = total time in saturation/ traffic light cycle duration (where total time in saturation conditions is when the instantaneous queue is > than max acceptable queue);
4. control effectiveness =average individual delay/average individual delay BPR<sup>3</sup>.

1 Cisium is the traffic centre that connects and integrates the ITS systems in the city. Utopia is traffic lights centralized system within Cisium.

2 The UTOPIA upgrade is functional to Cisium new algorithms.

3 The BPR (Bureau of Public Roads) is a method for predicting vehicle delay as a function of volume/capacity ratio in travel demand models. Usually the functions used to express the travel time (or cost) on a road link as a function of the traffic volume  $f$ , are expressed as the product of the free flow time multiplied by a normalized congestion function  $f(x)$ :

$$t = t_0 ( 1 + a ( f / C ) )$$

where the argument of the delay function is the  $f/C$  ratio,  $C$  being a measure of the capacity of the road.

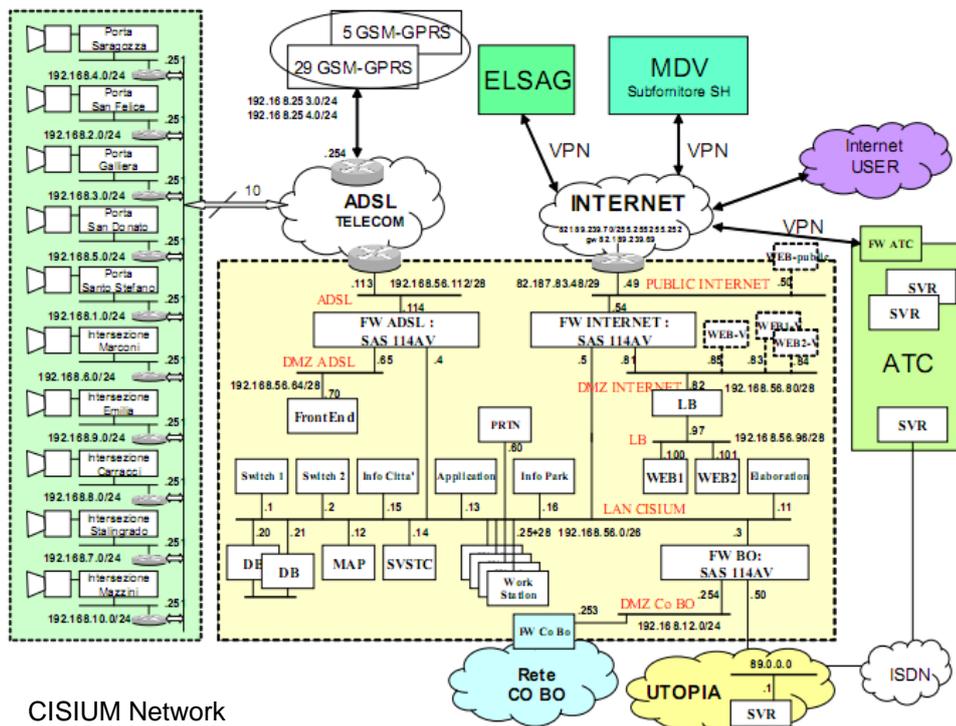
The BPR equation was originally fitted to 1965 Highway Capacity Manual freeway speed flow data. Since then additional research has been carried out, giving the equation this form:  $t = t_0 ( 1 + a ( f / C )^b )$

where:

## Outputs and Results

The tender specifications for Cesium upgrade summarize the main features studied representing technical specification of the supply, as follows:

- New loop detectors and coils specifications. Loop detectors and coils to be connected to traffic lights;
- Interface unit to extract data from Utopia to Cesium in order to populate the cartographic data base SIT<sup>4</sup>;
- New servers Utopia in order to optimize the telecommunication network; Cesium apparatus are grouped in a rack hosting network infrastructures (switch, firewall), servers and a patch pannel RJ145 to connect with outside;
- Variable-message signs to substitute the one's already installed.



CESIUM Network

## Resulting Decision-making

The RTD analysis was necessary in order to define the tender specifications for the system upgrade.

- t: predicted travel time
- t0: free-flow travel time
- f: traffic flow [vehicles/h]
- C: capacity [vehicles/h]
- a: coefficient (often around 0.15)
- b: exponent (often around 4.0)

The function uses two constants to fit the equation to various types of roadways and circumstances.

Parameters "a" determines the ratio of free-flow travel time to the travel time at capacity; "b" determines how abruptly the curve raises from free-flow travel time.

The BPR function is a major simplification of traffic engineering, which points out that traffic delay is an exponential function of roadway loading ( $f/C$ ).

Unit: average travel times.

4 SIT is the Bologna Municipality cartographic data base.

## Lessons Learnt

The strategy followed was to concentrate all the planning efforts within the municipality: the daily work of internal personnel is fundamental and cannot be substituted by external contributions. Internal technicians provide the logical solution to the software company; this driving role is the winning thing in such project that requires a deep knowledge of the local traffic context. Such operational context improved the technical skills of the internal personnel. The technological aspects learnt and developed during the analysis, according to the Italian Law, are summarized into the working plan, the technical document that reports all interventions developed during the designing phases.

## Cost-effectiveness

The RTD activity was a substantial element for the measure implementation, necessary to direct future decisions (Cisium is specifically studied for Bologna context; it is not such a standard element but a system projected and developed in Bologna considering Bologna characteristics: e.g. viability, traffic flows, mobility behaviours, city structure).

## Dissemination and Exploitation

The achieved competence in development of simulation models and algorithms represents an important success element to be utilized also for traffic and urban planning programs - projects and for circulation reorganization activities. The Cisium project has been presented during several technical meetings to other Municipalities' technicians: e.g. within the CIVINET (group of city networks that promote the CIVITAS approach at a local level), within the European Mobility Week.