ITS Architecture for Integrated Traffic Control Systems
Presentation

SICE is a company dedicated to systems integration

The specialty of SICE is implementing intelligent transport systems capable of integrating urban and interurban systems into one complete system.

The purpose of this presentation is to show how we solved the needs of the Madrid City Government when it wanted to integrate all of the different traffic control systems into one workable solution.
Madrid Case

**Initial Problem:** Different control systems and user interfaces

- UTC in 3 different zones
- M-30 Ring Road Control
- Urban Tunnel Control
- Access Control to historic areas
- Safety systems: Speed and red violations.
- User information: Internet fixed and mobile.
- Parking on road regulation
- Operating Procedures
- Incident and Emergency management
- Fault Monitoring System

Madrid data

- 3.200.000 people
- 1.700.000 cars
- 500.000 cars enter to the city every day
- More than 6.000.000 trips per day
- More than 2.400 intersections centralized
Datos Madrid:
3.200.000 habitantes
1.700.000 vehículos (80 % coches)
6000000 viajes
500.000 entran y salen

cbr-sice-alcobendas, 2008/11/08
Madrid Case

3 UTC Systems

M-30 Ring Road Control

Tunnel Management and Control

Access control to restricted areas
Bollards and Plate number recognition
Madrid Case

Red Light and speed violation

CCTV Management

Information to the users

Fault monitoring and Incident Management
How to Integrate

To create a complete ITS platform, capable of integrating the different traffic control systems a multichannel architecture is required with all of standardized communications protocol.
How to Integrate

SICTRAM Integrated Situation

Non integrated situation

SICTRAM

Interface 1

Access, Infraction Control and TV

Interface 2

Urban Traffic Control 1

Interface 3

Urban Traffic Control X

Interface 4

M-30 Ring Road Control

Interface 5

Fault Management and Maintenance (SAGA)

Interface 6

Incidents and Service Level Management

Interface 7

Tunnel Control
How to integrate: SICTRAM Top level of the ITS Architecture

- A unique Graphic User Interface based on GIS technology integrating all the systems
- A unique Data Base for Global Dynamic Objects
- Operation Plan to improve Management and Quality Control by continuous monitoring of processes and auditing of results.
- Coordination between departments to exchange information and support services
- Integration of Internal information for both the Police and governmental agents
- Flexibility and integration with new applications
ITS Integrated System

The proposed system is based on the SICTRAM system, this system is currently operating in many cities worldwide.

It is a four level ITS architecture that can integrate the current systems and new ones. It will fulfill the needs of the traffic authorities and solve the problems caused by the increase in traffic and congestion in cities.
ITS Architecture

- Level 0: Global Control and Information
- Level 1: Centralized Control
- Level 2: Zone Concentrators and Communications
- Level 3: Local Equipment
Description of the proposed subsystem integration

In the following pages we will show how each system will be integrated into one application that is based on a potent GIS system.
Modules to Integrate

- Operations Management
- Incidents and Emergencies Management
- Urban Traffic Control
- Management of Variable Message Sign (VMS)
- Traffic Signals and Red-Light & Speed Cameras
- Construction Projects Management (Road Works)
- APNR Registration Plate’s automatic recognition
- Enforcement of traffic laws speeding, red light jumping, lane and stop line violations
- VIP vehicle tracking
- Traffic Simulation
- Registry, Reporting and Configuration
- Periodical Reporting, Alarms and Processes
- Equipment monitoring
- Global Traffic Plans Management
- Integrated Video Management
- Export traffic levels and incidents data to Web Server
GIS Base Platform (Level 0)

The core of the system is a Geographical Information System from ESRI.
Centralized Command and Control Center (Level 0)

The map shows service level, accident and incidents location, location of police resources, congestion sites, road works, data from fault management, vehicle tracking, etc.
Operations, Incidents and Emergencies Management (Level 0)

- Identify the emergency scenery
- Activate a Global Traffic Plan
- Documents describing the Operation Plan
- Police is informed with details of the situation and recommendations on how to operate during the emergency.
- Internal responsible are also informed via email or SMS
- Work Methodology based on Workflow Management

Automatic Incident Detection (AID)

Incident management window
Urban Traffic Control (Level 0)

The Urban Traffic Module allows the user to operate the following elements of the centralized urban systems:

- Local Controllers
- Areas
- Subareas
- Routes
- Intersections with Traffic Lights (Crossings)
- Points of Measurement (Detectors)
Adaptive Traffic Control: ADIMOT (Level 1)

ADIMOT is a centralized control system for city traffic, it is based on the Multi-Algorithmic concept that supports the Adaptive Algorithmic.

ADIMOT ADaptIve Multialgorithmic Optimisation Technique
Adaptive Traffic Control: ADIMOT (Level 1)

Different Traffic Plan Calculation Modes

- Hourly Selection of Fixed Traffic Plans
- Manual Selection of Fixed Traffic Plans
- Dynamic Selection of Traffic Plans
- Dynamic Generation of Traffic Plans
- Adaptive System that performs small and frequent modifications in the Cycle, Splits and Offsets calculated by the previous algorithms.
Management of Variable Message Sign (VMS), Traffic Signals, Red-Light and Speed Cameras (Level 0)
VMS with Automatic Message Generation and Lane Control (Level 1)

- Incidents
- Traffic Status
- Diversions
- Weather Conditions

CARRIL CERRADO A 3 Km

ACCIDENTE A 2 KM

Decision Rules
Priorities
Relationships

RETENCIONES HASTA NUDO SUR

JOURNEY TIME

A NUDO SUR 3 min.
A SALIDA 19 9 min.
A SALIDA 22 12 min.
Construction Projects Management (Level 0)

This module allows the operator to be aware of construction projects affecting the traffic (Road works).

The system stores the following fields:

- Date and time when the Project started.
- Date and time when the Project is expected to end.
- Effective Date and time when the Project ends.
- Location of the Project (address, road, kilometric point …)
- Zone of influence of the project.
- Comments about the project.
- Reason why the project is being developed.
- Company responsible of the Project.
- Picture representing the current status of the project.
Enforcement of traffic laws (Level 1)

This module will allow the management of speeding, red light jumping, lane and stop line violations. Disposes an Automatic License Plate Recognition.
Vehicle Tracking and Routes for VIP and Emergence (Level 1)

This module will allow tracking in the GIS map all the VIP vehicles circulating in Delhi and establishing emergence and VIP Routes

Vehicle tracking in a GIS map
Send a message to the selected vehicle
Store in historical DDBB the tracks of the vehicle
Reporting Show in the map the movements of a vehicle in a timeframe chosen by the operator
The adaptive ADIMOT system can select an emergence or VIP route sending the appropriate data to Local controllers
Traffic Simulation (Level 0)

This module allows to integrate the traffic simulation application with the GIS Based Map.
Register, Reporting and Configuration Module (Level 0)

This module will automatically centralize all the information collected by all the control systems in the control centre, and all the operators in charge of those systems. The report generator allows the operator to program tailored reports with established periodicity.
Equipment monitoring (Level 0)

This module receives real-time data from the Control Systems and Fault Management System. Applying filters, each equipment can be displayed in a map or in a list showing its current state.

**NOTIFIED:** There has been a Fault, but the Maintenance Service Provider still has not reported it as ‘received’.

**REGISTERED:** The Maintenance Service Provider confirms the correct reception of the Notification, but has not done any action.

**INITIATED:** The Maintenance Service Provider has started correcting the fault (Work In Progress).

**FINALIZED:** The Maintenance Service Provider reports that the Fault has been closed.
Global Traffic Plans Management (Level 0)

There is a module which will allow the Operator to configure Global Traffic Plans in case of emergencies or special events.

The advantage is that the Operator can operate different subsystems by activating a single Global Plan.

<table>
<thead>
<tr>
<th>Global Plan Code</th>
<th>Description</th>
<th>Urban Traffic Control</th>
<th>Ring Road Control</th>
<th>Tunnel Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Sport Event 1</td>
<td>7</td>
<td>28</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>Sport Event 2</td>
<td>12</td>
<td>14</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>Emergency Route 1</td>
<td>15</td>
<td>19</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>Emergency Route 2</td>
<td>5</td>
<td>6</td>
<td>2</td>
</tr>
</tbody>
</table>

The operator can apply a plan for special events like sporting events, activating the global scenario prepared for that event.
Integrated Video Management (Level 0)

This module allows to manage CCTV images coming from different subsystems and display them via the same GUI.
Export Traffic levels and incidents data to Web Server (Level 0)

This module exports data of the different subsystems to the Web.