

# ICONIS

## The Traffic Control Center (TCC) System for DORTS Projects

ALSTOM Company

### Abstract

An Integrated Control Center (ICC) is the core of the control and supervisory systems that collect and manage in real-time all the operational railway information coming – through the network – from interlockings, stations and on-board equipment. As part of an ICC, ICONIS ATS provides both an operational and generic platform, which manages the Traffic Control function. As an operational platform, ICONIS ATS is a ready-to-use product for transport projects, requiring only application engineering to configure its database and displays. As you will see, ICONIS provides a very comprehensive solution for both train control and supervisory control and data acquisition (SCADA) applications that is flexible enough to be tailored according to the customer needs.

**Key Words :** ICC, ATS, TCC, ATR, SCADA, HMI

## 臺北捷運 ICONIS 行車控制中心系統

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### 摘要

整合控制中心 (Integrated Control Center, ICC) 為監控系統之核心, 其主要功能在於收集及處理來自現場電聯車車載號誌、轉轍器及號誌房等經由通訊系統光纖網路而來之即時訊息, 身為整合控制中心 (ICC) 的一部份, ICONIS 自動列車監控系統 (Automatic Train Supervision, ATS) 提供了人機介面的操作平臺來監控整體之列車行駛功能, 以一個操作平台而言 ICONIS ATS 為一完整且經驗豐富之產品, 僅須依據業主之需求調整相關資料庫及人機介面之顯示。由本文章內容讀者將能了解 ICONIS 提供了列車控制、監督及資料取得系統 (Supervisory Control and Data Acquisition, SCADA) 功能合理具彈性且符合業主需求之解決方案。

**關鍵字 :** 整合控制中心、自動列車監督、交通控制中心、自動列車調節、列車控制、監督及資料取得系統、人機介面

## 1 、 Preface

An Integrated Control Center (ICC) is the core of the control and supervisory systems that collect and manage in real-time all the operational railway information coming – through the network – from interlockings, stations and on-board equipment.

An ICC controls and supervises an entire network for railway operators by integrating the following main functions : ( Fig1 )

- Traffic Control
- Traction Power and Energy Control
- Ancillaries Management ( Ventilation, Station Lighting )
- Passenger Information System ( PIDS )
- Communication Control ( Telephone, Radio )
- Resource Management ( Crew )

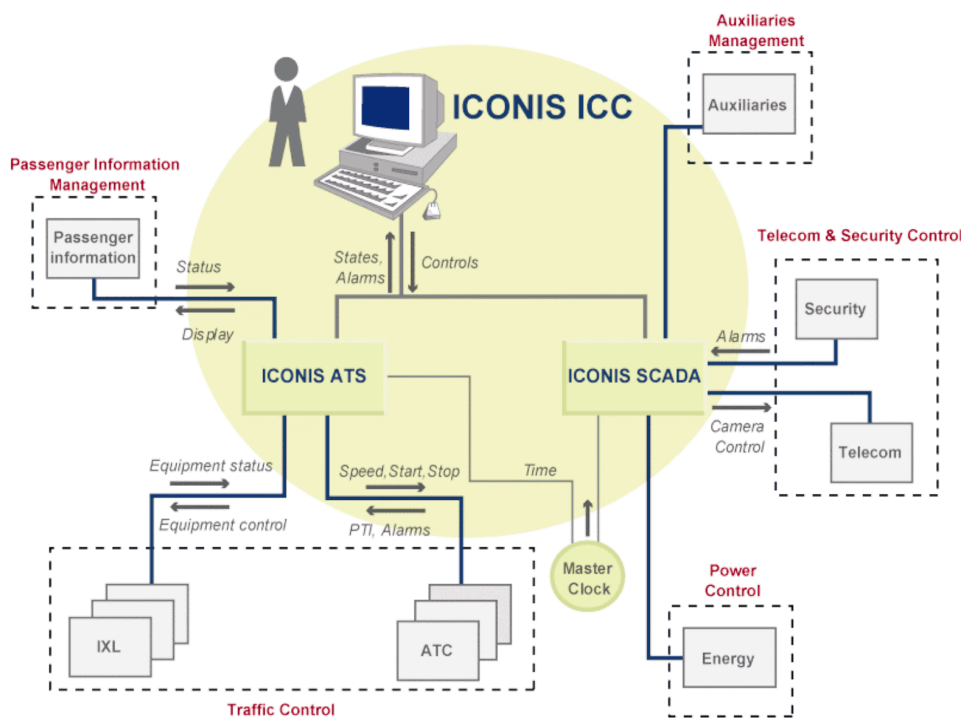


Fig1 The entire ICONIS ICC network

ICONIS ICC is ALSTOM's solution for integrated control centers and provides two main products, which are based on the same software platform:

- ICONIS Automatic Train Supervision (ATS), for rail traffic management and passenger information.
- ICONIS SCADA, for control and supervision of associated infrastructure devices for energy, auxiliaries, and security.

## 2、ICONIS Automatic Train Supervision Features

As part of an ICC, ICONIS ATS provides both an operational and generic platform, which manages the Traffic Control function. As an operational platform, ICONIS ATS is a ready-to-use product for transport projects, requiring only application engineering to configure its database and displays.

Since ICONIS relies on open technology – the Windows 2003/XP operating system and standard interfaces ( OPC, OLE-DB ) – it eases the integration of commercial off-the-shelf ( COTS ) products. Depending on the requirements, COTS integration can either be light, relying on existing compatible interfaces ( OPC, ActiveX ) , or more advanced leading to development of new interface components ( I/O modules ) . Full ( tight ) integration is also possible by direct modification of the existing code base.

Furthermore, ICONIS ATS ( Fig2 ) customization is not only based on configuration of the application, but also can be extended through the development of add-on components. The underlying ICONIS technology and design principles ( object oriented design, software bus, standard interfaces ) ease this customization.

- The ICONIS ATS product consists of:
- The general software architecture for ATS,
- A set of components dedicated to specific functionality ( signaling interfaces, train tracking, train identification, train regulation, etc. ) ,
- A set of application objects describing the behavior of the signaling equipment ( track circuits, signals, switch points, etc. ) , which are based on a large library of equipment templates that can evolve with each project.

To match the specific requirements of a project, each component or application object can be customized individually with changing the design of the system.

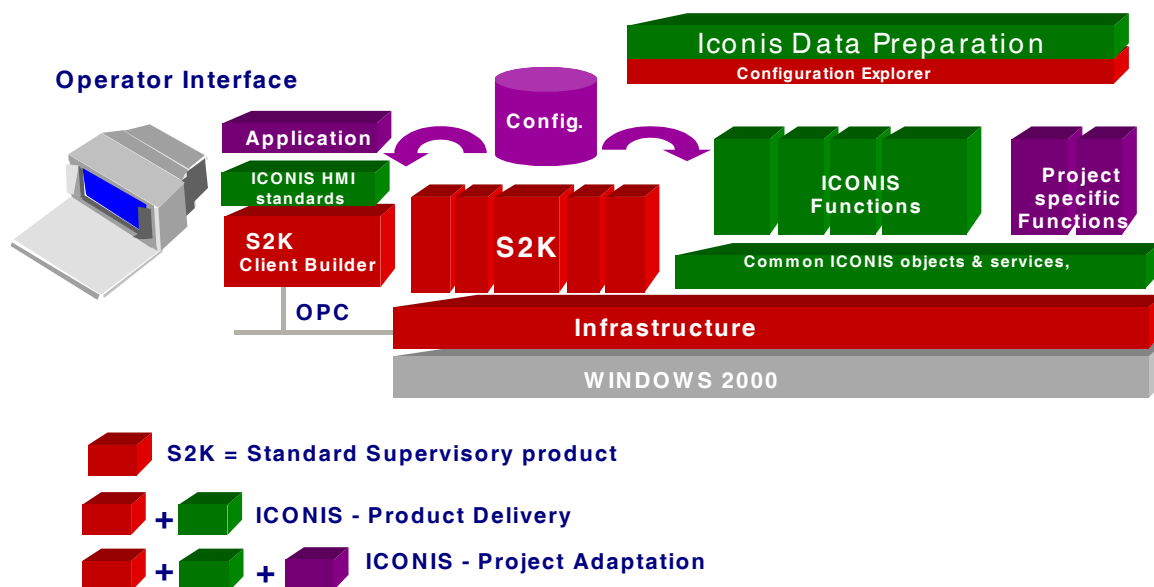


Fig2 The ICONIS ATS configuration

ICONIS ATS is also able to support different types of signaling system, such as:

- Fixed Block : where train location is based on track-circuit status delivered by the interlocking system and optional, Positive Train Identification (PTI) data delivered by the Automatic Train Control (ATC) system. Fixed Block is used by MTR in Taipei.
- Moving Block: where continuous transmission of train location and identification is received via bi-directional radio communication. An underlying fixed block system may provide track-circuit statuses, which provides additional information on train location for fallback train tracking in case of radio communication link failure.

### 3、ICONIS ATS FUNCTIONS

The ICONIS ATS for the Traffic Control Center (TCC) being provided for DORTS projects by ALSTOM consists of the following functions described below and as shown in the following figure:

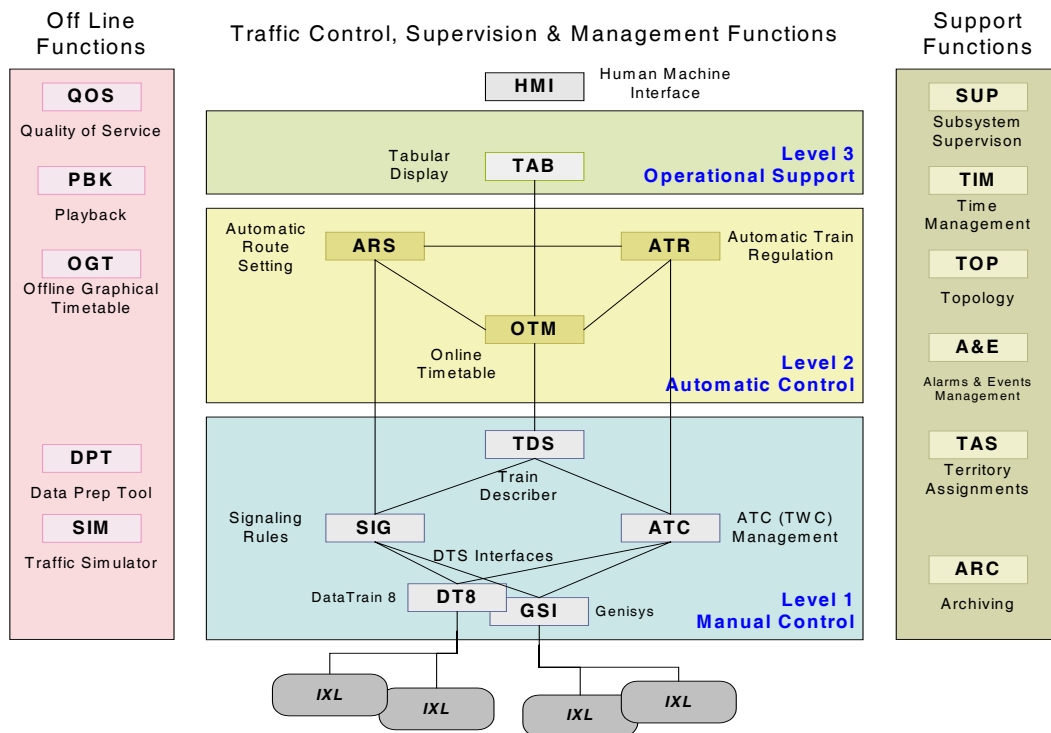


Fig3 The Traffic Control, Supervision & Management Functions

#### 3.1 Manual Control Functions:

- Front End Communication (FEC) : to manage the communication interface with the interlocking system (VPI) .
- Signaling Rules (SIG) : to monitor and control field signaling equipment.
- Train Descriptor (TDS) : to provide train identification, train tracking and train display based on field information.

- TWC Indications: to monitor Automatic Train Control (ATC) data received via the interlocking system using train-wayside communication (TWC) .
- TWC Controls : to update Automatic Train Control (ATC) data via the interlocking system using train-wayside communication (TWC) .

### 3.2 Automatic Control Functions:

- Online Timetable Management(OTM): to manage and modify the online(in-use)schedule.
- Automatic Route Setting (ARS) : to manage the routing of trains from terminals according to the schedule.
- Automatic Train Regulation (ATR) : to regulate traffic according the schedule and line-operating mode by sending appropriate controls to the ATC or Interlocking. The three line-operating modes supported by ATR include:
  - Scheduled Regulation (Normal) : ATR regulates trains by adhering to scheduled departure and arrival times at stations; disturbances are managed through adjustment of dwell times on station platforms and inter-station running times ( performance level ) .
  - Managed Regulation(Headway) : ATR regulates trains by adhering to the schedule, as above, while at the same time trying to manage uniform intervals ( headways ) between departing trains by applying additional hold ( retention ) time to a train based on a comparison of the delays with the train ahead, and any retention time already imposed by the train behind.
  - Constant Headway Regulation (Provisional) : ATR regulates trains without use of schedule by maintaining a constant headway between trains as defined by the ATS user. This mode is used in cases of degraded operations to provide provisional service such as when part of the line may be out of service ( flood gate operation ) .

### 3.3 Support Functions :

- Subsystem Supervision : to control and monitor the external communication interfaces and ATS equipment ( servers, workstations, etc. )
- Time Management: to manage the reference time from an external Master Clock, and synchronize the time of ATS connected equipment.
- Topology Management : to provide a technical and operational view of the rail network to other components.
- Alarms & Events Management: to generate and display alarms and events.
- Territory Assignments : to manage the assignment of exclusive control of interlockings to authorized ATS users.
- Archiving: to archive and purge data from the historical database, and allow subsequent restoration at a later date, if needed.

### 3.4 Offline Functions:

- Offline Graphical Timetable : to create, manage and modify timetables offline using a graphical time-distance chart that provides tools for conflict detection and resolution, and these enhancements to improve service to the riding customers:
  - ★Reduce Platform Congestion : to avoid the simultaneous arrival of trains operating in different directions on the same line during peak hours at specific stations.

- ★ **Improve Line Transfers** : to delay the departure of trains operating on different lines at key transfer stations to allow arriving passengers to transfer to other line without having to wait for the next train.
- **Quality of Service** : to generate, edit and print train performance data collected by the ICONIS ATS.
- **Playback**: to replay previously recorded events to allow analysis of operational incidents.
- **Simulation** : to provide a simulated environment for training of users and testing of system configuration changes to the database or displays.

## **4 、 Additional Support**

In addition to the above, ICONIS can support many different subsystems and interfaces, which will not all be covered in this article. But we can mention the following interesting subsystems, which demonstrate further integration of control center functions:

- **Operations & Incident Management** : to manage the creation and reporting of incidents. Incidents can be entered either manually by a user, or automatically by the system based on an alarmed condition. When an incident is created, the system can propose the most appropriated procedure to follow for a given incident. The system will guide the user through the procedure, allowing the user to approve each step before any actions are taken by the system.
- **Personnel Tracking System**: to track personnel, manually or automatically, throughout the network of field locations. Using the tracking system, operations and maintenance staff can identify field locations requiring maintenance or emergency response and located the nearest available personnel with the appropriate skills to handle the situation.

As for some additional interfaces supported by ICONIS, we can mention the following:

- **Resource Management System** (Crew, Cars)
- **Security System** (Access Control, Intrusion Alarms)
- **Surveillance System** (CCTV)
- **Fire Detection System**
- **Maintenance Management System** (MMS)

As you can see, ICONIS provides a very comprehensive solution for both Train Control and SCADA applications that is flexible enough to be tailored according to the customer needs.