Stretto di Messina

Concessionaria per la progettazione, realizzazione e gestione del collegamento stabile tra la Sicilia e il Continente Organismo di Diritto Pubblico
(Legge n° 1158 del 17 dicembre 1971, modificata dal D.Lgs. n°114 del 24 aprile 2003)

EurolinK

PONTE SULLO STRETTO DI MESSINA

PROGETTO DEFINITIVO

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Titolo del documento	Information and Coordination Management System, Annex	

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INDICE

Abbreviations

The following Abbreviations are the complete list for all documents under MACS/MMS

Abbreviations for system names:

BMS:	Bridge Management System
CS:	Communication System (internally/externally communication)
CSP:	Computer Simulation and Prediction
EDMS:	Electronical Document Management System
EMC:	Electrical and Mechanical Control
ICMS:	Information & Coordination Management System
MACS:	Management and Control System
MMS:	Management, Maintenance and Simulations
SCADA:	Supervisory Control and Data Acquisition
WSMS:	Work Site Management System
TMS	Traffic Management System

Other abbreviations:

EAP:	Event Action Plan
ERP:	Enterprise Resource Planning
FMECA:	Failure Modes, Effects and Criticality Analysis
I&M:	Inspection and Maintenance
IMAA.	Inspection and Maintenance Activity Analysis
LCC:	Life Cycle Cost
MO:	Maintenance Office
OCC:	Operation Control Centre
O&E	Operation and Emergency
O&M:	Operation and Maintenance
RBI:	Reliability Based Inspection
RCM:	Reliability Centered Maintenance
RFI	Rete Ferroviaria Italiana
SOA:	Service Oriented Architecture
UML	Unified Modeling Language

1 Executive Summary

The Messina bridge is a highly innovative bridge design for the world's longest span (3300m) to link Sicily with mainland Italy.The Messina Strait Bridge will span the Messina Strait between Calabria on the Italian mainland and the island of Sicily and will provide the first fixed link between Italy and Sicily. The suspension bridge crossing comprises a 3,300 m main span, which will be longest in the world when constructed.

In the current Progetto Definitivo project phase, the tender design is further developed in preparation for the subsequent Progetto Esecutivo phase.

The Bridge is to be equipped with a Management and Control System (MACS), which enables the Bridge Operator to carry out the operation and maintenance of the Bridge structure and installation in a safe and structured manner. The ICMS is a subsystem to the MACS

> *The Information and Coordination Management System (ICMS) is a system helping the operation managers executing an event, scheduled or not. The system can be activated by the manager himself e.g. by planned maintenance or automatically by other systems, e.g. the SCADA system in case of e.g. a traffic accident. In case of a traffic accident, the system assists the operation manager in executing a predefined event action plan. The information and coordination system establish traffic restriction, like changing the traffic signs, closing traffic lanes etc. When an event is being categorized as an emergency, the system automatically sends an alarm message to the relevant external emergency services taking part of the rescue. In case of a traffic accident this will include the police, ambulance services, hospitals etc. Also, the ICMS will log all relevant events and will be able to visualize in real time all information related to the events.*

The Management and Control System will be a collection of controlling software applications with analysis and management modules and interface to the following system packages:

- Monitoring (SCADA – described by the E&M design basis)
  - Traffic Management System (TMS)
  - E&M Control and Monitoring (EMC)
  - Structural Health Monitoring System (SHMS)

- Communication (CS)
- Railway monitoring (RTMS).

• Management, Maintenance & Simulations(MMS)

- Computing of Simulations and Predictions (CSP, Detailed in this report).
- Worksite Management System (WSMS).
- Bridge Maintenance Planning (BMS).
- Information and Coordination Management (ICMS).
- Electronic Document System Management (EDMS).

Figure 1.1 shows the overall system architecture for MACS where ICMS, which is described in this report, is highlighted.

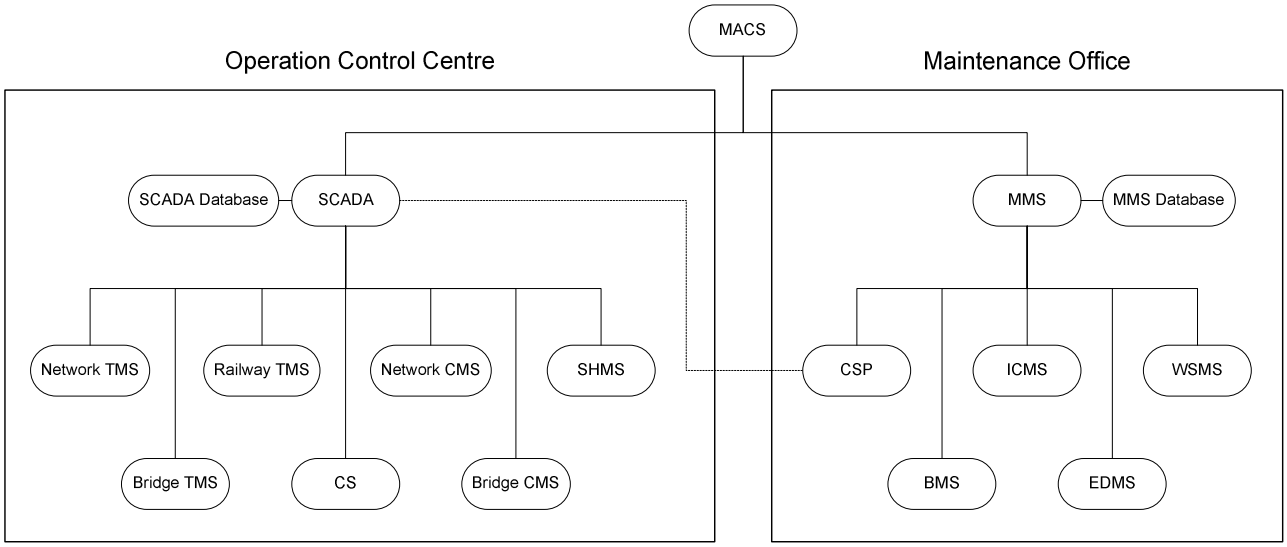

Figure 1.1 Over all system architecture

A more detail description of MACS can be found in, Management and Control, doc. no. CG1000-P-2S-D-P-IT-M4-C3-00-00-00-01.

All long-term data which is saved within the MACS system, will be located in a common database for each cluster; one for the SCADA systems and another for the MMS systems. The two databases for SCADA and MMS will have the same architecture to ensure compatibility for

querying data. Due to this central data storage, a common protocol for sending and query data will be defined. The outline of the protocol is explained for the MMS in the figure below.

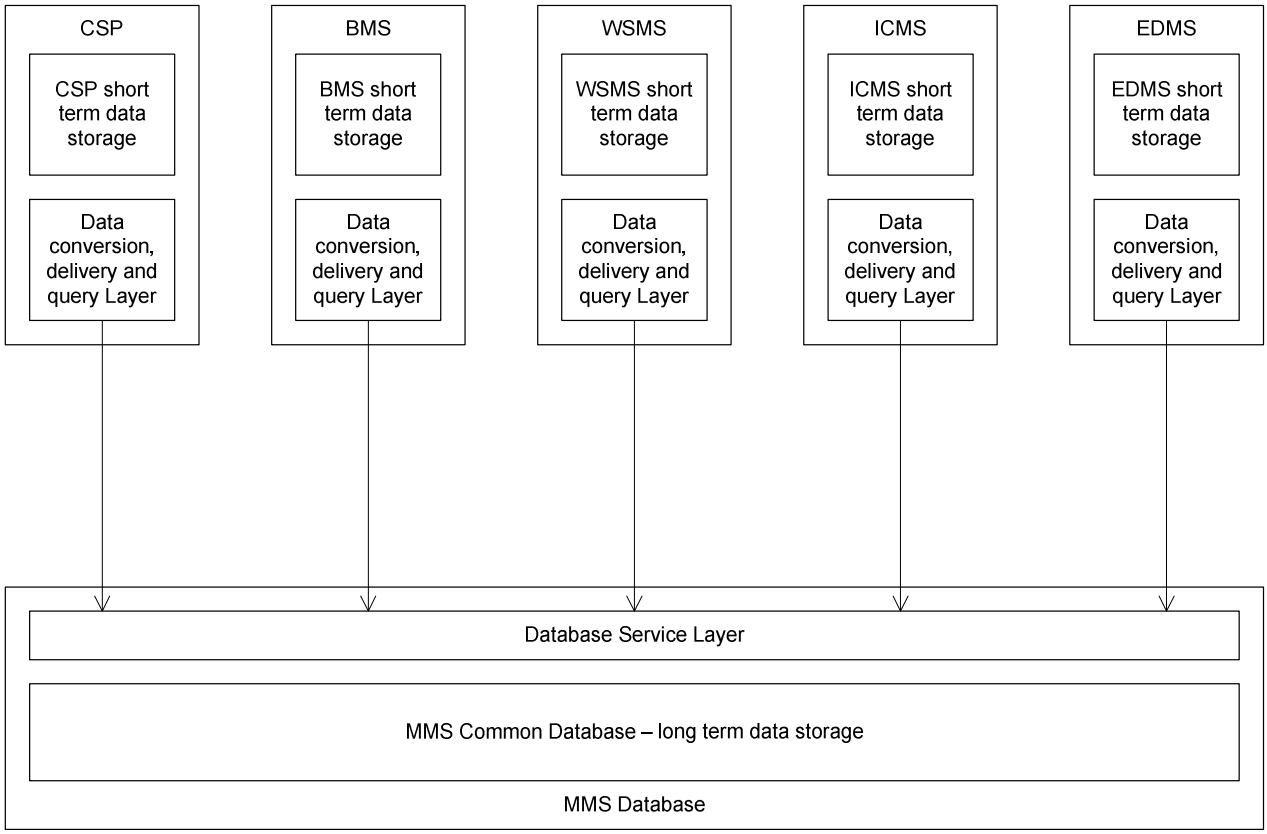

Figure 1.2 Long-term data storage process

1.1 Information and Coordination Management System (ICMS)

The ICMS will assist the OCC manager in executing an Event Action Plan (EAP) in response to an event, scheduled or not. The EAPs are derived from instructions and procedures defined in the Operation & Emergency Manual (O&E Manual).

The ICMS will:

- Assist the operations manager in selecting the EAP appropriate for the event

- Execute a number of predefined actions in one task as defined in the EAP such as: Establishing of traffic restrictions and alarms to emergency services
- Present the EAP like a check list for the operations manager to follow. In particular also to ensure that a return to normal is not taking place until all actions related to the main event like maintenance work is finished
- Coordinating the tasks when more events are occurring simultaneously.
- Produce a report on the event based on EAP and the operations manager's input during execution. The report is to be stored in the EDMS.

1.2 General for the Systems

The above mentioned sub-systems will interact with each other through two databases, with a common architecture, one in SCADA and another in MMS. Furthermore all sub-systems will also have the possibility of communicating directly. The Management and Control System's (MACS and sub-systems) software will be built upon standard software with the necessary extensions to achieve the required extra functionalities, if possible. Otherwise custom designed software will be developed. The MMS will share the SCADA Man-Machine-Interface in form of a large Display Wall with the SCADA system. Both SCADA operators and MMS operators are allowed to use the large display in the Bridge Control Room.

All systems and sub-systems working under the MMS will be integrated and will be able to exchange data by means of web services, as well as can be able to address and provide display of information on local screens and/or the common large Display Wall in the Operation Control Centre.

The IT-system will be positioned in the Operation Control Centre (OCC) and have a display wall and local displays for displaying of data relevant for the TMS, Safety System and SCADA, where MMS will share the SCADA interface. All subsystems will use the common enterprise service bus for communication between subsystems.

The specification of IS infrastructure is located in Component no. 19.

Figure 1.3 shows an possible setup of the video wall user interface.

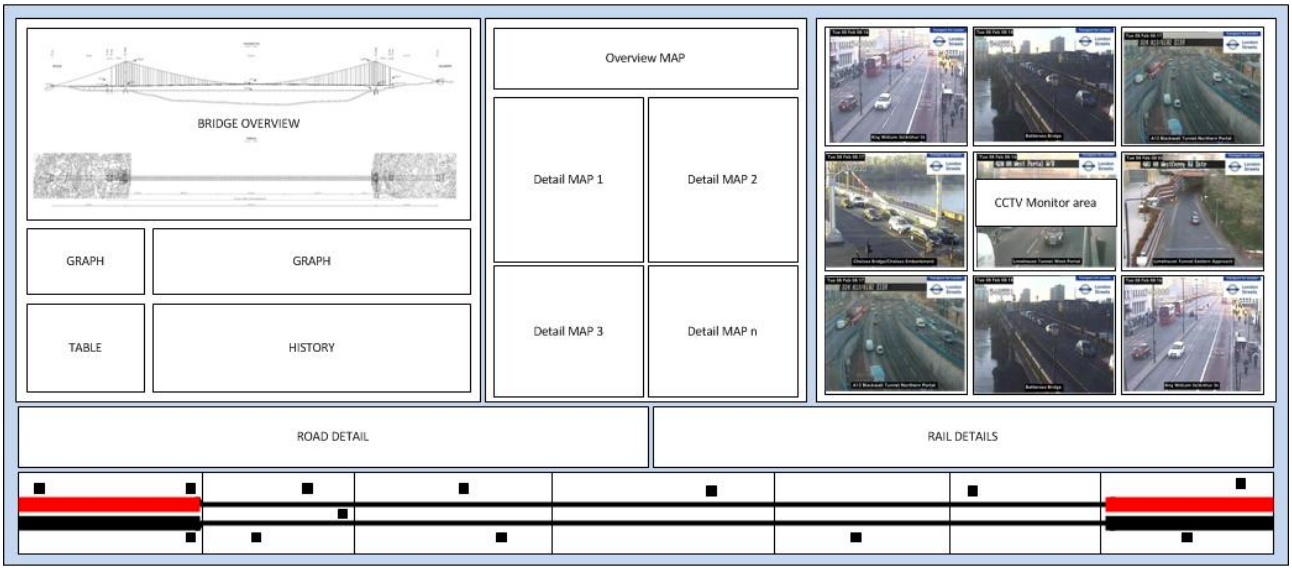

Figure 1.3 A simplified representation of a possible Video wall user interface

1.3 Pending development

This document is a design definition plan for the ICMS intended to form the basis for carrying out technical specification for an ICMS at a later stage. It cannot be used as a tender document. It is expected that, during the detailed design (Progetto Esecutivo) stage, this document will be further developed into a Specification.

2 Introduction

This section gives a brief introduction to the bridge and the individual main systems which are relevant for the report.

2.1 General

The Messina Strait Bridge will span the Messina Strait between Calabria on the Italian mainland and the island of Sicily and will provide the first fixed link between Italy and Sicily. The suspension bridge crossing comprises a 3,300 m main span, which will be longest in the world when constructed.

The bridge carries four marked vehicle lanes, two emergency lanes and two rail lines. The bridge superstructure comprises three separate orthotropic deck steel box girders, one for each of the Sicily and Italy bound roadways and one for the railway. The three box girders are connected by transverse steel box cross girders spaced at 30 m. The superstructure is supported by pairs of hanger cables connected to each cross beam end. The hangers are connected to pairs of main cables on each side of the bridge (four main cables). The main cables are anchored at each bridge end in massive reinforced concrete anchor blocks. The main cables are supported by two steel main towers, each with a height of 399 m above mean sea level. The main towers are founded on reinforced and post-tensioned concrete footings, which are supported on underlying rock formations.

This document is a design definition plan for the ICMS intended to form the basis for carrying out technical specification for an ICMS at a later stage. It cannot be used as a tender document. It is expected that, during the detailed design (Progetto Esecutivo) stage, this document will be further developed into a Specification. This design plan presents as outlined in the following

2.2 MACS

The Bridge is to be equipped with a Management and Control System (MACS), which enables the Bridge Operator to carry out the operation of the Bridge and maintenance of the Bridge structure and installations in a safe-and structured manner.

The Management and Control System will be a collection of controlling software applications with analysis and management modules and interface to the following system packages:

- Monitoring (SCADA – described by the E&M design basis)
  - Traffic Management System (TMS)
  - E&M Control and Monitoring (EMC)
  - Structural Health Monitoring System (SHMS)
  - Communication (CS)
  - Railway monitoring (RTMS).
- Management, Maintenance & Simulations(MMS)
  - Computing of Simulations and Predictions (CSP, Detailed in this report).
  - Worksite Management System (WSMS).
  - Bridge Management System (BMS).
  - Information and Coordination Management (ICMS).
  - Electronic Document System Management (EDMS).

Figure 2.1 shows the overall system architecture for MACS

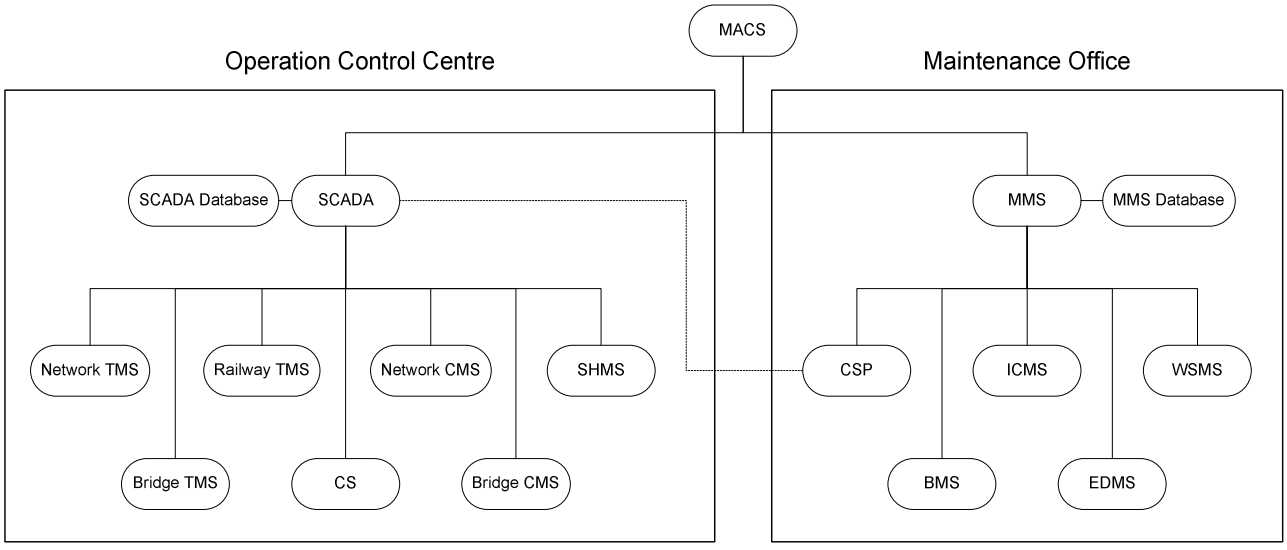

Figure 2.1 Over all system architecture

The Management and Control System (MACS) system softwares will be building upon standard software with the necessary extensions to achieve the required extra functionalities. The MACS will share the SCADA Man-Machine-Interface in form of a large Display Wall with the SCADA system. Both SCADA operators and MACS operators are allowed to use the large display in the Operation Control Centre (OCC).

Figure 2.2 shows an possible setup of the video wall user interface.

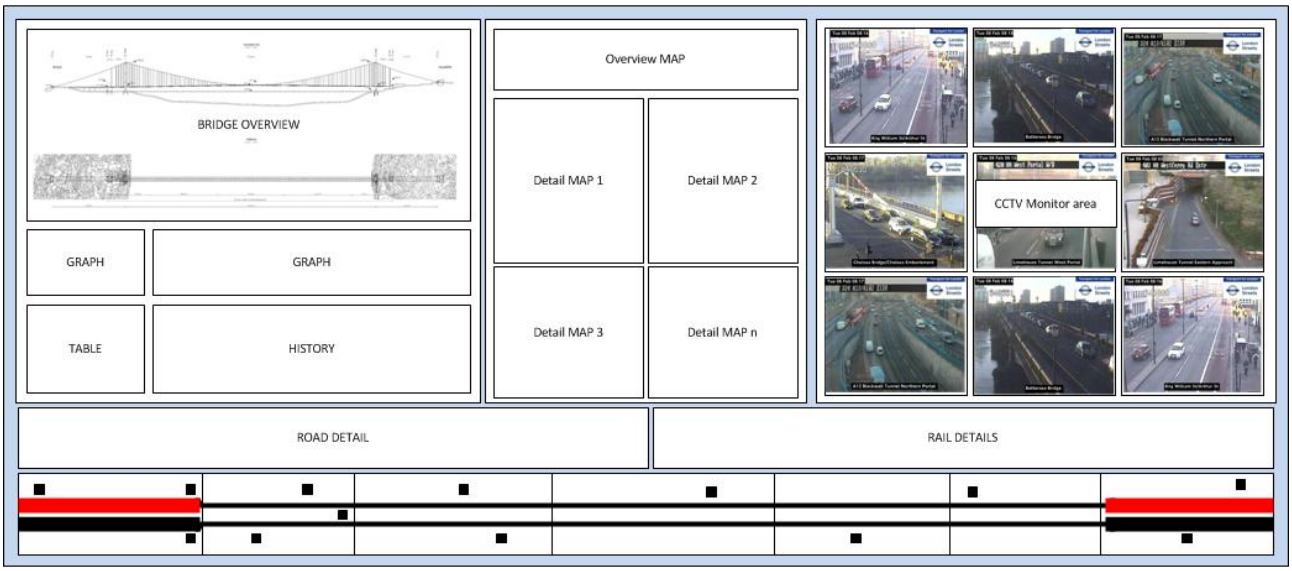

Figure 2.2 A simplified representation of a possible Video wall user interface

The MACS it self will be a data portal enabling the operator and bridge management to pull standard reports from each sub-system.

All systems and sub-systems working under the MACS will be integrated and will be able to exchange data by means of web services, as well as can address and provide display of information on local screens and/or the common large display wall in the OCC.

3 Information & Coordination Management System (ICMS)

3.1 General

An Information & Coordination Management System (ICMS) will be established with the objective of supporting the operation manager in distributing messages to predefined recipients in response to specific events, including incidents. These messages may take the form of instructions, including alarms to other systems and/or organisations, or information depending on the event and recipient. These specific event messages will to a large extent be predefined.

The ICMS is to be activated by the operation manager based on information, typically information related to planned maintenance, or is activated automatically by alarms from other systems, like SCADA etc.

In addition the ICMS will log and store all events and will have functionality to display in real time all information related to the events.

3.1.1 Event Action Plan

The definition of the predefined response messages is to be based on and comply with:

- Operation and Emergency Manual Basis (CG1000-P-RG-D-P-CG-00-00-00-00-00-05),
- Operation and Emergency Manual (CG1000-P-MI-D-P-GE-M7-00-00-00-00-00-01)

These documents are hereafter referred to as the O&E Manual.

The O&E Manual will in Progetto Esecutivo specify a vast number of events with related procedures and instructions.

An Event Action Plan, EAP can be made for each event, by listing all the actions described in the related procedures and instructions together with the assigned staff and transforming each action into a message for the specific recipient with an order for specific action. The EAPs are also organised into event categories for easier access by the operation manager.

Future changes to the O&E Manual's procedures and instructions shall cause consequential changes to the Event Action Plans of the ICMS.

3.2 Operation of the ICMS

Events are according to the O&E Manual categorised as being in Normal, Abnormal or Emergency mode, where both Normal and Abnormal can be considered trivial. These will be covered by very specific EAPs, whereas in Emergency mode the ICMS will support the rescuing operation and other preventive actions rather than specifically instruct and control all aspects.

The operation of the ICMS is presented in the use case diagram below:

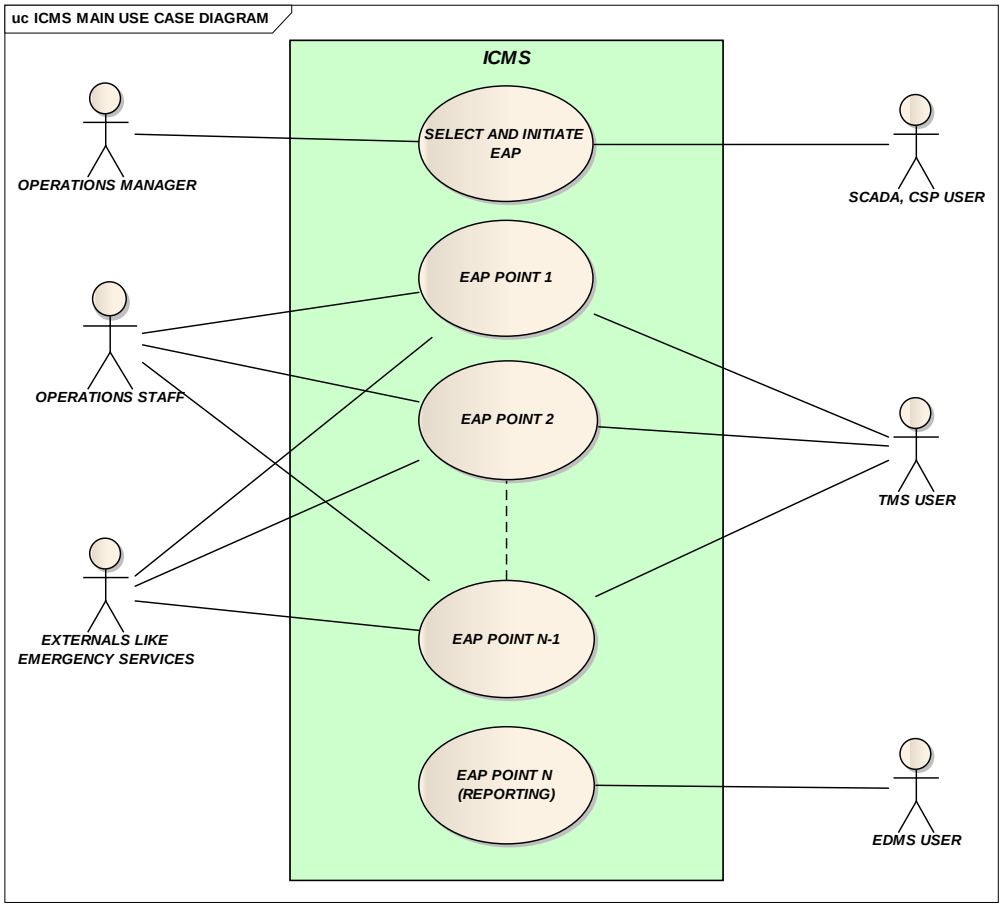

Figure 3.1 Use case diagram for ICMS

3.2.1 Activation of ICMS

The ICMS can be activated manually as well as automatic.

Certain alarms like fire alarms originating in CMS can activate the ICMS and based on the characteristics of the automatic alarm the ICMS selects the proper EAP, but it is expected that the ICMS mostly will be activated by the OCC staff based on information, typically planned maintenance or alarms from other systems, which do not trigger an automatic alarm.

3.2.1.1 Manual activation

In the manual activation situation the primary task of the operator is to select the EAP corresponding to the event.

It is the responsibility of the OCC staff to input valid information defining the type and scale of the event, thus forming the basis for the ICMS to support execution as correct and adequate as required. The system will include facilities for the operator's input to assist in defining the event, so that the appropriate EAP can be selected. This by picking from a list of predefined event categories followed by selecting a specific event. The ICMS will also assist in specifying the location of the event. In case of emergency also the type and number of vehicles as well as number of persons involved will have to be specified at this stage.

The appropriate EAP shall thus appear on the screen in the OCC.

3.2.1.2 Scheduled activation

Scheduled activation is typically to be used for maintenance operations requiring traffic restrictions. It is similar to the manual activation, 3.2.1.1, but using the execution start time. When using the ICMS the user must specify that the event is scheduled at input start to avoid the risk of having the EAP executed instantly.

Every event recorded/sent to the ICMS will be cross referenced with the O&E manual in order to check if any ongoing events are effected. If a conflict is found then an alarm should be issued and all the active events which are effected should be listed and shut down. E.g. an event is logged saying that a strong winds are predicted to occur within 1 hour. A cross check is made of all active events and it is found that people are inspecting the main cable and is working along it length. The

SCADA operator should inform the people working on the main cable that they have to stop working and leave the bridge.

3.2.1.3 Automatic activation

When an alarm activates the ICMS, the system automatically sends an alarm message to the relevant external emergency services taking part in a rescue operation. The alarm message will include the information available from the alarm i.e. type and location. The first task of the operation manager will be to verify the alarm as far as possible using other systems. The main purpose of this verification is to enhance the alarm to include other important information, like information on the number of injured persons. The main purpose is not to eliminate false alarms. This verification may lead to a change in the selection of EAP. In case of a change in EAP it is important that this change does not trigger a new alarm message to the external organisations, but only an update.

3.2.2 Execution of EAP

After the EAP has been selected it is the job of the operation manager by use of ICMS to initiate the actions of the Event Action Plan in the order they are presented in the EAP. This presentation will be similar to a check list.

It will be possible to initiate more actions at a time using a single or few commands including:

- Alarms to emergency services and other relevant parties with information on the emergency for which the alarm is initiated if not already automatically executed.
- Automatic actions affecting the traffic on the bridge such as change of traffic signs closing of traffic lanes, stopping of trains through the TMS
- Selection of relevant surveillance cameras and provision of other information necessary to manage the emergency according to the EAP.

When an action is finished the assigned internal operation staff reports to the operation manager, who records this in the ICMS. There will be an option to input comments for action.

The last part of an EAP will include a number of "return to normal" actions, which can only be executed, if the actions forming the core of the event have been finalised.

It is also very important during the end phase of an event, that the statuses of other events are taken into account and coordinated. This to identify the current "normal" situation. An example of this would be a road accident occurring during planned maintenance. When the accident EAP is coming to its end phase, the traffic restrictions of the still ongoing maintenance work EAP should be left active.

3.2.3 Emergency support system

If an event is being categorized as being in emergency mode the ICMS distributes information to external parties. The cooperation of the following organisations and authorities is envisaged and equipment for receiving messages from ICMS is expected to be installed with:

- Police authorities on both sides
- RFI, local control room
- Pertinent life-saving services
- Ambulance services
- Fire brigades
- Hospitals on both sides
- Local emergency services
- Pertinent local authorities on the Calabrian as well as the Sicilian side
- The highway authorities
- Other relevant entities

It is expected that this communication is performed using a dedicated network with dedicated terminals at each location. The definition of the actual setup does however require full participation of the other services and authorities in order to fulfil their requirements. This topic is covered in more detail in CG1000-P-RG-D-P-GE-00-00-00-00-00-01, Design Basis - Mechanical and Electrical, Chapter 13 - Communications Systems.

3.2.4 Public Information

A typical action on an EAP will be traffic restrictions. Depending of the impact of the restrictions it may be a required to inform the public of the restrictions. In case of scheduled maintenance the information should be issued timely. In other cases like accidents the public information actions are not initiated until immediately after the traffic restrictions are executed.

The following information channels will be used:

- Web portal
- Voice response
- Owners intranet
- Owners home page
- Other home pages
- E-mail group
- Highway and RFI authorities
- Radio motoring news
- SMS service. Frequent bridge users can subscribe to receive information through this service

3.2.5 Internal information

In addition to actions directly related to the event, other actions may be defined to inform managerial staff. The main purpose here is to inform the staff to be able to answer questions from the press or at least to inform that an event has occurred and maybe also of the current status of the event, so the staff is prepared in case of contact from the press.

3.3 Documentation and review

The ICMS will also facilitate the recording of time information for the actions in order to assist a later review of the event handling, with the particular aim of improving incident response time. ICMS will not record information on the quality of the work performed to execute the instructions, beyond what the operations managers may have provided as comments.

At the conclusion of an event a report will be automatically generated and stored in the EDMS.

A number of standard reports will be available containing statistical information, like number and type of event.

3.4 Event Log and Display

The ICMS will include a log of all relevant events in subsystem and functionalities for viewing and printing the event log. The definition of appropriate events will be specified during detailed design of the various subsystems.

3.4.1 Event log

The ICMS will register all events generated in the system in connection with complete information collected on events, included localization, date and time, and their progression will be recorded. The registered events and corresponding associated data can be extracted from the log either to be displayed on screen or in a report. The user may apply appropriate filters to data extraction from the log in order to limit output to the area of interest.

3.4.2 Display

The ICMS will visualize in real time all information related to the events either through the ICMS interface or trough MACS. Links to live video feeds, location and sensor feeds will be included if applicable.

4 List of requirements

The following is a list of requirements gathered through:

- The technical specification from Stretto di Messina
- The Contractors tender design
- Meetings with EUROLINK
- Meeting with designers of other subsystems
- Inferred from the design process itself

ID	Requirement	Requirement Reference
1.	Determine the present-day level of service • Management ○ Events	Technical Specification for Maintenance Engineering and Control and Management Systems, Management and Control System, GCG.F.06.01, rev. 0, 12th October 2004
2.	Determine the present-day level of service • Management ○ Emergencies	Technical Specification for Maintenance Engineering and Control and Management Systems, Management and Control System, GCG.F.06.01, rev. 0, 12th October 2004
3.	Determine the present-day level of service • Information on the bridges current and expected state ○ The users travelling along the Bridge	Technical Specification for Maintenance Engineering and Control and Management Systems, Management and Control System, GCG.F.06.01, rev. 0, 12th October 2004
4.	Determine the present-day level of service • Information on the bridges current and expected state ○ The users approaching the Bridge	Technical Specification for Maintenance Engineering and Control and Management Systems, Management and Control System, GCG.F.06.01, rev. 0, 12th October 2004
5.	Diffuse information, actual and foreseen, to users, concerning both the state and use of the Bridge, eventual prescriptions, proscriptions and whatever else is useful for a safe and conscious use of the Bridge	Technical Specification for Maintenance Engineering and Control and Management Systems, Management and Control System, GCG.F.06.01, rev. 0, 12th October 2004
6.	Communicate information, actual and foreseen, to all external organizations involved in the Bridge's operative management, as regards to use and state, to eventual prescriptions, proscriptions, maintenance sites,	Technical Specification for Maintenance Engineering and Control and Management Systems, Management and Control System, GCG.F.06.01, rev. 0, 12th October 2004

	events and related consequences	
7.	All information collected and elaborated by the system shall be verifiable by the operator through adequate interfaces. Collected information shall be recorded so as to build a historical data base of the Bridge.	Technical Specification for Maintenance Engineering and Control and Management Systems, Management and Control System, GCG.F.06.01, rev. 0, 12th October 2004
8.	An interface for alarms, breakdowns, accidents signaling shall be provided to the operator too.	Technical Specification for Maintenance Engineering and Control and Management Systems, Management and Control System, GCG.F.06.01, rev. 0, 12th October 2004
9.	The system shall consider as an Event every signaling of anomaly, breakdown, accident, unforeseen event, intrusion, sabotage that generate an alarm, as well as all planned activities that influence the Bridge's safety, traffic or durability.	Technical Specification for Maintenance Engineering and Control and Management Systems, Management and Control System, GCG.F.06.01, rev. 0, 12th October 2004
10.	Examples of events: maintenance sites, some weather, seismic-tectonic, structural phenomena, traffic (such as traffic jams and queues), accidents, breakdowns, sabotages, signaling of non-authorized vehicles approaching the Bridge, speed violations and all violations to prescriptions regarding the use of the Bridge which, alone or combined with other, can compromise the users' safety and Bridge's durability.	Technical Specification for Maintenance Engineering and Control and Management Systems, Management and Control System, GCG.F.06.01, rev. 0, 12th October 2004
11.	Every event will be monitored by the system in its whole duration. Information related on the event's evolution might be acquired by monitoring the Bridge, the maintenance sites,	Technical Specification for Maintenance Engineering and Control and Management Systems, Management and Control System,

	the accidents, as well as through coordination with the managers of the interconnected roadways/highways and railways, and/or might be written in by the operator. All information collected on events, included localization, date and time, and on their evolution shall be recorded.	GCG.F.06.01, rev. 0, 12th October 2004
12.	The system will visualize in real time all information related to the events, in the most appropriate way to obtain an immediate and efficient representation (maps, tables, videos), and will grant the research, visualization and necessary elaboration related to user-specified periods or events.	Technical Specification for Maintenance Engineering and Control and Management Systems, Management and Control System, GCG.F.06.01, rev. 0, 12th October 2004
13.	The events' management shall first of all provide an estimation of the specific event's impact on the Bridge: more into specific, the impact on the admissible level of service shall be assessed. Based on this evaluation, a management priority will be assigned to each event.	Technical Specification for Maintenance Engineering and Control and Management Systems, Management and Control System, GCG.F.06.01, rev. 0, 12th October 2004
14.	The system shall plan and coordinate the diffusion of information related to the state and level of service of the Bridge, to traffic, to expected and unforeseen events and <the diffusion of> any other useful or necessary information for a safe use of the Bridge. The diffusion shall be timely and efficient and such as to reach all possible interested subjects (users traveling on or approaching the Bridge, emergency and maintenance teams,	Technical Specification for Maintenance Engineering and Control and Management Systems, Management and Control System, GCG.F.06.01, rev. 0, 12th October 2004

	managers of interconnected highways/roadways and railways, police, etc.) with contents, times, modes that allow an optimal use <of the provided information>. Most of the operative communication shall take place via the mobile radio net TETRA (TErrestrial Trunked RAdio), that shall be conceived and organized so as to allow that the above-stated communication are safe and reliable. Particular attention shall be given to the diffusion of information in critical areas of the Bridge, and in particular of the Bridge. This implies an accurate analysis of the locations in which the information shall be diffused, of its diffusion frequency, and on the typology of information diffused. These parameters influence the localization of diffusion points (panels, signals, free telephone numbers and web accesses) and the choice of the forms of diffusion.	
15.	All planned activities in relation to maintenance will be recorded by the system as "programmed" events; the system itself will provide for making them "active" in the appropriate period. Active or programmed maintenance activities might be revoked or suspended as events occur whose impact is considered as incompatible with the presence of the site.	Technical Specification for Maintenance Engineering and Control and Management Systems, Management and Control System, GCG.F.06.01, rev. 0, 12th October 2004