AIR TRAFFIC MANAGEMENT
Thales Australia Centre, Atrium Lobby Level
WTC Northbank Wharf, Siddeley Street
Melbourne, Victoria, 3005
Australia
Tel. +61 (0)3 8630 4000
Fax.+61 (0)3 9614 0187
www.thalesgroup.com

The New CNS/ATM Systems Development Project (Package-1)

PH-ATM

PH-ATM ATMS System / Segment Design Document

Contract Number: PH-P228

CDRL Number: ENG(ATMS)-001

Prepared for:

Department of Transportation and Communications (DOTC)

The Columbia Tower,
Ortigas Avenue, Brgy, Wack-Wack
Mandaluyong City,
Metro Manila, Philippines 1555

Prepared by:

Thales Australia Ltd
(ABN 66 008 642 751)

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Revision	Date	Author	Modification
-	04 July 2011	Shintaro Toriyabe	Initial Release
A	29 August 2011	Shintaro Toriyabe	Update TopSky - ATC Software Descriptions, HWCIs and ADs as per comments received from the Employer and Engineer during PDR. Updated with internal peer review comments
B	09 November 2011	Shintaro Toriyabe	Update according to revised Bill of Materials received in P1-ES-11-073. Updated with internal peer review comments
C	21 March 2014	Thusyanthi Jayasinghe	TopSky – ATC HE Updates

	APPROVAL			
	Name	Role	Date	Signature
Written by:	Thusyanthi Jayasinghe	Systems Engineer	21/3/14	
Verified by:	Roshan Salian	QA Manager	21/3/14	
Approved by:	Gareth Evans	System Engineering Manager	21/3/14	
Approved by:	Michael Tomlinson	Project Manager	24/3/14	

Authorised for use	Thales Australia Ltd	Approved by	Engineer	Approved by	Employer
Name	R. LIONS	Name		Name	
Date	24/3/2014	Date		Date	

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1. Scope

1.1. Identification

Table 1 Project Identification

Project Identification	
Project Name	The New CNS/ATM Systems Development Project (Package-1)
Contract Number	PH-P228
Prime Contractor	Sumitomo Corporation and Thales Australia Ltd
Solution Lead	Thales Australia Ltd

Table 2 Document Identification

Document Identification	
Document Full Title	System / Segment Design Document
Document Abbreviated Title	SSDD
Business Identifier and DTC	61 616 636-424
Thales Reference Number (TRN)	N/A

1.2. Philippines ATM Project Overview

The Department of Transportation and Communications (DOTC) is responsible for providing air navigational services in the Philippine Flight Information Region (FIR), and this FIR occupies one of the largest areas in the region.

The Philippine FIR is bounded to the north by the Hong Kong, Taipei and Fukuoka FIRs, to the east by Oakland Oceanic FIR, to the south by Ujung Pandang FIR, to the southwest by the Kota Kinabalu and Singapore FIRs, and to the west by the Ho Chi Minh and Sanya FIRs.

The New CNS/ATM System Development Project is a program of works designed to rejuvenate and enhance the Air Traffic Management capabilities within the Republic of Philippines, and includes civil works (new ATM building in Manila), plus a full suite of new core products related to the new ATM functionality.

The New CNS/ATM Systems Development Project is divided into two (2) separate contract packages as follows:

- Package 1 – ATM Automation, Communication, Navigation and Meteorological Systems; and
- Package 2 – Communication and Surveillance Systems.

Package 1 of the project consists of 6 segments composed of the following systems:

- ATM ATC Segment
    - ATM System (ATMS)
    - Central Technical Monitoring System (CTMS)
    - Computer Based Training (CBT)
    - Journaling and Playback Data Processing (JPDP)
    - Search and Planning System (SAR)
    - Airspace Design and Evaluation Workstation (ADEW)
    - Time Distribution System (TDS)
- ATM AISS Segment
    - Aeronautical Information System (AISS)
- COM G/G Segment
    - AMHS/AFTN System (existing and upgrade)
    - ATN G/G router (existing and upgrade)
- COM Voice Segment
    - Voice Switching and Control System (VSCS)
    - Emergency Radio Bypass System (ERBS)
    - Voice Recording System (VRS)
- NAV Segment
    - GNSS Signal Monitoring System
    - Web Server system
- MET Segment
    - MDPS (WAFS, MTSAT, MCS)
    - Automated Weather Observation System (AWOS)
    - ATIS System

1.3. Document Overview

The PH-ATM ATM System/Subsystem Design Document (SSDD) contains high level design description for the PH-ATM ATM system. It presents the organisation of the system, as composed of Hardware Configuration Items (HWCIs) and Computer Software configuration Items (CSCIs).

The SSDD has the following objectives:

- To provide an overview of the functional capabilities of the system,
- To describe the system design of the ATM system to be implemented for the Department of Transportation and Communication,
- To provide a basis for performing system integration.

In addition, it outlines top-level system operational procedures such as start/stop as well as redundancy management procedures.

1.4. Applicability of this Document

This document applies to the ATM segment of the PH-ATM project.

1.5. Terminology, Acronyms and Abbreviations

Refer to Chapter 7 Acronyms

2. Referenced Documents

2.1. Contractual Documents

Table 3 Contractual Documents

Ref.	Contract No.	Title	Revision	Date
C_01	PH-P228	Document III (ES) Specifications for Equipment and System works of the Contract	Final	Jan 2010

2.2. Referenced Standards

Table 4 Referenced Standards

Ref.	Standard Title	Reference Number
S_02	International Commercial Terms 2010	INCOTERMS 2010

2.3. Project Documents

Table 5 Thales Product Documents

Ref.	Document Title	Business Identifier and DTC	Revision	Date
P_01.	PH-ATM Radar / ATM Interface Control Document	61 616 626 AG-558	A	24/05/11
P_02.	PH-ATM ATM / ADS-B Interface Control Document	61 616 626 AF-558	A	24/05/11
P_03.	PH-ATM ATM / ACARS Interface Control Document	61 616 626 AD-558	A	24/05/11
P_04.	PH-ATM ATM / A-G Router Interface Control Document	61 616 626 AC-558	A	24/05/11
P_05.	PH-ATM AMHS Interface Control Document	61 616 626 AY-558	Rev 0.7	09/05/11
P_06.	PH-ATM ICAO Interface Control Document	61 616 626 AB-558	A	02/06/11
P_07.	PH-ATM ATM / AIDC Interface Control Document	61 616 626 AE-558	A	24/05/11
P_08.	PH-ATM AIS Interface Control Document	61 616 626 BQ-558	A	02/06/11
P_09.	PH-ATM MDPS Interface Control Document	61 616 626 BV-558	10611	02/06/11
P_010.	PH-ATM ATM / AWOS Interface Control Document	61 616 626 AL-558	B	08/06/11
P_011.	PH-ATM ATM / JPDP Interface Control Document	61 616 626 AP-558	-	24/06/11
P_012.	PH-ATM MAESTRO Interface Control Document	61 616 626 BY-558	-	17/06/11
P_013.	PH-ATM ATM / Billing Interface Control Document	61 616 626 BR-558	-	18/04/11
P_014.	PH-ATM VSCS ICD	TBD	TBD	TBD
P_015.	PH-ATM DPR HMI Specification	TBD	-	TBD
P_016.	PH-ATM ATM / AISS Interface Control Document	61 616 626 AJ-558	-	04/07/11
P_017.	PH-ATM Operational Concept Document	61 616 627-425	A	TBD

3. Operational Concepts

3.1. Missions

The principal mission of the automation system is:

To enhance the safety and efficiency of Air Traffic Management within the airspace controlled by our customers.

The functional subsystems provided by TopSky - ATC are:

- Surveillance Data Processing sub-system to support the following functions:
  - Main Surveillance Data Processing,
  - Bypass Surveillance Data Processing,
  - Safety Nets and Alert Processing,
  - Coupling and Monitoring Aids Processing.
- Flight Data Processing sub-system to support the following functions:
  - Flight Plan Function,
  - Aeronautical Information Processing,
  - Flight Plan Conflict Detection Processing.
- Air-Ground Data Communication sub-system to support ADS-C, PDC, and CPDLC functions over ACARS network.
- Ground-Ground Data Communication sub-system to support data exchange with external systems through AIDC, AFTN/AMHS protocols and between TopSky - ATC partitions.
- Operational Display sub-system to support the Human Machine Interface.
- Recording and Replay sub-system to support the following functions:
  - Exact HMI Recording and Replay,
  - Data Recording,
  - Data Replay Function.
- Offline sub-system to support the following functions:
  - Data Preparation Function,
  - Data Analysis Function.
- System Control and Monitoring sub-system.
- Simulator
- Training Capabilities

The above list comprises the full functional scope for a comprehensive Air Traffic Management automation system as a commercial off-the-shelf solution using TopSky - ATC.

3.2. Operational Requirements

The TopSky - ATC system will be installed to support the following operational positions:

Manila ATC Operations Room positions consisting of:

- 2 Flight Data Operator (FDO) positions
- 1 Technical Supervisor (TKSUP) position
- 1 Air Traffic Flow Management (ATFM) position
- 1 Area Supervisor (ASUP) position, configured for Airspace Management (ASM)
- 1 En-Route Operational Supervisor/ Watch Supervisor (OPSUP/WSUP) position
- 8 En-Route Executive Controller (EC) positions
- 8 En-Route Planning Controller (PLC) positions
- 2 Spare Executive Controller (EC) positions
- Approach Operational Supervisor/ Watch Supervisor (OPSUP/WSUP) position
- 8 Approach Executive Controller (EC) positions
- 8 Approach Planning Controller (PLC) positions

Remote Monitor and Control Room position consisting of:

- 1 Technical Supervisor (TKSUP/CTMS) position

Briefing Room position consisting of:

- 1 Observation (OBS) position for use as the ATM Briefing Workstation (BRF)

FIS Room positions consisting of:

- 2 Observation (OBS) positions, configured for AMS (HF operations)
- 2 Observation (OBS) positions, configured for FSS

ATMS Equipment Room position consisting of:

- 1 Technical Supervisor (TKSUP) position

AISS Room position consisting of:

- 1 Airspace Design (ADEW) position

PADCC Room position consisting of:

- 1 Observation (OBS) position for use as the Monitoring Workstation (MON)

DSS Room positions consisting of:

- o 1 Airspace Design (ADEW) position
- o 1 combined Data Base Management (DBM) position and Data Analysis Replay Tool (DART) position
- o 1 Data Analysis (JADE) position

Remote Tower positions consisting of:

- o Total of 10 Tower Controller (TWR) positions
  - NAIA: 2 Tower Controller Positions
  - Clark: 1 Tower Controller Position
  - Kalibo: 1 Tower Controller Position
  - Iloilo: 1 Tower Controller Position
  - Mactan: 2 Tower Controller Positions
  - Bacolod: 1 Tower Controller Position
  - Davao: 1 Tower Controller Position
  - Caticlan: 1 Tower Controller Position

Manila Training and Evaluation System (TES) positions consisting of:

- o 1 Exercise Editor (EED) position
- o 1 Database Management (DBM) position
- o 1 Technical Supervisor (TKSUP) position
- o 1 Operational Supervisor (OPSUP) position
- o 8 Executive Controller (EC) positions
- o 8 Planning Controller (PLC) positions
- o 1 Leader/Pseudo Pilot (SUP/PIL) position
- o 5 Pseudo Pilot (PIL) positions

Manila Computer Based Training (CBT) System positions consisting of:

- o 15 Student Workstation (CBT) positions

3.3. Functional Requirements

3.3.1. TopSky - ATC Main Functions

The TopSky - ATC main functions comprise the set of functionality, which are directly required to provide safe Air Traffic Management (ATM) services. The following basic functions are provided for the TopSky - ATC system:

- **Flight Data Processing Function**
  - Manages flight plan related data as well as aeronautical information.

- **Data Preparation Function**
  - System Parameter Management Function

- **Surveillance Data Processing Function**
  - Sensor Gateway
    - Surveillance data reception and error filtering
  - Multi Sensor Tracking Function
    - Processes surveillance track data and distributes system (ASTERIX CAT 62) surveillance tracks

- **Fall-back Surveillance Processing Function**
  - Reception, processing and maintenance of surveillance track data
  - Multi-sensor Tracking Processing Function
    - Processes surveillance data from a Sensor Gateway and tracking (SGT) function and distributes system (ASTERIX CAT 62) surveillance tracks

- **Air/Ground Data Link Function**
  - ADS-C Reporting
    - Provides ADS-C position reports for aircraft
  - ADS-C based alerts and warnings
    - Provides alert and warning processing for ADS-C aircraft
  - Controller Pilot Data Link Communication Function
    - Provides a mechanism for the controller to conduct a dialogue with the aircraft
  - Pre-Departure Clearance Management Function
    - Provides a mechanism to deliver departure clearances initiated by the controller prior to departure for specified aircraft

- **Safety Net and Monitoring Aids Processing Function**
  - Provides alert and warning processing as well as association of flight plans to surveillance tracks

- **Simulation and Training Functions**
  - Air Traffic Generator Function
    - o Provides simulated data in the training system

- **Human Machine Interface providing**
  - Air Situation Displays
  - Ability to issue commands and enter information
  - Alert and warning management

All functions are considered essential for the provision of ATS and are therefore implemented as redundant functions in an operational system. The exception is the RBP function, which is a secondary level backup to the already redundant main Multi Sensor Tracking function, and the ATG function, which is only used in the Simulator.

3.3.2. TopSky - ATC Complementary Functions

The TopSky - ATC complementary functions comprise the set of functionality to enhance the basic functions, but they are not essential for providing basic air traffic separation services. The following complementary functions are provided for the TopSky - ATC system:

- Communication Data Function
- Operational Data Analysis Facilities Function
- Flight Plan Conflict Function
- Recording and Replay Function
- System Control and Monitoring Function
- Inter-Operability and Data Exchange Function
- Traffic Flow Management System Function

As these functions are not essential for providing ATS, not all of these are implemented as redundant functions in an operational system. Nonetheless, some functions are considered to be of high importance and are therefore implemented as redundant functions as noted in section 6.10.3.5 CSCI Redundancies.

4. System Architecture

4.1. TopSky - ATC System Partitions

A System state is implemented via a set of run-time applications. These application software items communicate with each other and run as an independent configuration. Each run-time application runs isolated from other run-time applications executing in another System state and are defined by specific System Configurations.

Partitions facilitate these System Configurations, which are specific deployment and configurations of a combination of hardware equipment and software functions configuration of the TopSky - ATC system to meet particular operational requirements.

The PH- ATM Architecture is divided into the following partitions:

- Area/Approach Control Centre (ACC/APP) partition
- 8 Remote Tower (TWR) Control partitions
- Simulator (TES) partition
- Computer Based Training (CBT) partition

4.1.1. ACC/APP Centre Partition

The ACC/APP Centre partition provides centralised data processing for all partitions of the FIR. The centre is the gateway to external services. All services are interfaced at the main centre. Remote towers also have independent local surveillance interfaces.

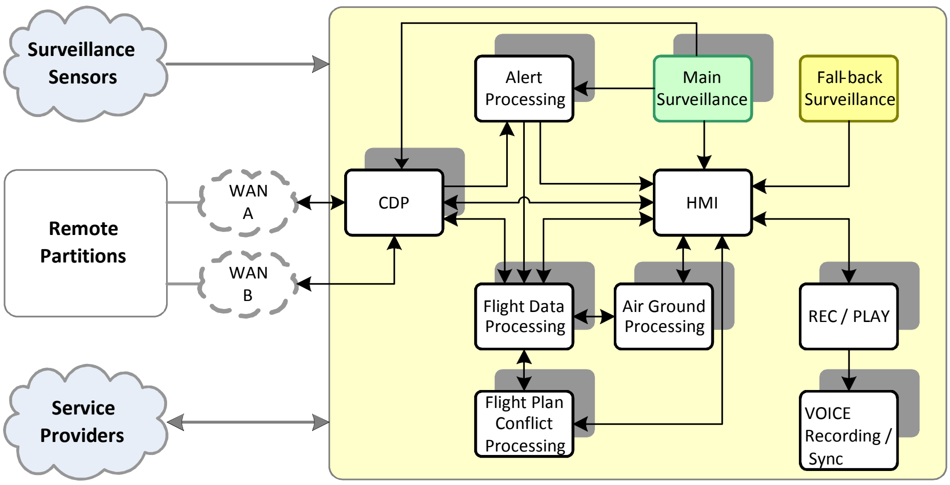


Figure 1 ACC/APP Partition

Data is exchanged with remote partitions over a redundant TopSky - ATC Wide Area Network. A Communications Data Processor (CDP) provides a filtering and routing service to only exchange necessary data with remote partitions.

4.1.2. Remote Tower Partition

The Remote Tower (TWR) partition provides tower services at a location which is remote from the centre. The Tower partition supports two modes of operation; normal and fall-back.
In normal mode all data processing is performed at the centre and distributed to the Tower via redundant communication paths for display on local HMI. Operators of the Tower receive system tracks from the centre, which is geographically filtered to an offline defined size (the filtered area is centred at the remote Tower partition).
Switching to fall-back mode automatically occurs in the event of both communication paths to the centre fail. A local flight processing function in the HMI takes ownership of any flight plan that was known to the HMI for continued operations. On re-establishment of communications with the centre, each operator can switch back to normal mode on demand.

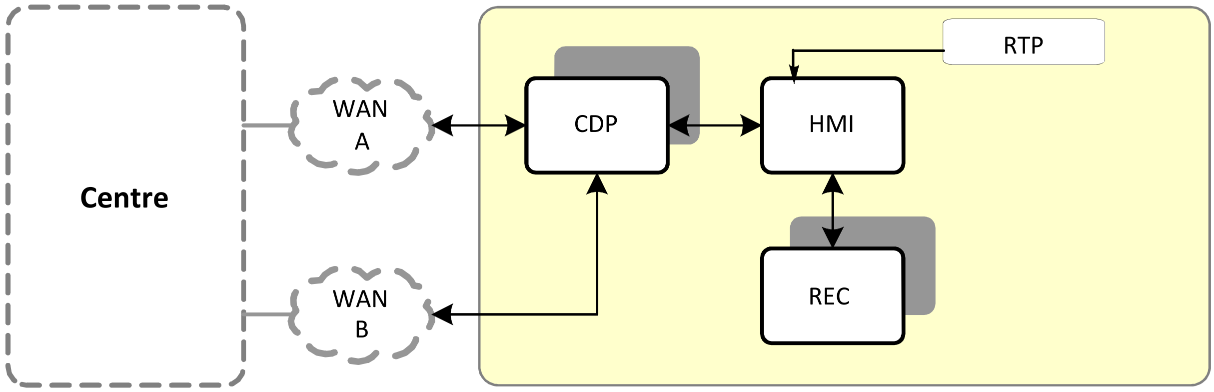
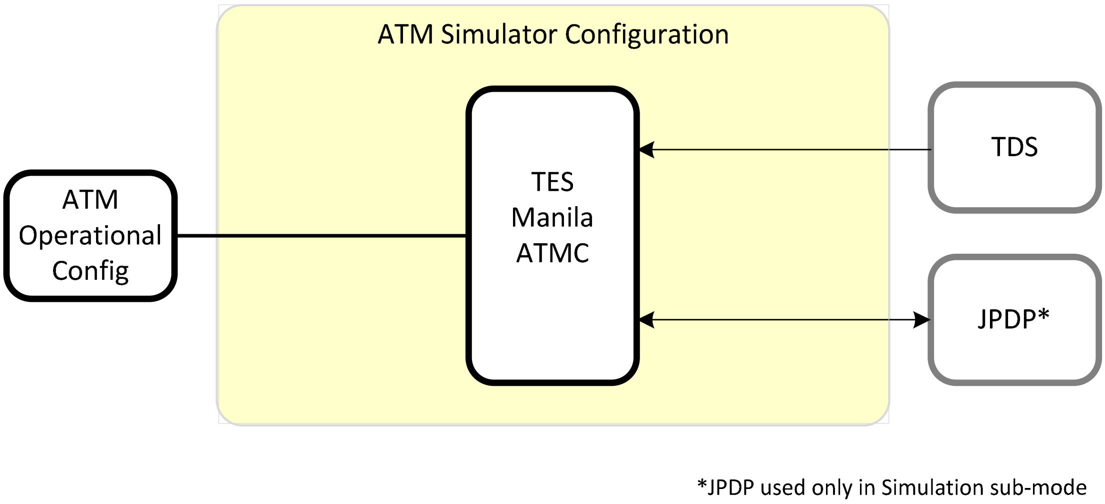


Figure 2 Remote Tower Partition

In both modes of operation, TopSky - ATC data and voice is recorded at the TWR.

4.1.3. Simulator Partition (TES)

The Simulator Partition provides Training, evaluation and Maintenance facilities and is designed to simulate a TopSky - ATC partition with inputs that mimic the real world.



4.1.4. Computer Based Training (CBT)

The ATC Computer Based Training allows individual learning of the Air Traffic Control, based on the ATM (TopSky - ATC Product) Controller's interface.

4.1.5. Partition Distribution

The TopSky - ATC design caters for a physical architecture that is deployed over the following sites:

Table 6 Partition Distribution

Location	Partition Type	Operational ATM	Simulation ATM	Voice Recording / Sync	MAP Displays	Consoles
Manila ATMC	ACC/APP	✓		✓	✓	✓
NAIA	Remote Tower	✓			✓	✓
Clark	Remote Tower	✓			✓	✓
Kalibo	Remote Tower	✓			✓	✓
Iloilo	Remote Tower	✓			✓	✓
Mactan	Remote Tower	✓			✓	✓
Bacolod	Remote Tower	✓			✓	✓
Davao	Remote Tower	✓			✓	✓
Caticlan	Remote Tower	✓			✓	✓
Manila TES	SIM	✓	✓	✓	✓	✓

4.2. Capabilities

Three System capabilities are identified, each of them corresponding to a specific operational need of Civil Aviation Authorities:

- Operational capability which encompasses en-route, approach and tower traffic control,
- Training capability which encompasses the training needs,
- Support capability which encompasses the data preparation system, data analysis and replay facilities.

4.3. Logical Architecture

4.3.1. Position Types Per Geographical Location

Table 7 Position Types Per Geographical Location

Location / Position Types	Manila (ACC/APP)	Manila Training and evaluation (TES)	NAIA Remote Tower (TWR)	Clark Remote Tower (TWR)	Kalibo Remote Tower (TWR)	Iloilo Remote Tower (TWR)	Mactan Remote Tower (TWR)	Bacolod Remote Tower (TWR)	Davao Remote Tower (TWR)	Caticlan Remote Tower (TWR)
Flight Data Operator (FDO)	✓									
Technical Supervisor (TKSUP)	✓	✓								
Air Traffic Flow Management (ATFM)	✓									
Airspace Management (ASM/ ASUP)	✓									
Watch Supervisor (WSUP/OPSUP)	✓	✓								
Executive Controller (EC)	✓	✓								
Planner Controller (PLC)	✓	✓								
Operational Supervisor (OPSUP)	✓									
Tower Controller (TWR)			✓	✓	✓	✓	✓	✓	✓	✓
Leader (JLDR)		✓								
Data Base Management (DBM)	✓	✓								
Data Analysis (JADE)	✓									
Airspace Design (ADEW)	✓									
Pilot (PIL)		✓								
Exercise Editor (EED)		✓								
Observer (OBS configured as BRF, AMS, FSS and MON)	✓									

4.3.2. Operational

4.3.2.1. Overview

TopSky – ATC is a state-of-the-art, solution for Air Traffic Control (ATC), designed and built by Thales for Air Navigation Service Providers (ANSP) around the world. TopSky - ATC is a modular system used to control traffic in continental, en-route, terminal approach and oceanic airspace and is built on top of a Unix Based System Software (UBSS) middleware layer that provides service abstraction of the Operating System, Network Interfaces and Hardware, all of which can vary during the deployment and operational lifecycles of the system.

The TopSky - ATC surveillance function supports many different data sources and provides the user with a single, consolidated surveillance display. Data from conventional radars, Mode-S radars, Automatic Dependant Surveillance (Broadcast or Contract), and flight plans can be displayed according to user requirements. This data fusion capability allows the DOTC to adopt any surveillance policy and to scale the system accordingly.

The TopSky - ATC Flight Data Processing (FDP) is designed to maximise system interoperability by supporting ICAO and AIDC protocols through the AFTN/AMHS network. Tight system integration allows the FDP to take full benefit of new surveillance capabilities to improve profile computation accuracy and conflict detection.

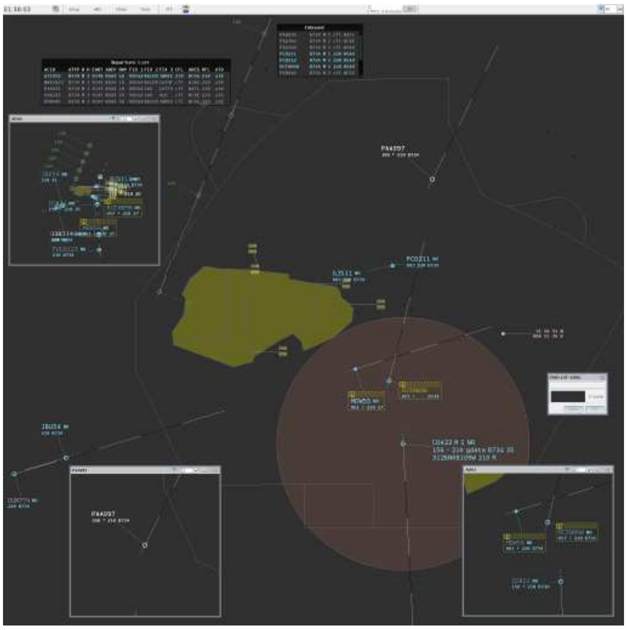


Figure 3 PH- ATM HMI

Design adaptations applied to the ATC Segment software and hardware components in order to achieve technical and architectural requirements include:

- Provision of multiple sensor gateway architecture to achieve a very high level of physical redundancy for the surveillance sensor data reception and distribution.

TopSky - ATC incorporates an Arrival Manager (MAESTRO) server function for the computation and management of optimal arrival times in the context of a multi runway configuration. Departure list functionality is also available via the arrival manager.

4.3.2.2. Position Types

4.3.2.2.1. Executive Controller (EC)

An Executive Controller (EC) is a position used for the control of airspace. An EC can have an assigned Assistant Controller (PLC) but when there is no PLC an EC acts as a combined EC-PLC.
The EC primarily performs the following functions:

- Responsible for separation/traffic management within sector
- Conducts transfer for sector entry
- Normally responsible for coordination dialogue for sector/FIR exit depending on timings
- Conducts transfer for sector exit
- Primary A/G communicator for VHF/UHF and CPDLC

Multiple ECs can be assigned to a single volumetric sector, for example APP/DEP sectors in the TMA or CIVIL and MIL sectors sharing a volume.

4.3.2.2.2. Planner Controller (PLC)

A Planner Controller (PLC) supports an EC in the management of traffic in the relevant volumetric sector. A PLC can ‘service’ one or many EC (max 6).
The PLC primarily performs the following functions:

- Plans/Clears a flight through the sector and Coordinates Sector Entry
- Check conflicts, airspace/traffic requirements, plan/negotiate clearance changes
- Identifies specific problems for the EC to resolve: some ANSP assign the PLC separation responsibility for non-surveillance airspace in the sector
- Plans Sector and/or FIR Exit prior to coordination start: it is possible to be responsible for coordination dialogue for sector exit depending on timings/procedures
- Potential secondary communicator (for example via CPDLC) if such operation is supported by the ANSP concepts and procedures

4.3.2.2.3. Operational Supervisor (OPSUP/WSUP)

Operational Supervisors/ Watch supervisors are responsible for the day-to-day management of the operational facilities. Typically there are supervisors for each of the key operational domains – ACC, APP and TWR. There can also be an overall Supervisor, or Supervisors that are responsible for a group of positions.

Supervisors perform a range of tasks which include:

- Managing the allocation of ATM resources within their domain, including sectorisation
- Managing and configure various operational capabilities of the ATM system - for example alerts
- Liaising with Technical Supervisors in relation to system status and maintenance actions
- Managing the operational aspects related to system or adaptation data upgrades
- Promulgating the availability/non-availability of airport or navigational facilities
- Coordinating SAR responsibilities with the Rescue Coordination Centre (RCC)
- Liaising with adjacent ATSU(s)

4.3.2.2.4. Flight Data Operator (FDO)

Flight Data Operators (FDO) are responsible for the correction of erroneous messages received in the ATM system – for example Flight Plans that cannot be processed and messages that cannot be associated to a flight.

FDO positions are also responsible for liaising with other ATSU in order to clarify erroneous messages or request missing data, or to respond to such requests.

In some systems Flight Data positions can also play an Assistant role for EC and PLC positions – typically in this case they assist with inter-centre coordination.

4.3.2.2.5. Tower (TWR)

TWR positions provide control services to aircraft operating on the airport or in the airport circuit area as well as to ground vehicles. A TWR can have assigned airspace but this is not mandatory. All control positions (including TWR Supervisor) in Tower facilities are of type TWR.

TWR positions have access to specific TWR functions and processing as well as unique HMI facilities related to processing of airport traffic:

- Specific TWR state management
- Ability to transfer flights between the various TWR positions

4.3.2.2.6. Observer

Observer positions provide monitoring of airspace. An Observer position is not assigned airspace. Observer positions have access to functions and tools that do alter the state of the system.

Observer positions can be used for:

- Operational Monitoring of airspace
- Technical Monitoring of airspace

4.3.2.3. Technical

4.3.2.3.1. Technical Supervisor (TKSUP)

The Technical Supervisor position provides control and monitoring of the multi-node architecture of the ATC system by providing a real-time, graphical presentation of the status of the various nodes, together with the state of the dual node redundant partner for server nodes. The ability to instantly flag system errors and non-operational conditions greatly aids the maintainer's response time to any system errors.
The Technical Supervisor position is used for:

- Application Control and Monitoring
- System and Memory monitoring
- Integrated Graphical Recorded Data Archiving Tools
- Network Monitoring
- System Data Set Handling
- CTMS Monitoring

4.3.2.4. Offline

4.3.2.4.1. Data Preparation (DPR)

The Data Preparation position provides the ability to set or adjust the variable system parameter values used by TopSky - ATC, namely:

- The definition of operational data
- The storage of these data in the associated offline database
- Distribution of the resulting parameter data to the relevant nodes of the applicable partition(s) of the TopSky - ATC system
- The backup and recovery of the offline database

4.3.3. Simulator (TES)

4.3.3.1. Overview

TopSky - ATC Simulation is a high-fidelity air traffic simulator that is designed to stimulate a TopSky - ATC partition with inputs that mimic the real world. This arrangement provides realistic ATC training in an environment that accurately replicates the environment controllers will experience on operational positions. This characteristic ensures trainees on the simulator are fully familiar with the operational HMI and can transition into a controller role seamlessly.
TopSky - ATC Simulation provides the following features:

- Simulation of the external interfaces of the TopSky - ATC operational software;
- Graphical Exercise Preparation tool with exercise pre-simulation;
- Allocation of pilot and controllers at exercise launch;
- Auto-pilot can be assigned to aircraft.

The training system uses dedicated ATC suites that are identical to those of the operational system, or make use of operational positions that are not being used. In addition to the controller positions the simulator includes:

- Air Traffic Generator (ATG),
- Pilot positions,
- Simulator Supervisor position (Leader),
- Exercise Editor (EED).

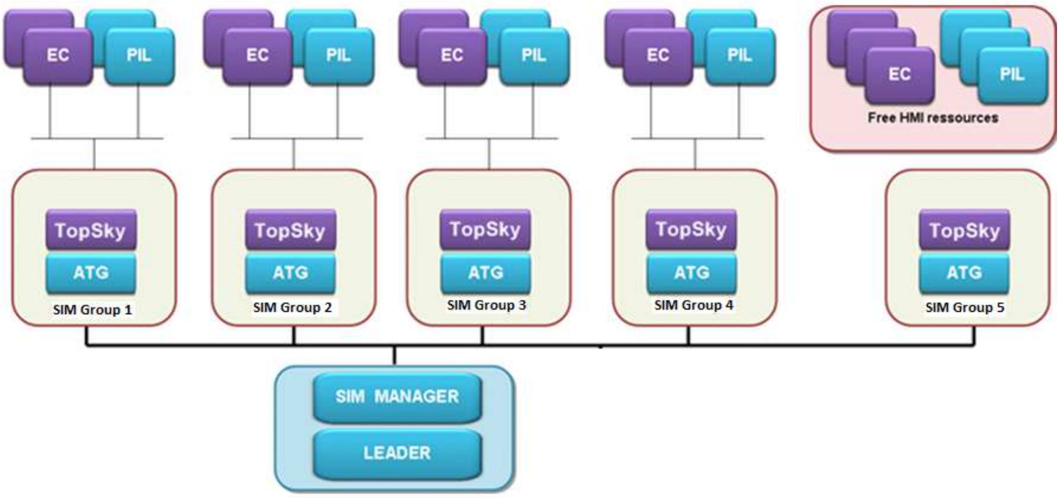


Figure 4 TopSky - ATC Simulator

4.3.3.2. Position Types

4.3.3.2.1. Trainee Controller

A trainee controller can be configured for an exercise to run as an Executive Controller (EC), Planner Controller (PLC), Multi-Sector Planner Controller (MSP), Assistant Controller, or Operational Supervisor (OPSUP). A description of these position types can be found in section 4.3.2.2 Position Types.

4.3.3.2.2. Pilot

A Pseudo Pilot is a position used to manipulate a running exercise (simulation). Each exercise can have one or more pseudo pilots. Each pseudo pilot plays the role of zero to many aircraft. The main functions of a pseudo pilot are:

- changing the trajectories of aircraft
- changing the exercise environment (e.g. Changing gust wind, failing and restoring ADS-B site monitors and degrading the AFTN)

4.3.3.2.3. Leader

The Leader is a dedicated position with the capabilities to set up and manage the simulation environment. There is only one Leader per training partition.

The functions of the Leader are:

- Selecting an exercise from a dataset
- Single exercise management capabilities (impacting the selected exercise)
- Managing one exercise (group configuration, start, end, freeze, change of speed)
- Starting and stopping the recording of the exercise
- Toggling on/off the archiving of the exercise
- Multiple exercise management capabilities (one Leader action impacting all the exercises)
- Ending, freezing or resuming all exercises
- Assigning the OPSUP position to a simulation group
- Managing a replay from archive session (group configuration, start, stop, freeze, change of speed)
- Displaying the exercise(s) status
- Displaying the pilot and controller positions status

4.3.3.2.4. Instructor

An Instructor position is a special case of Pseudo Pilot. It has the same functionality as a pilot.

4.3.3.2.5. Exercise Editor (EED)

The Exercise Editor is a position that is used to prepare scenarios for TopSky - ATC – Simulation. The EED allows offline management (creation, editing and deletion) of exercises which are to be played via the Air Traffic Generator (ATG).

The EED CSCI provides editing and visualisation of training data associated to one or more Data Preparation (DPR) servers. The visualisation of the data is further extended through pre-simulation features, which animate training scenarios in real or accelerated time.
The EED provides exercise preparation through the following:

- Various choices of data presentation (table, form, 2D plan sector, vertical sector and timing views)
- Dataset management to allow the use of several datasets
- Exercise data validation against a dataset
- Exercise and SKPL library management
- Pre-simulation to easily tune the exercises prior to live execution

4.3.4. MAESTRO

4.3.4.1. MAESTRO Basic Functions

4.3.4.1.1. External Data Reception

MAESTRO/AMAN establishes a sequence based on data received from internal interfaces. The Internal Data Reception function is in charge of reception of this data:

- Time synchronisation data;
- Flight plan data received from the FLP;
- Wind data received from the FLP.

4.3.4.1.2. Sequence Establishment Function

The Sequence Establishment function has several tasks, with the overall goal to compute a sequence of inbound traffic including for each flight its allocated runway, landing time and delay to be absorbed to meet its landing time.

This function can be decomposed as follows:

- Based on the flight plan information received, it computes for each flight an Estimated Time of Arrival at the Feeder Fix (ETA-FF) and at the runway (ETA);
- Depending on the ETA and some off-line definable runway allocation rules, the system allocates each flight to a destination runway;
- The flights are then sequenced for each based on a first-come-first-served algorithm controlled by the flight ETAs;
- Runway separations specified by the controllers are then applied to this sequence, taking into account various configurations of runway dependency; this leads to the computation for each flight of a Scheduled Time of Arrival at the feeder fix (STA-FF) and at the runway (STA);
- The difference between the STA and the ETA gives for each flight the amount of delay which need to be absorbed along its path in order to meet its slot in the sequence; this total delay is split between delay to be absorbed in the ACC and delay to be absorbed in the Approach based on pre-defined delay absorption potential;
- A final optimisation stage can also be applied to improve the runway allocation, minimising the delay distribution.

4.3.4.1.3. AMAN-HMI

The sequence established by the system is displayed in a dedicated window on the Controller Working Positions.

The objectives of this AMAN-HMI are:

- To present in a user-friendly manner the computed sequence;
- To give the user control over the computed sequence in order for the system to fit the control strategy used.

In order to achieve these objectives, the sequence is presented on different time lines allowing sorting of the various flows of inbound traffic, giving a synthetic view of the traffic which can be logically interpreted by the controller, thereby minimising any potential for error.

In addition to the sequence, some general information is displayed such as the runway configuration in use and separation to be applied on each runway.

The AMAN-HMI can be configured individually for each control position in terms of displayed information and access to commands in order to reflect the controller's work on each position.

The main capabilities available in the AMAN-HMI are:

- Change the runway configuration in use and the separations on each runway;
- Moving a flight in the sequence, on the same runway or on a different runway;
- Inserting flights in the sequence;
- Temporarily taking a flight out of the sequence to manage situations where some aircraft cannot land due to exceptional conditions (e.g. weather);
- Reserving slots in the sequence for inserting departures or for coping with runway unavailability.
- Departure List functionality where flights are added upon reception of flight plan data.

All these capabilities are accessible via the mouse; no keyboard interaction is necessary.

4.3.4.1.4. System Supervision

MAESTRO/AMAN is a distributed system involving several users: the terminal sectors controllers, the tower controllers and the approach controllers. These users can all interact with the MAESTRO system and use it to define a common strategy for transferring flights between the ACC terminal sectors and the approach positions and for merging traffic flows in the approach area.

For these reasons heavy supervision constraints must guarantee that the user benefits from high system availability. Supervision must enable the operators to view alarms (coming from different components of the system) and to rapidly reconfigure and restart the whole system (or part of it) in order to ensure optimum operation.

These constraints are fulfilled by two functions available within MAESTRO:

- A technical supervision AMAN-HMI;

The functionality of the Supervision AMAN-HMI covers:

- The presentation of the status of all the elements composing the system along with alarm messages;
- The possibility to start/stop any element of the system individually;
- The possibility to reconfigure the system to reflect changes in the operating modes (e.g. re-sectorisation).

4.3.4.2. MAESTRO Auxiliary Functions

4.3.4.2.1. Recording/Replay

MAESTRO includes a recording capability that automatically records all messages exchanged between the various components of the system, including flight plans, wind data, sequence computed and the sequence modifications performed by controllers.

The recording function operates permanently by storing data on server hard disks until an automatic procedure moves the recorded data to removable media for permanent storage.

The recorded data can be used off-line for replaying an air traffic situation. This replay can be configured from the supervision AMAN-HMI to:

- Display the computed sequence for analysing it;
- Replay the external data received for training purpose or system parameters tuning.

The replay speed can be adjusted to allow a finer analysis of the system or to skip sections of no interest. The replay can be frozen at any point.

4.3.4.2.2. Data Analysis

The recorded data can be processed for data analysis purposes. This data analysis can take two different forms:

- The sequence data can be transformed into a text file for analysis by external programs such as Excel;
- The sequence information can be presented in a graphical tool allowing to, display various graphs such as traffic load and delay; the information displayed in each type of graph can be filtered by different flight fields (e.g. aircraft type, runway, feeder fix etc.).

4.3.4.2.3. System Parameter Management

The MAESTRO system provides users with the ability to configure the functionality of the system for operational and technical conditions and to evolve with any changes in the overall Air Traffic Control environment.

The parameter setting is performed through two different graphical tools accessible from an off-line data management position:

- The Data Manager supports definition of the airspace and airport configuration;
- The AMAN-HMI preparation tool supports configuration of the various HMI displays.

4.3.5. TopSky - ATC Configuration

4.3.5.1. Operational Configuration

Functions used in the OPS include:

- Surveillance Data Processing Function (SDP)
  - Multi-Sensor Tracking System (MSTS)
  - Radar Front Processing Function (RADAR-FP)
  - Automatic Dependent Surveillance-Broadcast Front Processing Function (ADSB-FP)
- Fall-back Surveillance Data Processing Function (FSDP)
  - Fall-back Mono Radar Tracking Processing Function (RTP)
  - Fall-back Automatic Dependent Surveillance-Broadcast Tracking Processing Function (ADSB-TP)
  - Multi-Sensor Tracking Processing (MSTP)
- QNH Data Processing Function (QNH)
- Flight Data Processing Function (FDP)
- Flight Data Exchange Function (FD_EX part of FDP)
- Air-Ground Datalink Processing Function (AGDP)
- Safety Nets and Monitoring Aids Processing Functions (SNMAP)
- Aeronautical Information Processing Function (AIP part of FDP)
- Recording and Playback Functions
  - Data Recording Function (REC)
  - Exact HMI Recording Function (EHMIR)
  - Air Situation Playback Function (ASPB)
- Interoperability and Data Exchange Function (IODE)
- Human-Machine Interface Function (JHMI)
- Arrival-sequence Manager Function (AMAN)
- Operational Data Exchange Function (ODXP)
- Segregated Airspace Probe (SAP)
- Flight Plan Conflict Function (FPCF)

4.3.5.2. Simulator specific Functions

Functions dedicated to the Simulator include:

- Exercise Editor Function (EED)
- Air Traffic Generation Function (ATG)
- Leader HMI Function (JLDR)
- Pilot HMI Function (JPIL)

4.3.5.3. Offline specific Functions

Functions dedicated to the OFL partition include:

- Data Preparation Function (DPR)
- Display Analysis and Replay Tool (DART)
- Java Assisted Data Analysis Environment (JADE)

4.4. Physical Architecture

4.4.1. ATC Operational System: Manila ATMC System Architecture

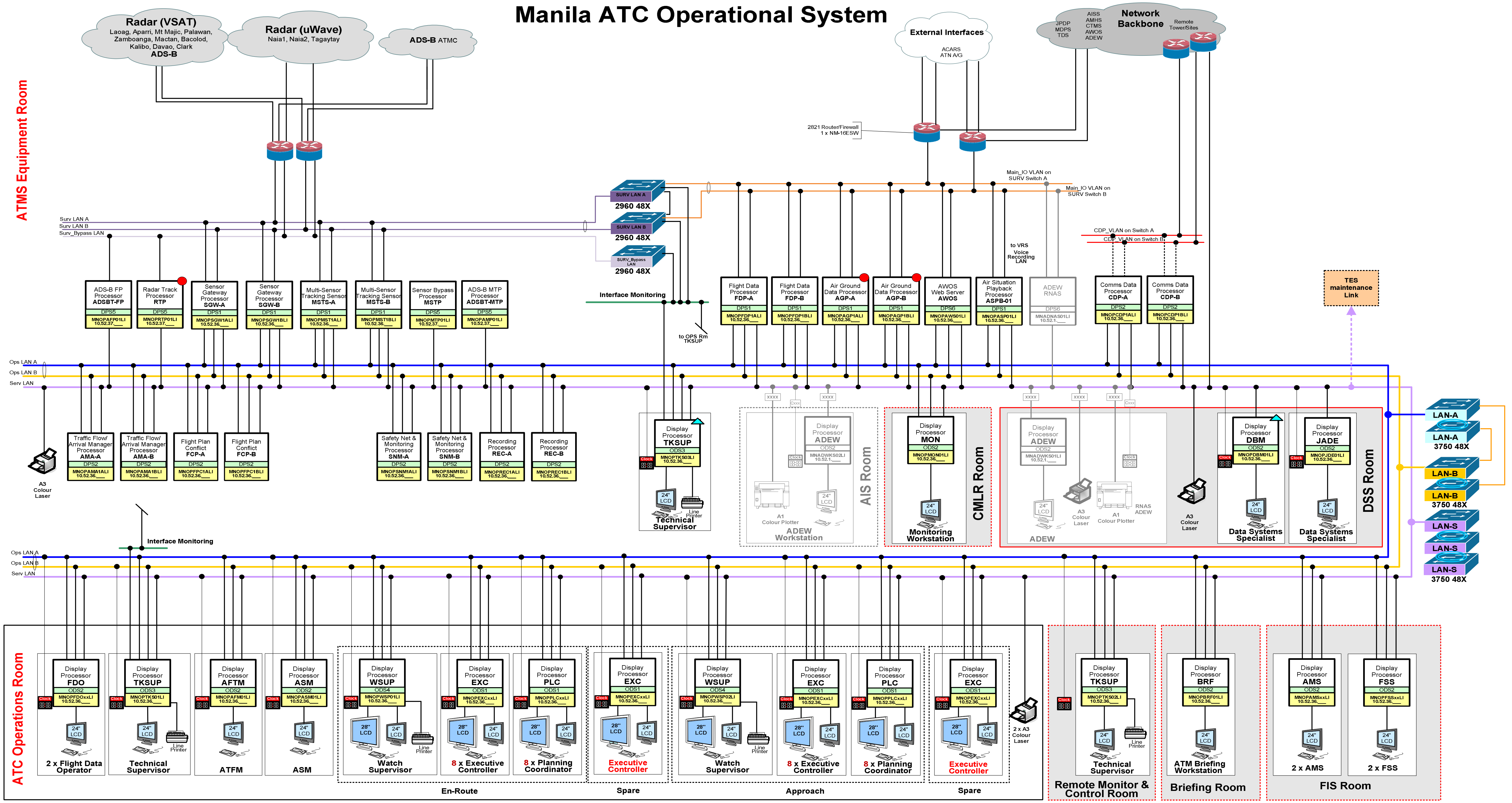


Figure 5 Manila ATMC System Architecture

Entity Identifier	Business Identifier	DTC	Revision
9950 – Z1W93	61 616 636	424	C
Filename: PH-ATM ATMS SSDD RevC.docx		Document Class: Thales Group Internal	

4.4.2. NAIA Remote Tower System Architecture

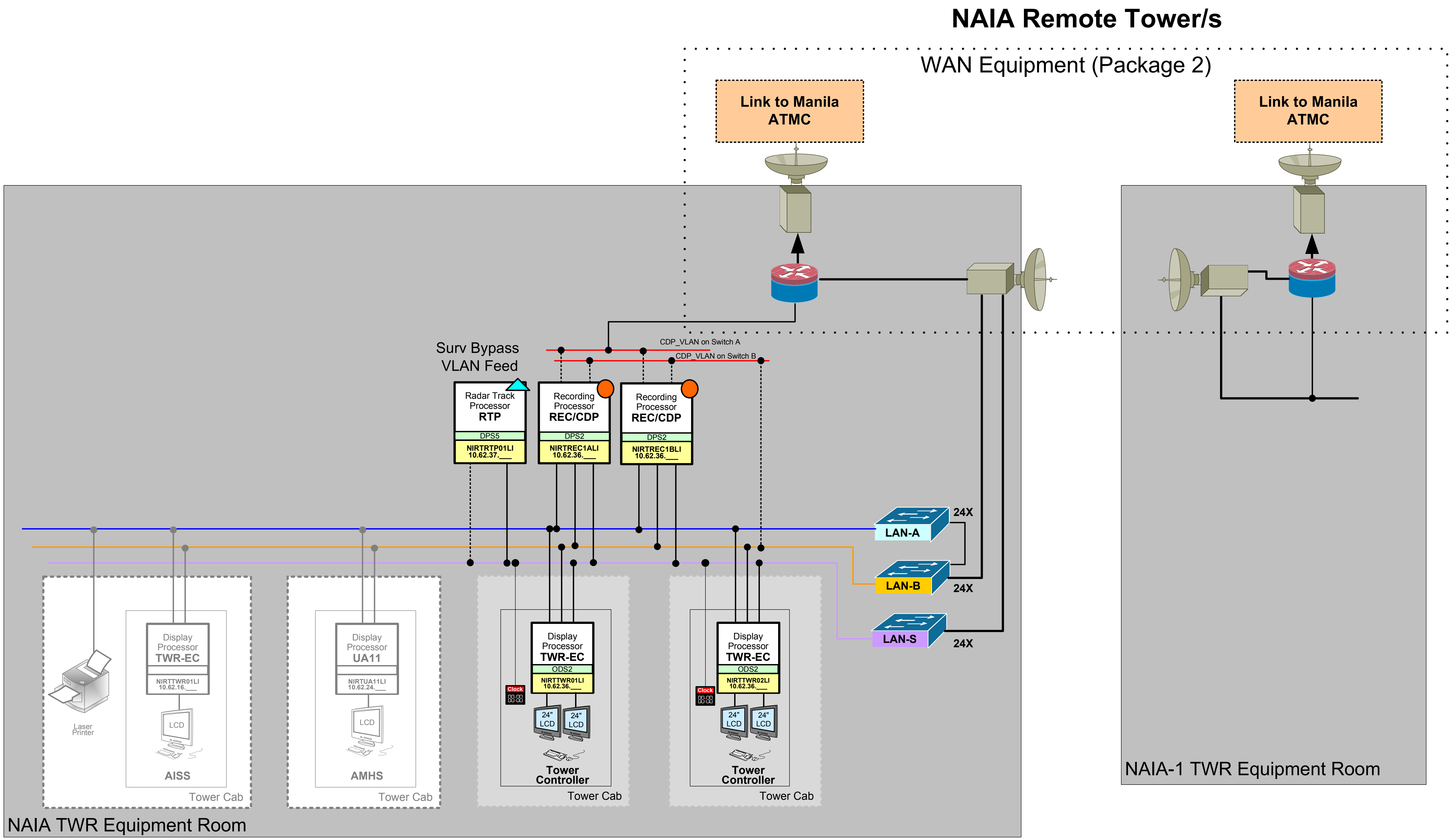


Figure 6 NAIA Tower System Architecture

Entity Identifier	Business Identifier	DTC	Revision
9950 – Z1W93	61 616 636	424	C
Filename: PH-ATM ATMS SSDD RevC.docx		Document Class: Thales Group Internal	

4.4.3. Clark Remote Tower System Architecture

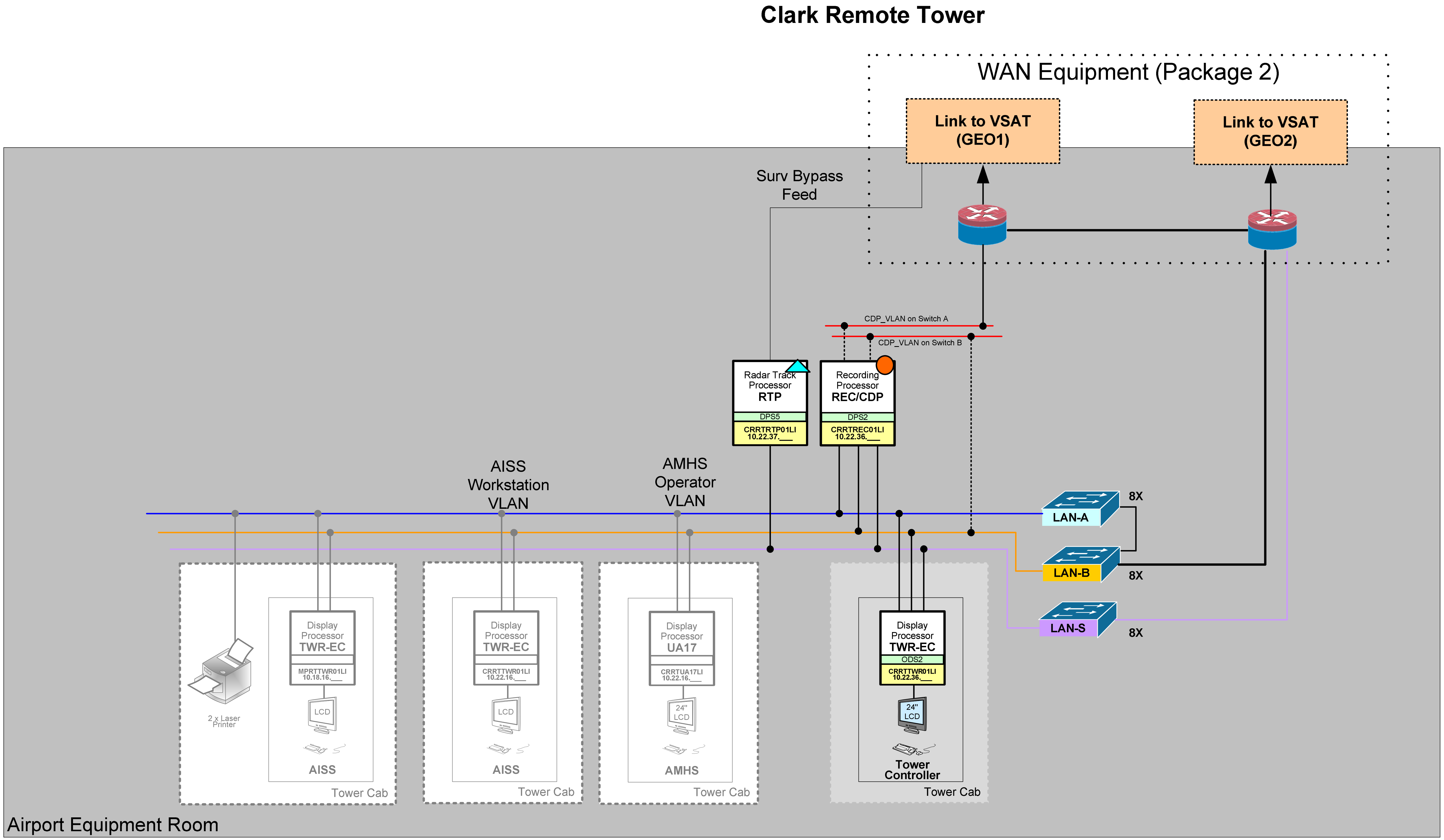


Figure 7 Clark Remote Tower System Architecture

4.4.4. Kalibo Remote Tower Systems Architecture

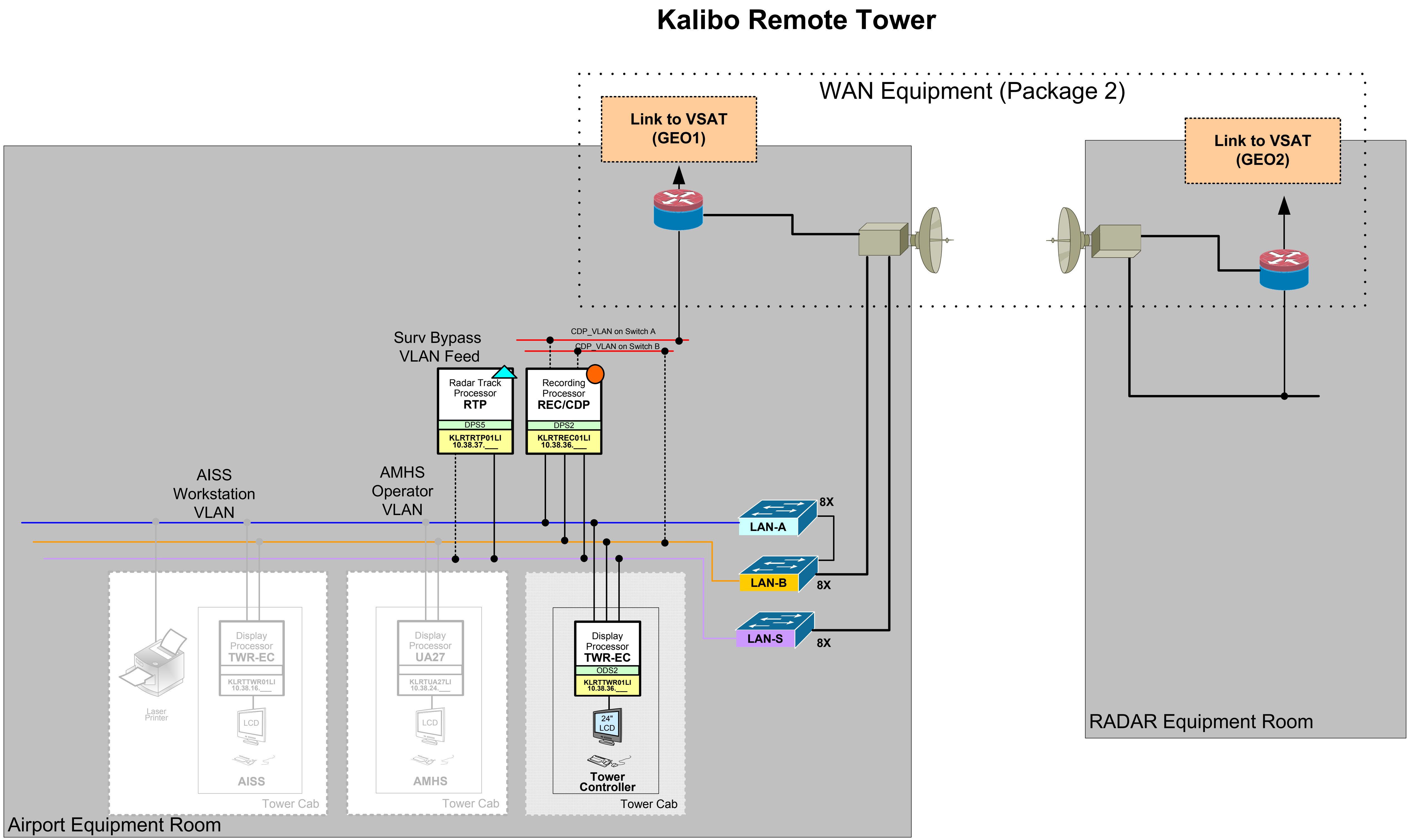


Figure 8 Kalibo Remote Tower System Architecture

4.4.5. Iloilo Remote Tower System Architecture

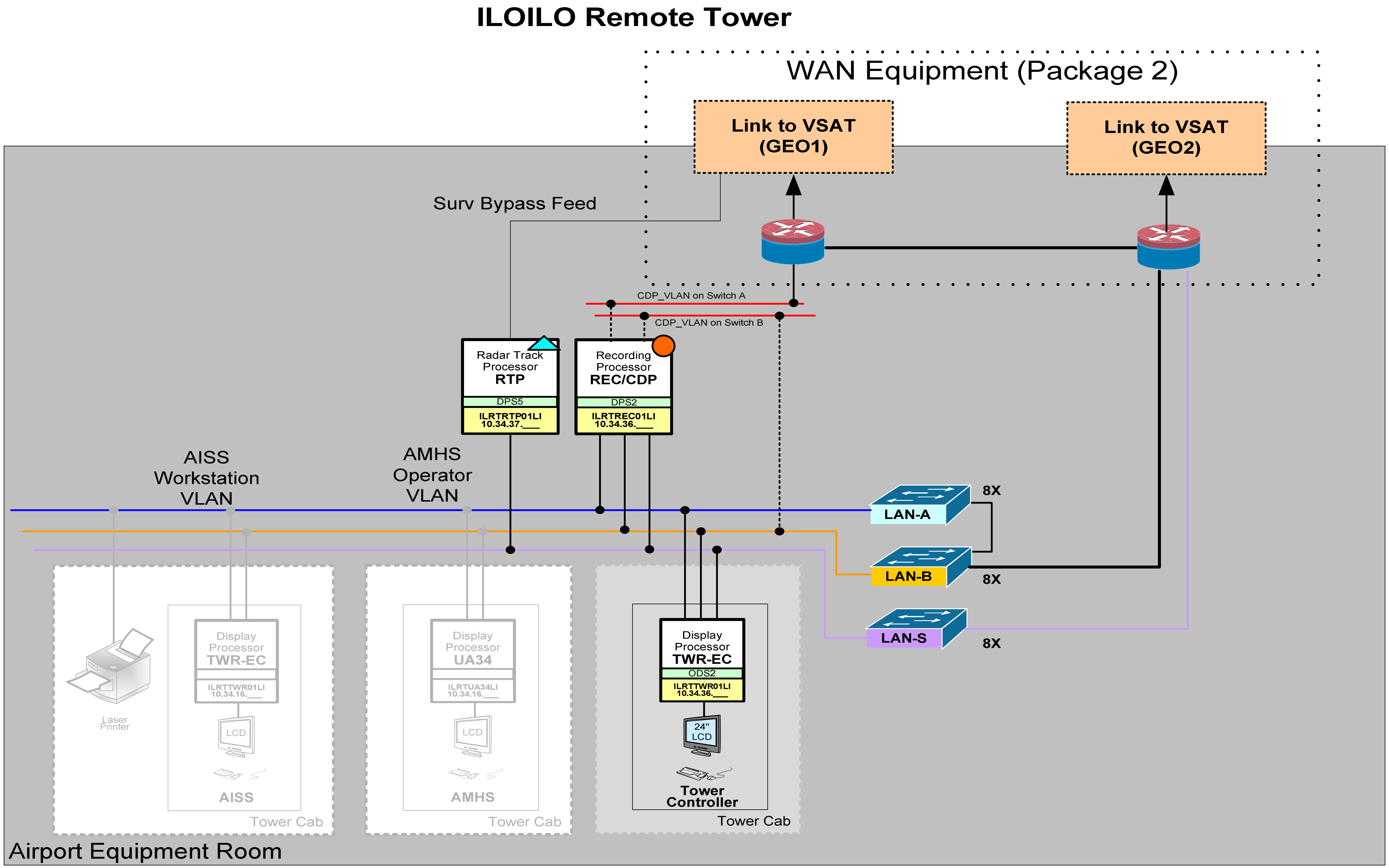


Figure 9 Iloilo Remote Tower System Architecture

4.4.6. Mactan Remote Tower System Architecture

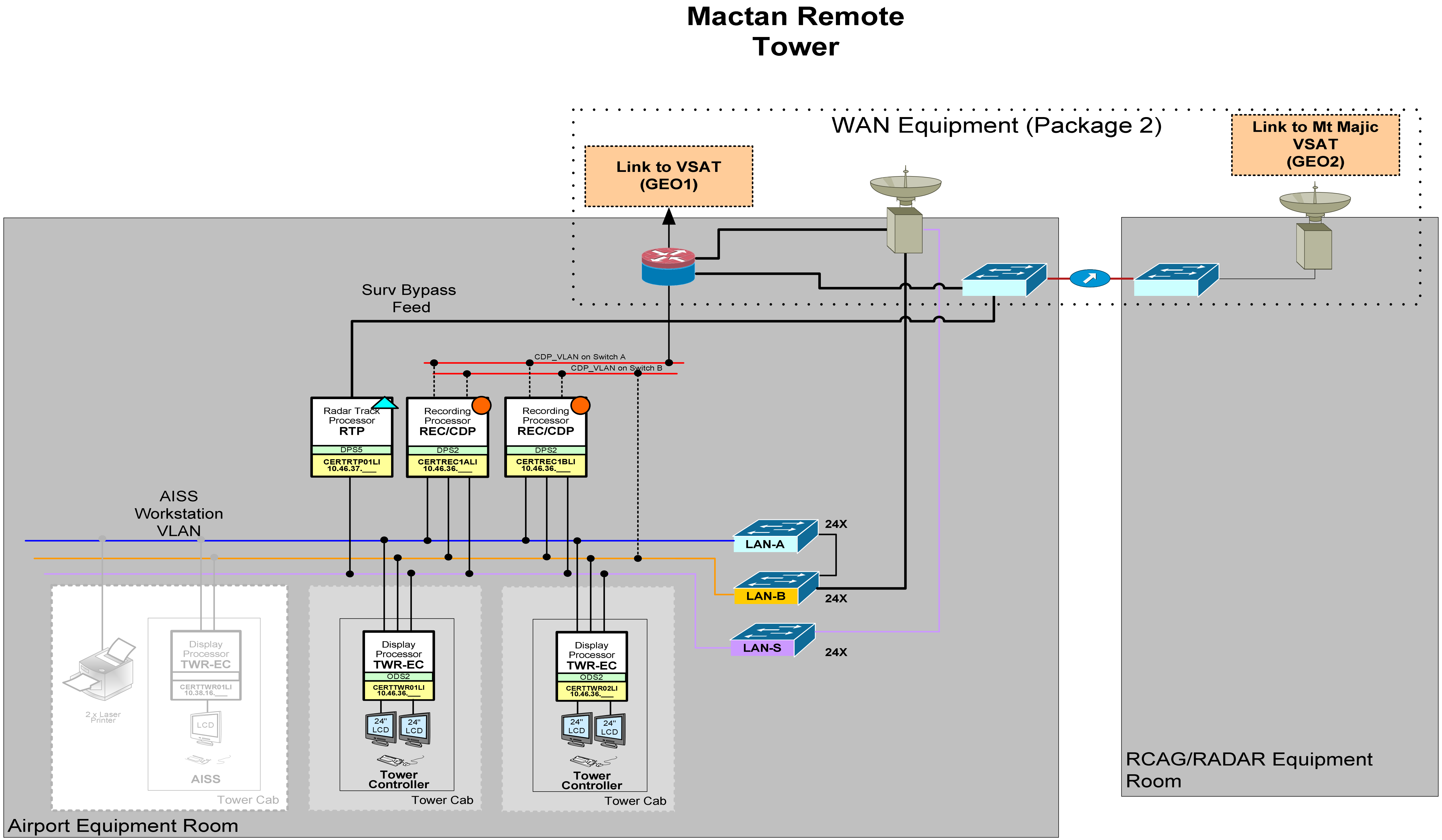


Figure 10 Mactan Remote Tower System Architecture

4.4.7. Bacolod Remote Tower System Architecture

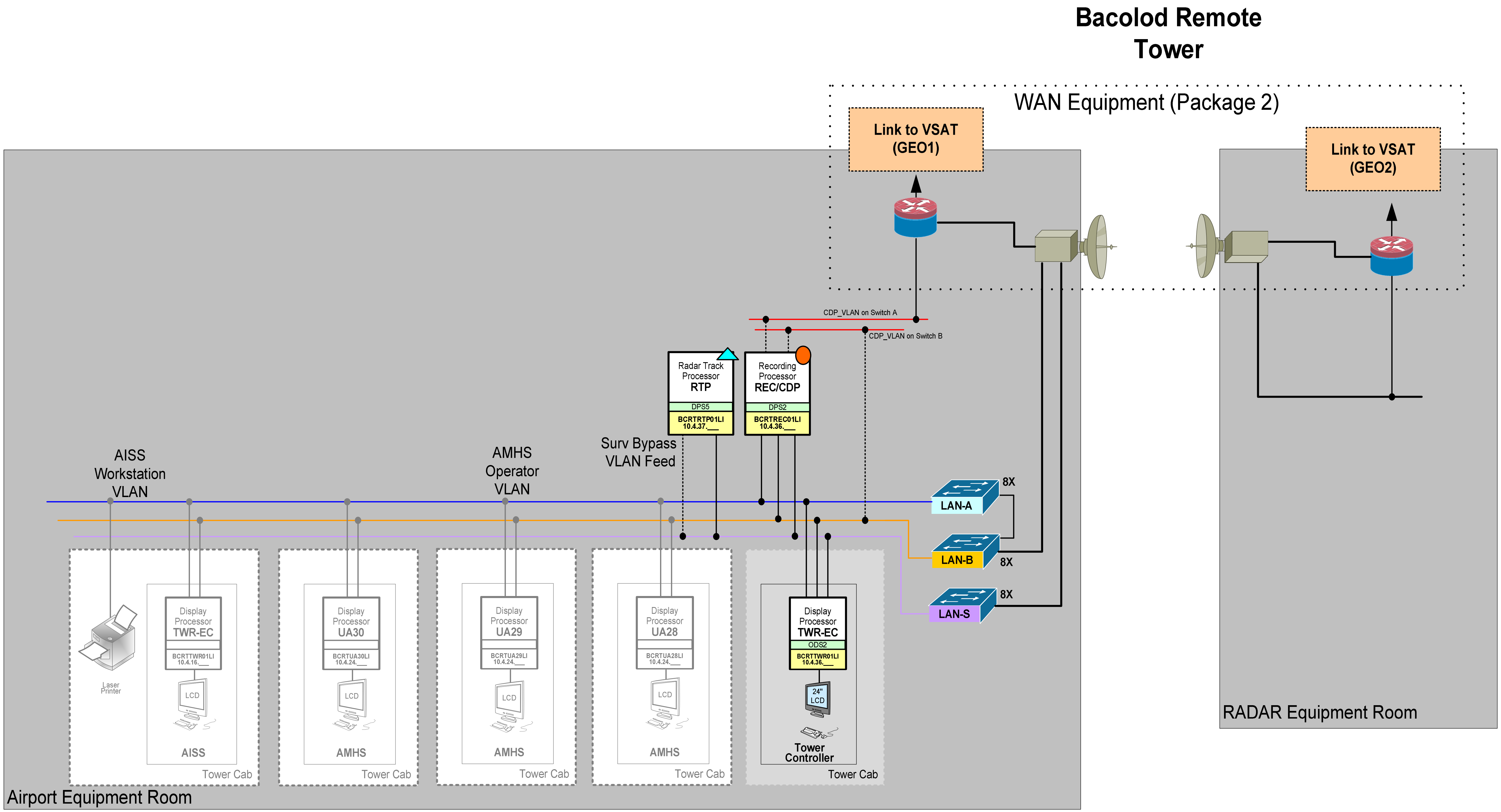


Figure 11 Bacolod Remote Tower System Architecture

4.4.8. Davao remote Tower System Architecture

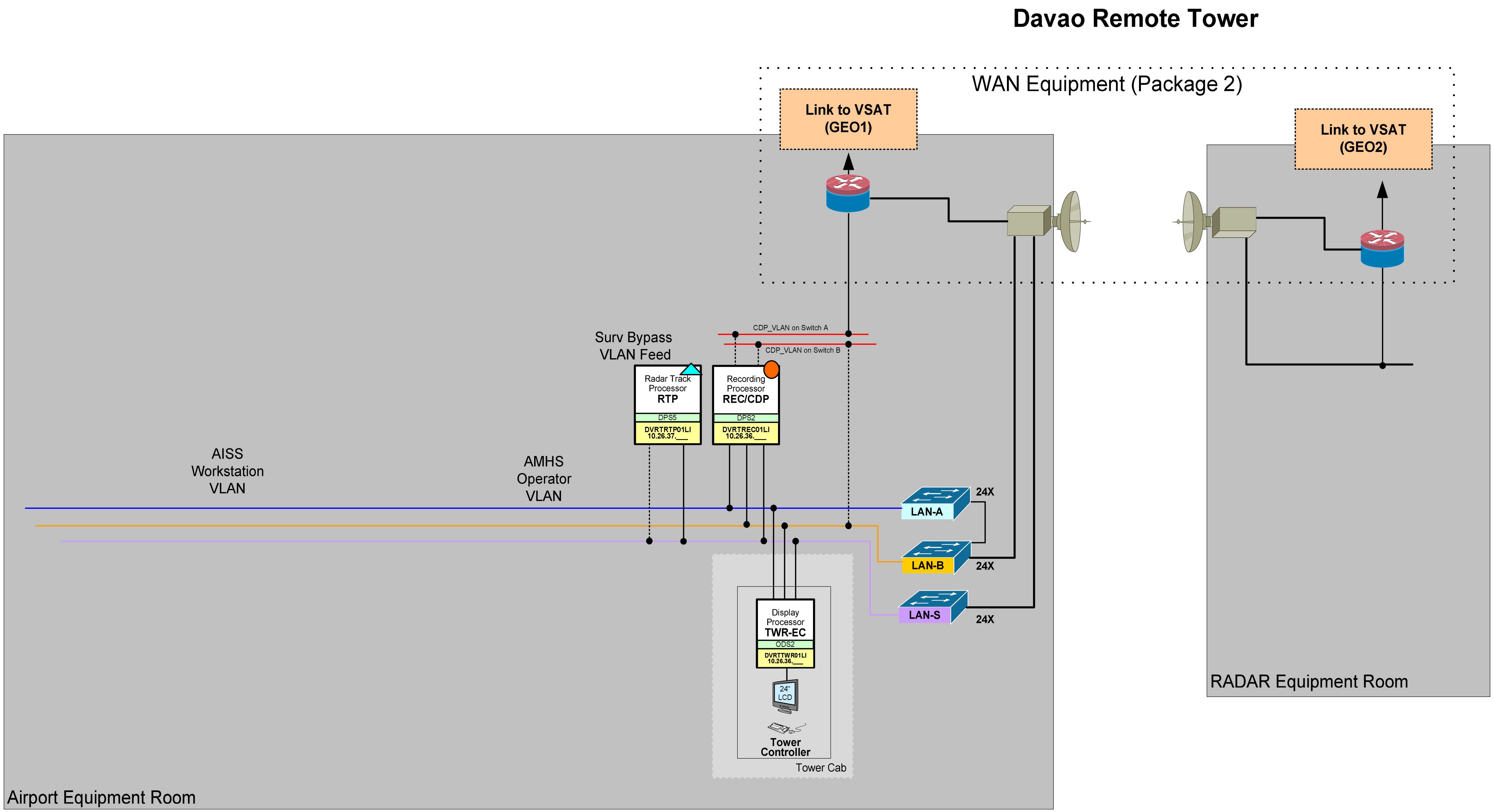


Figure 12 Davao Remote Tower System Architecture

4.4.9. Caticlan Remote Tower System Architecture

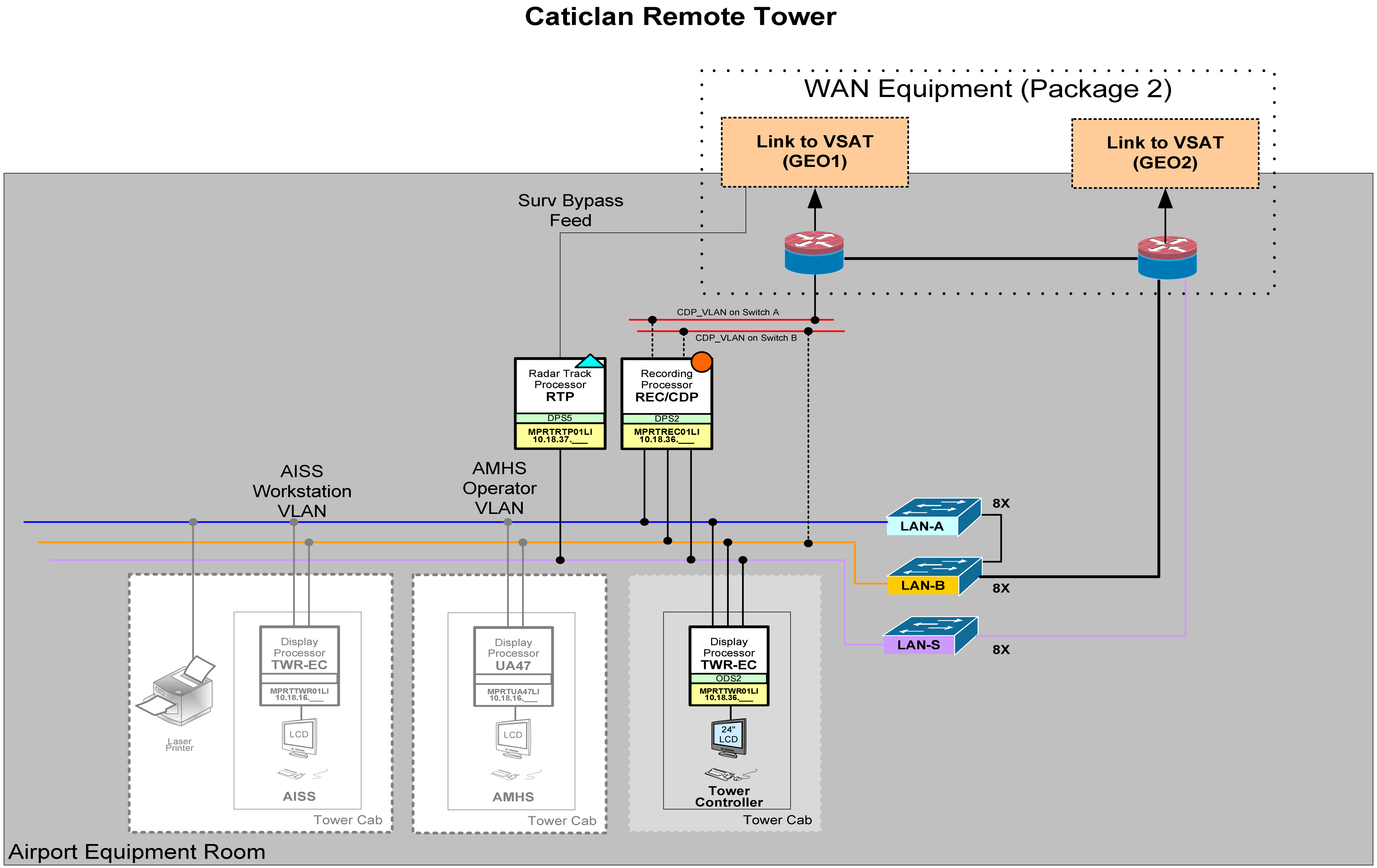


Figure 13 Caticlan Remote Tower System Architecture

Entity Identifier	Business Identifier	DTC	Revision
9950 – Z1W93	61 616 636	424	C
Filename: PH-ATM ATMS SSDD RevC.docx		Document Class: Thales Group Internal	

4.4.9.1.1. Manila Training and Evaluation System (TES) System Architecture

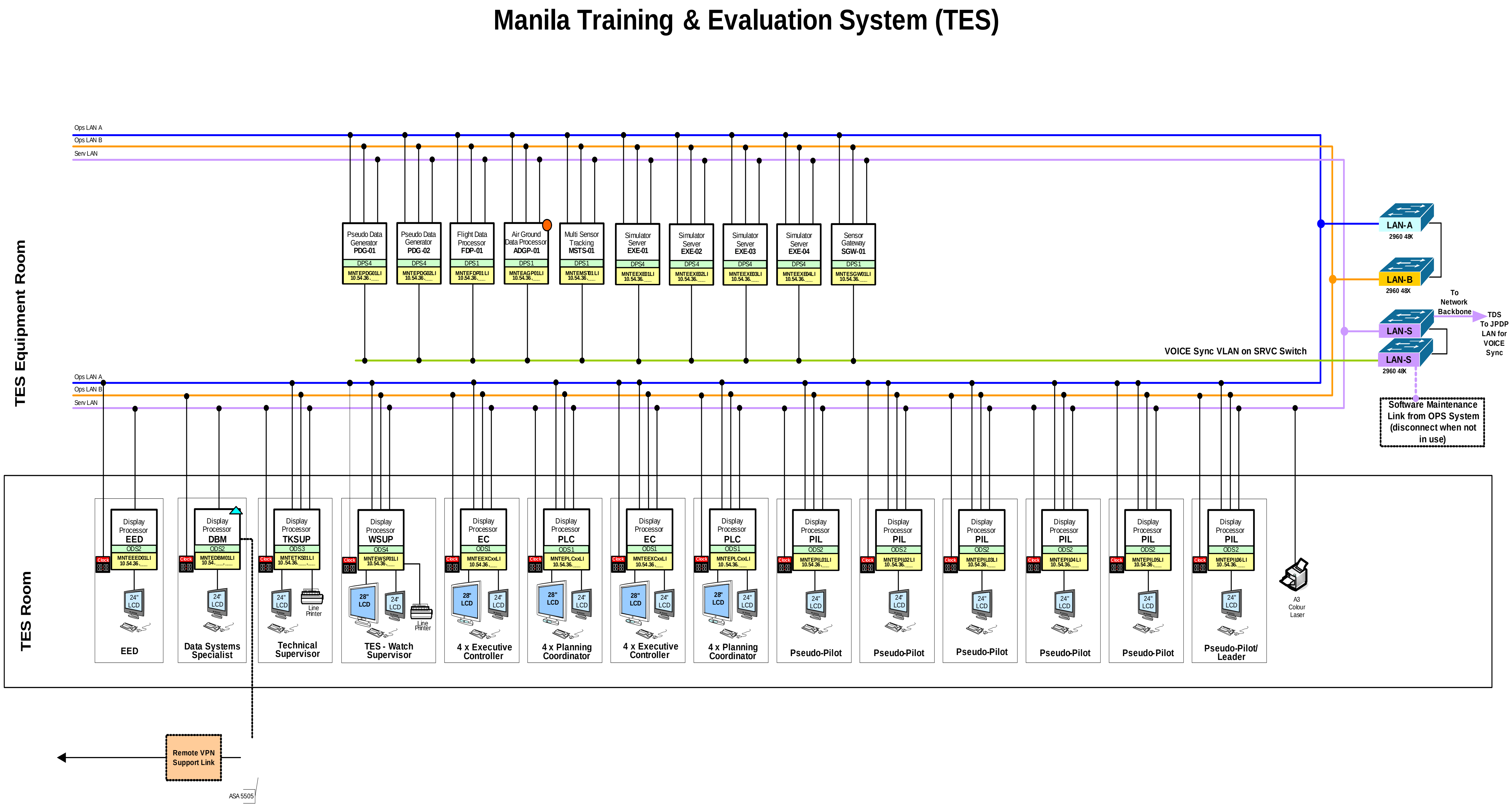


Figure 14 Manila Training and Evaluation System (TES) System Architecture

4.4.9.1.2. Computer Based Training System (CBT) System Architecture

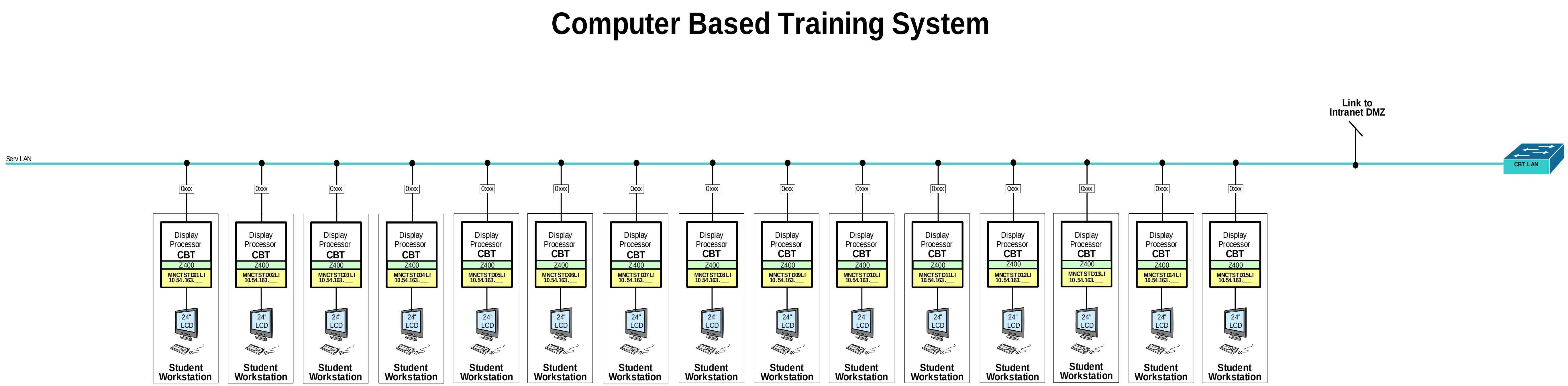


Figure 15 Computer Based Training System (CBT) System Architecture

5. Functional and operational scenarios

5.1. Start Up and Recovery Procedures

5.1.1. Introduction

The TopSky - ATC system can be divided into four major Hardware/Software levels:

- **Process level**: the process is the basic software entity, which fulfils a given task. Typically, a CSCI is a collection of processes. UBSS manages the activation of individual processes. Nevertheless TopSky - ATC software does not implement any recovery procedures at this level.
- **Node/dual node level**: the node is composed of both hardware equipment (the computer) and software (the implemented CSCIs), providing a global function. For fault tolerant applications, a node can be duplicated: such a node pair is called a dual node. Different node/dual node start and restart procedures are implemented according to the current state and the availability of necessary data.
- **Session level**: this level represents, in the simulator partition, the set of nodes required either by the exercises of a training session, or by the data preparation.
- **System level**: this level represents, in the operational partitions, the set of nodes/dual nodes necessary to achieve all TopSky - ATC functions. Its start and restart procedures are the additions of the corresponding elementary node/dual node level procedures.

5.1.2. Applicable Procedures in the Operational Partitions

5.1.2.1. Node level procedures

5.1.2.1.1. Definitions

The two main scenarios to be considered are:

- Node initial start-up, which is a maintenance operation,
- Node starting after previous runs (operational case). For this situation, the following table summarizes the four cases depending on the necessity of rebooting the computer and the permissibility of re-using previously created disk-based data.
-

Table 8 Procedure Definitions for Starting a Node

	Reset of Data	Re-use of Data
Reboot Required	Cold Reboot	Hot Reboot
No Reboot	Cold Restart	Hot Restart

Note: A node/dual node can be brought into the system either automatically or manually. Each node can be inserted into the system, regardless of the state of any other running nodes.

5.1.2.1.2. Node initial start-up

A technical operator can only perform the node initial start-up.

A node initial start-up is necessary on first installation of the system, on new software release, or when a drastic failure requires re-installation of the local disk.

During initial start-up the node goes through the following phases (installation of Thalix is assumed):

- (1) Bootstrap of the operating system from the local disk,
- (2) Start-up of central and other nodes
- (3)) Start-up of UBSS; this includes subscriptions to shared data and downloading of front processor(s),
- (4) Transfer of system parameter files,
- (5) Start-up of BSS; this includes subscriptions to shared data and downloading of front processor(s), as well as graphic generator if any (in which case devices are downloaded simultaneously),
- (6) Start-up of all application processes.

5.1.2.1.3. Node cold reboot

A node cold reboot can be performed either upon Technical Operator's request at the station, or automatically after a long duration power failure. The previously created disk-based data cannot be re-used, either because they are too aged (i.e. the duration of node unavailability was greater than a system parameter) or because a new system parameter file release has been performed during node unavailability.

During cold reboot the node goes through the following phases:

- (1) Bootstrap of the operating system from the local disk,
- (2) Start-up of BSS (see 5.1.2.1.2),
- (3) Operator request for start of application with disk- based data reset, or with files created during a “planned shutdown”,
- (4) Check for availability of the system parameter file on the local disk,
- (5) Start-up of all software application processes,
- (6) Application re-initialization on re-used data (e.g. re-activation of time-outs related to flight plan life cycle) if restart from “planned shutdown” requested.

5.1.2.1.4. Node hot reboot

A node hot reboot can be performed either upon Technical Operator's request from their position or automatically after a short duration power failure (i.e. the duration of node unavailability was shorter than the system parameter).

During hot reboot the node goes through the following phases:

- (1) Bootstrap of the operating system from the local disk,
- (2) Start-up of BSS (see 5.1.2.1.2),
- (3) Start-up of all software application processes,
- (4) Application re-initialization on re-used data (e.g. re-activation of time-outs related to flight plan life cycle).

Note: By default, at power on, the hot reboot is performed whenever possible. If the Technical Operator wants to force a data reset, he uses the cold restart procedure afterwards.

5.1.2.1.5. Node cold restart

A node cold restart can be performed upon an operator request, after a new release of system parameter files, or after a hot reboot failure or a hot restart failure. It always requires a manual request.

Since Thalix and BSS are still running, the cold restart consists only in dataset retrieval, if necessary, and in the starting up of all software application processes.

5.1.2.1.6. Node hot restart

A node hot restart is triggered automatically by UBSS after a software fatal error, or on Technical Operator's request.

Since Thalix and BSS are still running, the hot restart goes through the following phases:

- o (1) Start-up of all software application processes,
- o (2) Application re-initialization on re-used data (e.g. re-activation of time-outs related to flight plan life cycle).

Note: In the unlikely case a failure occurs in Basic System Software, it is possible the node will not start automatically. If for any reason the hot restart procedure does not succeed, the Technical Operator is warned and he will initiate manually the appropriate procedure.

Remarks:

- During all these procedures, the node is protected from unwanted interactions with other nodes until it announces its availability.
- During these procedures, UBSS manages a number of internal state transitions. However these internal states are transparent to the rest of the system. From any other node, a given node is seen either globally available or unavailable.
- Restart procedures involve globally all the CSCIs implemented on the node.
- The nodes, which manage data with very fast update rate (e.g. MSTP), never re-use such data after having been stopped. The only applicable procedures in such cases are cold reboot and cold restart.
- The Technical Operator can initiate all the above procedures from the TopSky - ATC station.

5.1.2.1.7. Node procedure diagram for the ACC partition

The following figure summarizes the main steps of the different node level procedures. The states shown are at conceptual level and will not be confused with the internal UBSS states mentioned in the node state diagram in **Figure 16**.

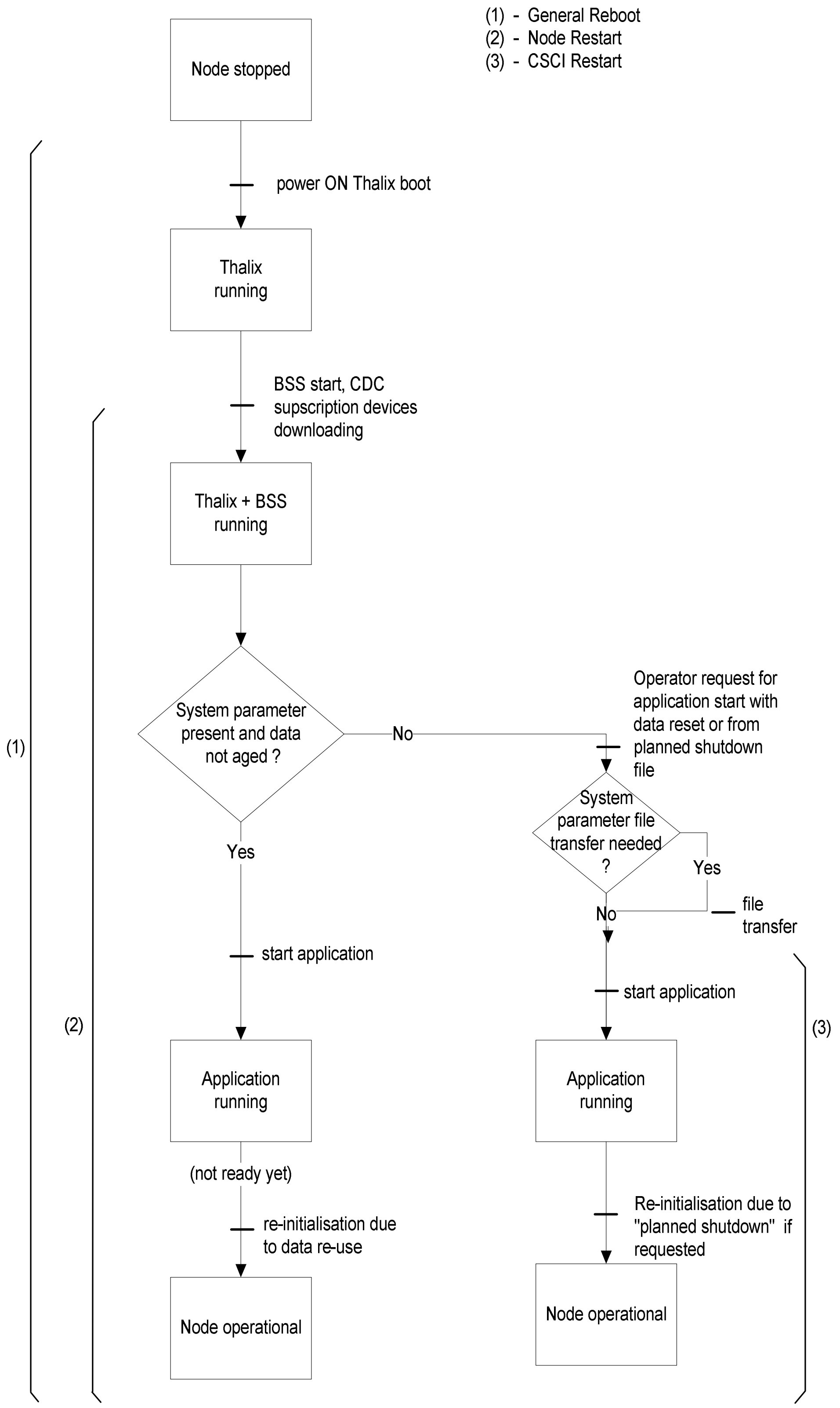


Figure 16 Reboot/ restart in the ACC Partition

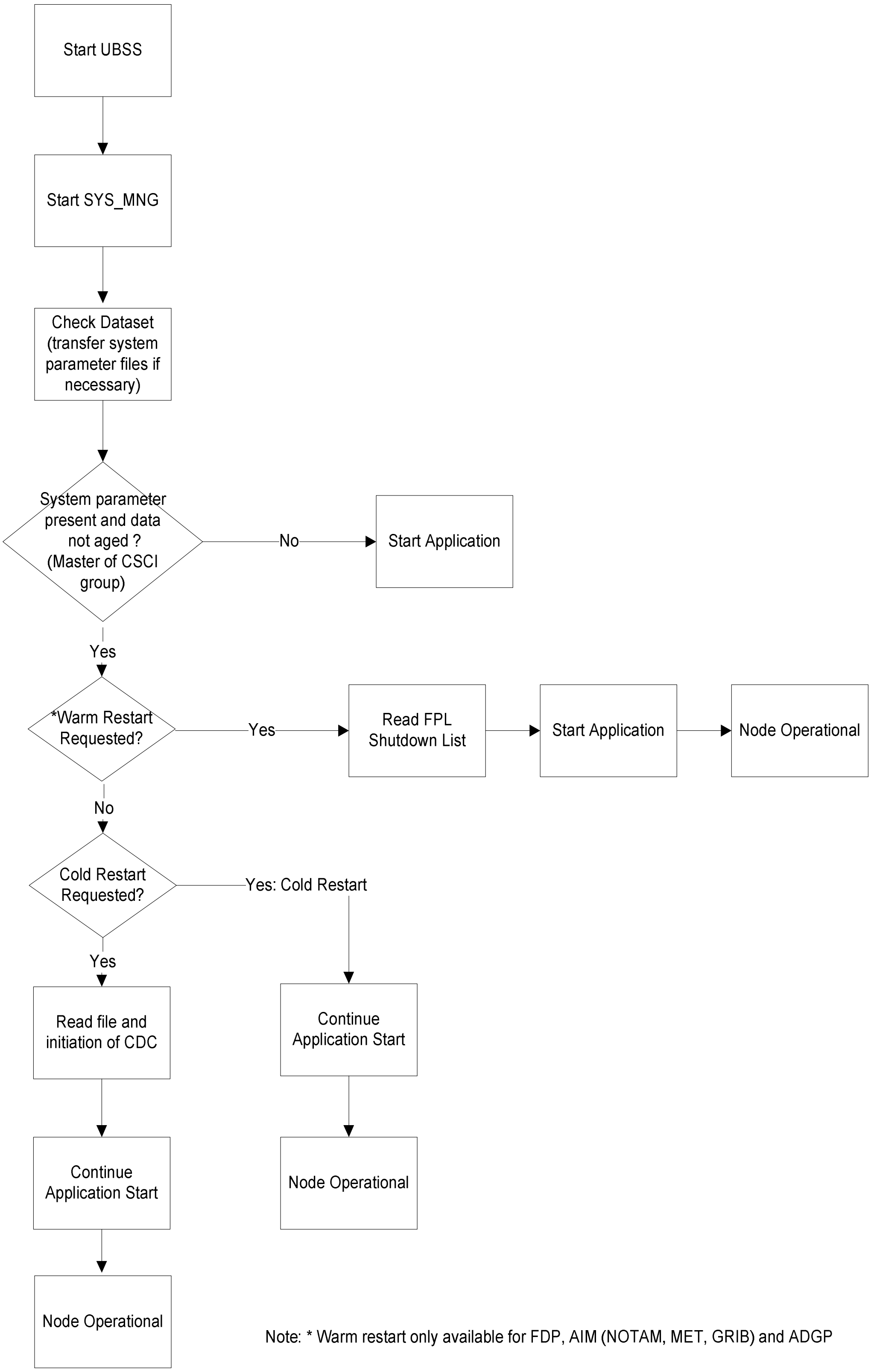


Figure 17 Node Level Procedures in the ACC Partition

5.1.2.2. Dual node level procedures

Two redundancy principles are applied within the TopSky - ATC system: Multiple Computation Redundancy (MCR) and Hot Stand-by Redundancy (HSR).

A node not operating with a Slave partner is called a Single node,

Regardless of the redundancy mode (MCR or HSR), both nodes of a pair distribute their technical outputs, (e.g. software and hardware status) to other nodes; this so that, among other things, SCM can supervise both nodes).

5.1.2.2.1. Multiple Computation Redundancy (MCR)

Multiple computation is a parallel processing performed on the two CSCIs, both connected to the same external inputs. Only one CSCI defined as Master distributes its operational outputs for use by other CSCIs.

In order to check the processing of the Master CSCI and to allow synchronization between both CSCIs, the output of the Master CSCI is sent to the Slave CSCI.

5.1.2.2.2. Hot stand-by redundancy (HSR)

In a hot stand-by configuration only one CSCI (defined as Master) receives input and performs processing. After having processed the inputs, the Master CSCI uses a safe data protocol to continuously update the local databases of the Slave CSCI, and then distributes its output for use by other CSCI.

5.1.2.2.3. Dual node reboot / restart procedures

The reboot/restart procedures of each node in a dual node configuration can be performed independently. However, the re-use of data is only relevant for a single node (i.e. a node which is not a member of a dual node, or the first node starting in a dual node configuration). A slave node is always completely initialized by its master node and so never re-uses previously created disk-based data.

UBSS manages an additional 'dual node control status' thus assigning to each node its role (i.e. Master, Slave or Single).

For a node starting in the Slave state, any update of its disk-based data necessary to synchronise with the Master node is carried out by the application CSCI.

5.1.2.2.4. Redundancy switch-over

In order to minimize operational impact where there are severe problems on the Master node, the Slave node takes over its function. This switchover will have no impact on the operation of the CSCIs on other nodes in the system.

A redundancy switchover can be initiated either manually upon Technical Operator's request, or automatically upon UBSS trigger on the Slave node.

On both nodes, UBSS performs an estimation of the node quality level, combining application quality level determined by each CSCI and a basic quality level determined by UBSS monitoring. The results are gathered by UBSS on the Slave node each time one of the quality items changes. Additionally, a permanent polling (check-alive message exchanges) allows each node to verify the counterpart node availability.

The decision to perform a switchover is taken by UBSS on the Slave node. Then, on this node, UBSS performs the following actions:

- Stops the processes specific to slave node state,
- Activates the processes specific to Single node state, and

- Appoints the new Single node as master for data stores that were managed by the failed Master node,
- Switch of connections (virtual circuits) from the failed Master node to the new Single one.

In parallel to these steps, UBSS informs the SCM about the problem detected and the switchover completion.

If necessary, the now Single node has to update data stores to make them consistent with its latest data base version.

If a switchover cannot be performed correctly (simultaneous failure of Master and Slave nodes), a reboot or restart must be initiated manually.

5.1.2.3. System level procedures

5.1.2.3.1. System start-up procedures

System start/restart is the addition of node/dual node reboot/restart procedures leading to the system availability. Each node that starts proceeds through the appropriate phases to join the already operating nodes (if any), and begins its operational processing.

Global commands are provided to the Technical Operator for stopping the whole system, triggering a hot or cold restart of the whole system, as well as a specific global cold restart after a new release of system parameter files.

The ability to process a “planned shutdown” file is provided. This file is created when a shutdown is anticipated by the operator (e.g. upon distribution of a new system parameter files set). It saves data prior to the expected cold restart.

5.1.3. Applicable Procedures in the Simulator Partition

This section describes start-up and recovery procedures for training sessions within the Simulator Partition or System Development Environment partitions.

5.1.3.1. Node level procedures

After a training session has been running, if a need arises to restart one or more of the nodes in the partition, the following reboot/restart actions can be performed.

The node types used in the Simulator partition are listed in section 4.1.

Remarks:

- During these procedures, the node is isolated from other nodes until it announces its availability (ON).
- UBSS manages internal state transitions associated with the restart. However, these internal states are transparent to the rest of the system. From any other node, the restarting node is seen as unavailable (OFF).
- The Technical Operator initiates the procedures from TKSUP.
- There are no redundant nodes in the simulator as all nodes are single.

5.1.3.1.1. Node cold reboot

The node cold reboot procedure is invoked by a Technical Operator's request from the TKSUP position.

During cold reboot the node goes through the following phases:

- o (1) Bootstrap of the operating system from the local disk,

- o (2) Start-up of BSS,
- o (3) Start-up of simulator supervision and session leader interface on the relevant node(s).

Step 3 is only performed on nodes, which contain the air traffic generator (ATG) and the session leader functions. The ATG is only started when the exercise group is stared. The other nodes cold reboot stops after step 2.

5.1.3.1.2. Node cold restart

The node cold restart procedure is invoked by a Technical Operator's request from the TKSUP position.

A node cold restart assumes that the operating system is ready. The node goes through the following phases:

- o (1) Start-up of BSS,
- o (2) Start-up of session supervision on the relevant node(s).

5.1.3.1.3. Node hot restart/reboot

Only ODS nodes can be hot restarted or hot rebooted. The procedures are essentially the same as in the operational partition except that they are only performed upon technical operator's request, and are only relevant when an exercise is running.

5.1.3.1.4. Node procedure diagram for the Simulator partition

The following figure summarizes the procedural steps at the node level. The states are shown at conceptual level. These should not be confused with the internal UBSS states mentioned in the node state diagrams in Figure 21 and Figure 22.

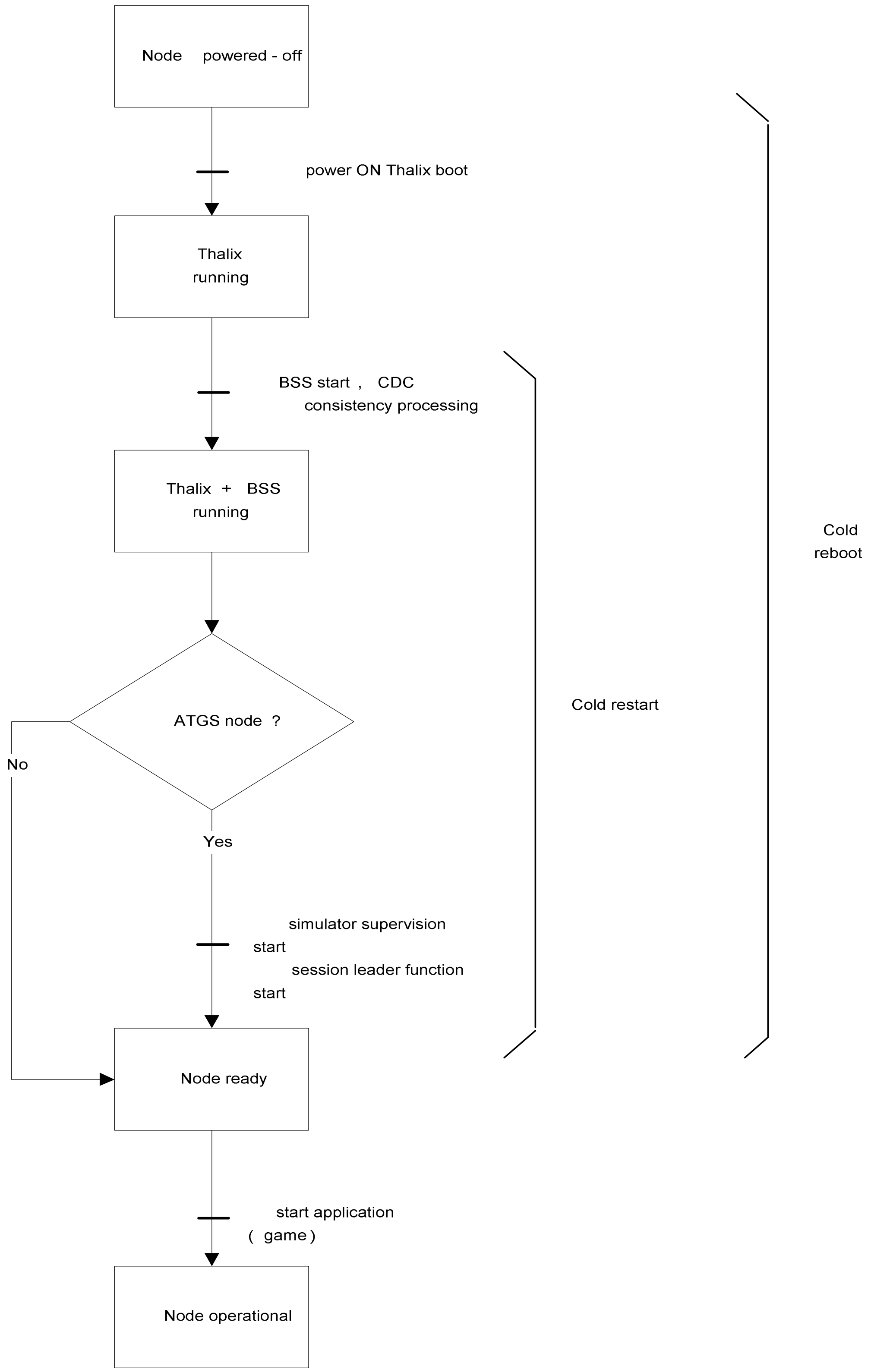


Figure 18 Node Level Procedures in the Simulator Partition

5.1.3.2. Dual node level procedures

For the simulator, no redundancy is available; there are therefore no dual node level procedures.

5.1.3.3. Session level procedures

5.1.3.3.1. Session initial start-up

The initial start-up of a session is equivalent to 'cold booting' the simulator partition. This procedure would be similar to a sequence of cold reboot for all nodes in the partition.

5.1.3.3.2. Session start

Each node that starts proceeds through the appropriate phase to join the already operating nodes (if any). Starting of a session is initiated by a session leader command (start exercise) and corresponds to the addition of nodes via start application procedures, leading to the session availability (when all nodes defining the session are operational).

5.1.3.3.3. Impact of node failure at session level

Failure shows the availability of the exercise and of the running exercises upon node failure and the restart session level procedure to follow.

Table 9 Impact of Node Failure

Node Failure	Impact	Procedure
JLDR/ATG	ATG not available Exercise not available	(1) Cold reboot or cold restart of the failed node (2) Cold restart of all the other nodes (3) Begin exercise
JPIL	Pilot position not available	Manual hot reboot or hot restart of the failed PIL node
EXE nodes	Exercise still available, Corresponding exercise which were running on that node not available any more	(1) Cold reboot or cold restart of the failed node (2) Stop the corresponding exercise (3) Begin exercise
EC PLC OPSUP DBM TKSUP	Exercise still available	Manual hot reboot or hot restart of the failed node

Note: The simulation of degraded modes is not taken into account in this section, as it is not within the scope of this document.

5.2. Working Modes

5.2.1. Introduction

Under normal circumstances all the nodes/dual nodes making up the TopSky - ATC system are in use. Nevertheless, the system is designed to provide continuous service despite the failure of a number of nodes. There are a number of degraded modes in which only a part of the total number of nodes/dual nodes is running.

Individual nodes/dual nodes can be brought into, or taken out of the system at any time. However, a system state transition might then take place, depending on the CSCI(s) running on this node.

In addition to the global system modes, there are a number of modes defined locally at each operator position level (ODS modes). These modes are not directly related to the availability of other resources but concern the way the ODS is used.

5.2.2. System Modes

5.2.2.1. System modes definition

System modes in this document are defined on a partition basis and according to the availability of the following minimum set of resources required for normal operation:

- ACC/APP:
    - One Operational LAN,
    - At least 1* ODS position,
    - At least one channel of each of the following redundant functions is available:
        - MSTS (Main surveillance data processing) CSCI,
        - SNMAP (Safety Net and Monitoring Aids Processing) CSCI,
        - FDP (Flight Data Processing) CSCI.
        - Human Machine Interface (JHMI) CSCI.

Table 10 defines the System Modes for the operational ACC/APP and TWR partition in relation to the availability of minimal resources:

Table 10 Resource Set Per System Mode For ACC, APP, and TWR Partitions

System Mode	**Minimal set of necessary resources**
NORMAL	• All minimum resources are available (As defined above)
DEGRADED	• FDP is available • At least one Operational LAN and 1* ODS are available • At least one of the minimal required functions (see above) other than FDP is available.
LOCAL	• FDP is unavailable (FDP is managed locally at each HMI) • At least one Operational LAN and 1* ODS are available
NON OPERATIONAL	• No Operational LAN and no FDP is available

Note: * Provided the position will not exceed the maximum offline defined number of sectors.

5.3. System Parameter Handling

5.3.1. Introduction

5.3.1.1. System parameter definition

System parameters are defined as being the set of:

- Environmental and technical data that is needed to tailor the system to its operational environment (e.g. maps, sectors, aircraft performances...)
- Variables that characterize the system at a certain moment during its operational use (e.g. enabled/disabled status of visual/ audible alerts for STCA)

Note: Some system dimensioning constants, which are global to one or several CSCIs but defined inside the CSCIs software, and which are not accessible to the operators, as well as the Thalix and UBSS configuration files, are not considered as system parameters in this document.

5.3.1.2. System parameter classification

System parameters can be divided into two categories:

- Static system parameters: These parameters are prepared off-line, their values in the system can change only upon a new release distribution performed via the DPR CSCI, and the new values can only be taken into account after a node restart.
- Dynamic system parameters: These parameters have an initial value prepared off-line, but they can be modified on-line, by a CSCI other than DPR, upon operator request. The new values are taken into account after the modification without requiring a restart.

5.3.1.3. System parameter management functions

Management of system parameters comprises the following functions:

- System parameter off-line preparation (in the operational and simulator partitions)
- System parameter release distribution (in the operational partitions only)
- System parameter acquisition upon node restart (in the operational partitions only)
- System parameter distribution upon exercise start (in the simulator partition only)
- Dynamic system parameter on-line modification (in the operational and simulator partitions)

5.3.2. System Parameter Management in the Operational Partitions

5.3.2.1. System parameter off-line preparation

The DPR operators by means of the DPR CSCI perform the Off-Line preparation of the system parameters. This is an independent function, which can be performed while the rest of the ATC centre is operating.

5.3.2.2. System parameter release distribution

5.3.2.2.1. System parameter distribution structure

Each CSCI can use only system parameter files that are available on the local disk of the computer it runs on. A new system parameter release distribution has to copy physically all the necessary files on the relevant nodes.

The DPR CSCI upon DPR operator request always performs system parameter release distribution. This can be done before system start-up or while the system is operational.

5.3.2.2.2. System parameter release distribution implementation

System parameter release distribution is implemented via file transfer over the service LAN.

This file transfer is transparent to the destination CSCIs, i.e. no application request to these CSCIs is needed.

5.3.2.2.3. System parameter distribution before system initial start-up

The DPR CSCI maintains off-line the whole set of system parameter values making up the initial system configuration. These values are called the default values for the system parameters.

Before start-up of the whole system, the DPR CSCI places all the necessary system parameter files on the local disks of relevant nodes. This will allow other CSCIs to retrieve the system parameters later, upon node restart, without involving DPR (as it is possible that the node supporting DPR will not permanently run).

On start-up, the local system parameter management function of the CSCIs read the system parameter files, and initiates the sharing of the system parameters they are responsible for and that are used by other CSCIs.

5.3.2.2.4. System parameter distribution during system operation

In addition to the current configuration, (i.e. the values previously distributed by the DPR CSCI to the system), the DPR CSCI manages new configurations, composed of values of the system parameters already modified by the DPR operator but not yet distributed to the system.

The operator can trigger the distribution of new system parameter values to the system.

To distribute these modified system parameters in the system, the following subsequent actions have to be performed:

(a) On a manual command, the system parameters are distributed by creating the new data in both the central and other nodes. From the central node, the ‘Handle new distribution’ command is run causing the previous data to be replaced with the new system parameters.

(b) To take into account the newly distributed system parameter configuration, the technical operator requests a global 'cold restart after system parameter change'.

(c) Then each sys_mng verifies the presence and the validity of the files on its local disk and copies them from the distribution directory to the operational one.

Note: If the node was not contactable at the distribution time, the new files are not present in the distribution directory on the local disk. In that case, they are retrieved from the Central UBSS node. This retrieval is done via a file transfer over the service LAN.

5.3.2.3. System parameter acquisition upon node restart

When a node is starting up, the CSCIs running on that node have to check the availability of the current system parameters on their local disk (these parameters might have been changed during node unavailability).

5.3.2.4. Dynamic system parameter on-line modification

Dynamic system parameters can be sub-divided into two categories:

- Parameters that are modified by one CSCI (excluding DPR) and used only by this CSCI.
- Parameters that are modified by one CSCI (excluding DPR) and used by more than one CSCI.

5.3.2.4.1. Dynamic system parameter used by only one CSCI

For a system parameter used by only one CSCI, this CSCI is responsible for updating the parameter. The modification remains local to the CSCI.

5.3.2.4.2. Dynamic system parameter used by more than one CSCI

System parameters used by more than one CSCI are shared via CDC or BNS datastore. There is one CSCI responsible for updating the parameter, upon request of other CSCIs. To share these on-line modified system parameters within the system, the following subsequent actions have to be performed:

1. The CSCI requesting the modification (hereafter called the client CSCI), shall send a point-to-point message containing the new value of the system parameter to the CSCI responsible for the system parameter.
2. The responsible CSCI shall check the value of the system parameter (syntactically and semantically). If the value is not correct, the responsible CSCI shall send a point-to-point message to the client CSCI to indicate that is not correct. The system parameter is not modified.
3. If the new value of the system parameter is correct, it is distributed by means of CDC or BNS datastore. The responsible CSCI shall send a point-to-point message to the client CSCI to acknowledge the parameter change. When relevant, the latter shall inform the user of the update of the parameter.
4. The local system parameter management functions of the CSCIs subscribed to the updated CDC stores or BNS datastore names receive a trigger of the system parameter update.

5.3.3. System Parameter Management in the Simulator (TES) Partition

5.3.3.1. System parameter off-line preparation

The DPR operators by means of the DPR CSCI perform the Off-Line preparation of the system parameters. This is an independent function and therefore can be done during training.

System parameter release distribution is always performed by the ATG CSCI upon session leader request (checking the distribute dataset box). All the nodes participating in the exercise must be ready.

System parameter release distribution is implemented via file transfer over the service LAN, or the simulator operational LAN in case of service LAN unavailability.

5.3.3.2. System parameter on-line modification

System Parameter on-line modification is implemented in the same way as in the operational partition.

6. System Design

6.1. System Design Principles

The TopSky - ATC system is based on a distributed computing architecture that is designed to be modular, flexible and expandable, allowing its successful deployment on the many different architectures and collections of computing servers.

The TopSky - ATC system application software is built on top of a Unix Based System Software (UBSS) middleware layer that provides service abstraction of the Operating System, Network Interfaces and Hardware, all of which can vary during the deployment and operational lifecycles of the system.

The full set of TopSky - ATC system Functions is modularized into independent Computer Software Configuration Items (CSCIs). This way, each CSCI can be developed, maintained and executed independently. This distributed architecture also allows reducing the impact of newly introduced features on the overall system, as it is less constrained by server resources such as CPU processing power and memory capacity, as the execution can be distributed across several machines.

The positions and functions of the TopSky - ATC system are organized by means of one or more separate partitions, depending on operational requirements. A partition is composed of a grouping of hardware and software resources.

The TopSky - ATC software components are hosted on Thalix based computer hardware systems, which are part of the suite of Hardware Configuration Items (HWCI) that make up a complete TopSky - ATC system. Included in the suite of HWCIs are all additional hardware components required to construct a complete system such as display screens, network switches, routers etc.

TopSky - ATC HWCIs are termed Non-Development Items (NDI) and all HWCIs are comprised of Commercial Off The Shelf (COTS) equipment.

The complement of either a DPS or ODS (HWCI) and the CSCIs it hosts represents a TopSky - ATC node.

Two main aspects were taken into account in the hardware system design: redundancy that will enable the normal operation of the system even in case of a single failure; and the use of COTS products to enable maintainability and upgradeability through the life of the system at the best performance/cost and availability of spare parts.

6.2. Mapping of TopSky - ATC Functions to CSCIs

Table 11 Mapping Of TopSky - ATC Functions To CSCIs

Sub-System	Function		TopSky - ATC CSCI
FDP	**Flight Data Processing Function**		**Flight Data Processor (FDP)** Handles part of the external interfaces of the system (ATS messages from adjacent centres messages, meteorological data) and manages the different flight plans. These flight plans come from ICAO, AIDC interfaces, the RPL database or from operational positions. FDP receives and processes GRIB data for flight profile estimation. FDP receives and stores meteorological and NOTAMs as well as static data.
SDP	**Surveillance Data Processing Function**	**Sensor Gateway**	The Sensor Gateway Function receives and processes ADS-B surveillance data and distributes the data to the Multi Sensor Tracking Function: • Automatic Dependent Surveillance-Broadcast (ADS-B) surveillance data, **ADS-B Front Processor (AFP)**
		Multi Sensor Tracking Function	**Multi Sensor Tracking System (MSTS)** Receives and processes surveillance data (including primary radar data, secondary radar data, Mode-S SSR data, and ADS-B reports and distributes ASTERIX CAT 62 surveillance tracks to other TopSky - ATC CSCIs. The MSTS function also hosts the **QNH server (QNH)**, which receives QNH data from QNH sensors and distributes the data to other CSCIs. The MSTS combines received data pertaining to a single aircraft into a single surveillance track, taking advantage of the best contribution from each sensor and eliminating the influence of their respective drawbacks. The MSTS CSCI also processes weather data from weather radar sensors and distributes the data to other TopSky - ATC CSCIs.
	Fall-back Surveillance Data Processing Function	**Fall-back Radar Track Processing Function**	**Fall-back Radar Track Processing (RTP)** Receives local radar data coming from different radar heads via the bypass sub-LAN. The data is processed and distributed to other CSCIs as local radar tracks. The RTP CSCI also processes weather data from weather radar sensors and distributes the data to other TopSky - ATC CSCIs.

Sub-System	Function		TopSky - ATC CSCI
		Fall-back **ADS-B Track Processor**	**ADS-B Track Processor (ADSB-TP)** Receives and processes Automatic Dependent Surveillance-Broadcast (ADS-B) surveillance data and distributes the data to the Multi Sensor Tracking Function.
		Multi Sensor Tracking Function	**Multi Sensor Track Processing (MSTP)** Processes local radar tracks and ADS-B tracks to present a single surveillance track. The tracks are distributed onto the Service LAN for display in the event the Dual Operational LANs are not available or in case of failure of the Surveillance Data Processing Function.
SNMAP	**Safety Net and Monitoring Aids Processing function**		**Safety Net and Monitoring Aids Processing (SNMAP)** Establishes coupling between surveillance system tracks (multi-sensor) and flight plans and performs a surveillance based alert and monitoring functions.
AGDC	**Air-Ground Data Link function**		**Air-Ground Datalink Processing (AGDP)** Manages all air-ground communication between TopSky - ATC and airborne aircraft: • **Datalink Initiation Function (DLIC),** establishes communication between the aircraft and the controller. • **Automatic Dependent Surveillance,** processes ADS-C reports and provides ADS-C data based alerting and warning processing. • **Controller Pilot Data Link Communication,** allows the controller to conduct a dialogue via a datalink with appropriately equipped aircraft • **Pre Departure Clearance,** processes pre-departure clearance.
ODS	**Human Machine Interface**		**Java Human Machine Interface (JHMI)** Operational software that drives the ODS and provides a degraded level flight data management (Local FPL) and radar processing in the event SDP functions and FDP functions are not available, e.g. if the dual Operational LANs becomes unserviceable.

Sub-System	Function	TopSky - ATC CSCI
REC/REP	**Recording and Replay function**	**Recording (REC)** Records data that can be used by offline tools like JADE, DART and export purposes. **Replay (REP)** Replays recorded data (ATC data or exact video recording) on CWP positions. **Operational Data eXport Processor (ODXP)** Converts recorded operational data into XML for export. Main receiver of these files is JADE but can be used for other data export purposes. **Exact HMI Recording (EHMIR)** Records the graphical image generated by the graphics card of the HMI display processor for display on the operator position screen (i.e. the exact video image generated by the HMI application for display).
OFFL	**Operational Data Analysis Facilities function**	**Java Assisted Data Analysis Environment (JADE)** Java/web based system that provides statistical data analysis capability and pre-billing data processing. **Display Analysis and Replay Tool (DART)** Tool for the detailed analysis with graphical presentation of surveillance and flight plan data. The Display Analysis and Replay Tool is an interactive tool used to: • Display air situations (Aircraft Trajectory Plotting) • Analyse alerts generated by an alert server.
	System Parameter Management	**Data Preparation Tool (DPR)** • Adaptation of operational data to TopSky - ATC system • Adaptation of simulated data to TopSky - ATC SIM
FPCP	**Flight Plan Conflict Function**	**Flight Plan Conflict Function (FPCF)** Performs conflict probing on flight plans. **Segregated Airspace Probe (SAP)** Probes flight plans against potential infringements of restricted areas.
GGDC	**Communication Data Function**	**Communication Data Processing (CDP)** Ensures that specific interfaces are also provided for exchanging of data between a TopSky - ATC centre and its associated remote partitions. **Inter-Operability and Data Exchange (IODE)** Provides import and export data capability.

Sub-System	Function	TopSky - ATC CSCI
ATFM	**Traffic Flow Management System Function**	**MAESTRO Server Processing (MSP)** Receives TopSky - ATC data to compute a sequence of inbound traffic including for each flight its allocated runway, landing time and delay to be absorbed to meet its landing time. Displays departing traffic.
		Flow Control Processing (FLP) FLP is implemented as a component of the MSP CSCI. FLP is an internal interface that transmits data required between the FDP CSCI and the MSP CSCI.
SIM	**Simulation and Training Functions**	**Air Traffic Generator (ATG)** Generates simulated surveillance track data and flight plan data, from pre-defined kinematics data. **Java Pilot (JPIL)** Provides Pseudo pilot positions for the simulator **Java Leader (JLDR)** Provides the simulator training session leader capability **Exercise Preparation (EED)** Provides exercise preparation tools
SUP	**System Control and Monitoring function**	**Technical Supervision Tool (TKSUP)** Provides automated monitoring of ATC system, network and nodes status.

6.3. Software Non-Development Items (NDI)

TopSky - ATC uses of a number of Software NDIs, each of which can contain several components. These are listed here to facilitate interface mapping:

Table 12 Software Non-Development Items (NDI)

NDI CSCI	Function
Thalix	Linux based Thales ATM operating system
BSS	Thales Basic System Software toolbox which is made of: • **Unix Based System Software (UBSS**) which provides supporting services for interfacing the application and the operating system • **System Modes Management software (SYSMNG**), which handles The management of CSCIs according to their environment and partitions System start-up as well as recovery procedures at node and system level
UBSS	Part of the BSS toolbox and provides: • **Basic Name Server (BNS),** which provides a facility to map logical symbols onto values that can be distributed in a multi-node system. • **Consistent Datastore Copies (CDC),** which perform the management of replicated information in a multi-node system, i.e. distributed data processing by means of replicated datastores in a Local Area Network environment. • **Dual Node Control (DNC),** which allows two nodes, connected to the same LAN, to form a redundant configuration for fault tolerant applications by assigning states to these two nodes. • **Node and Process Management (NPM),** which controls nodes and dual nodes in a pre-defined way (start/restart, shutdown, control and monitoring of each node). • **Input/Output Calls (IOC),** which provides all the necessary facilities to manage files on disk(1) or archive media, to access the files and to transfer them from one node to another. • **Inter-Process Communication (IPC),** which handles the communication between processes in a multi-node system as transparent inter-process/inter-node point-to-point communications. • **Open Communication Processor Supervision (OCPSUP),** which supervises the operation of OCPs. • **System Control and Monitoring (SCM),** which offers a facility for a technical operator to monitor and control the status of the technical part of the system from a technical operator position (status acquisition of node, processes, process groups, devices and data store). • **Time and Clock Management (TCM),** which provides functionalities regarding time and clock related aspects (extensive set of time related services such as high resolution timers, different times, and support for clock synchronization over node boundaries) within a network-based system.
TMH	Time Management Handling (**TMH)**, which is used for maintaining the virtual times in all connected software items.
NTP	**Network Time Protocol**, which is part of Thalix and provides accurate, dependable, and synchronized time via the Time Distribution System (TDS) for hosts on local area networks. In particular, NTP provides synchronization traceable to clocks of high absolute accuracy, and avoids synchronization to inaccurate clocks.

NDI CSCI	Function
CTMS	**Central Technical Monitoring System** utilises a COTS package Zabbix configured to monitor sub-systems within the TopSky - ATC system.

6.4. External Interfaces

Several TopSky - ATC functions exchange information with external ATS centres and agencies:

- Exchange of operational messages with other ATS centres and AMHS terminals using ground/ground communication,
- Air/ground communication between aircraft and the Manila ATMC,
- Reception of surveillance data, i.e. radar data, ADS-B data,
- Reception of Aeronautical Information,
- Reception of GRIB data,
- Exchanging of data for voice synchronisation at replay,
- Sending of billing information.

The following figure and table describe the External Interfaces to the TopSky - ATC system. Detailed interface requirements for the TopSky - ATC system are specified in section 2.3 Project Documents. The Interface Control Documents (ICD) defines the physical protocol and application level of each interface.

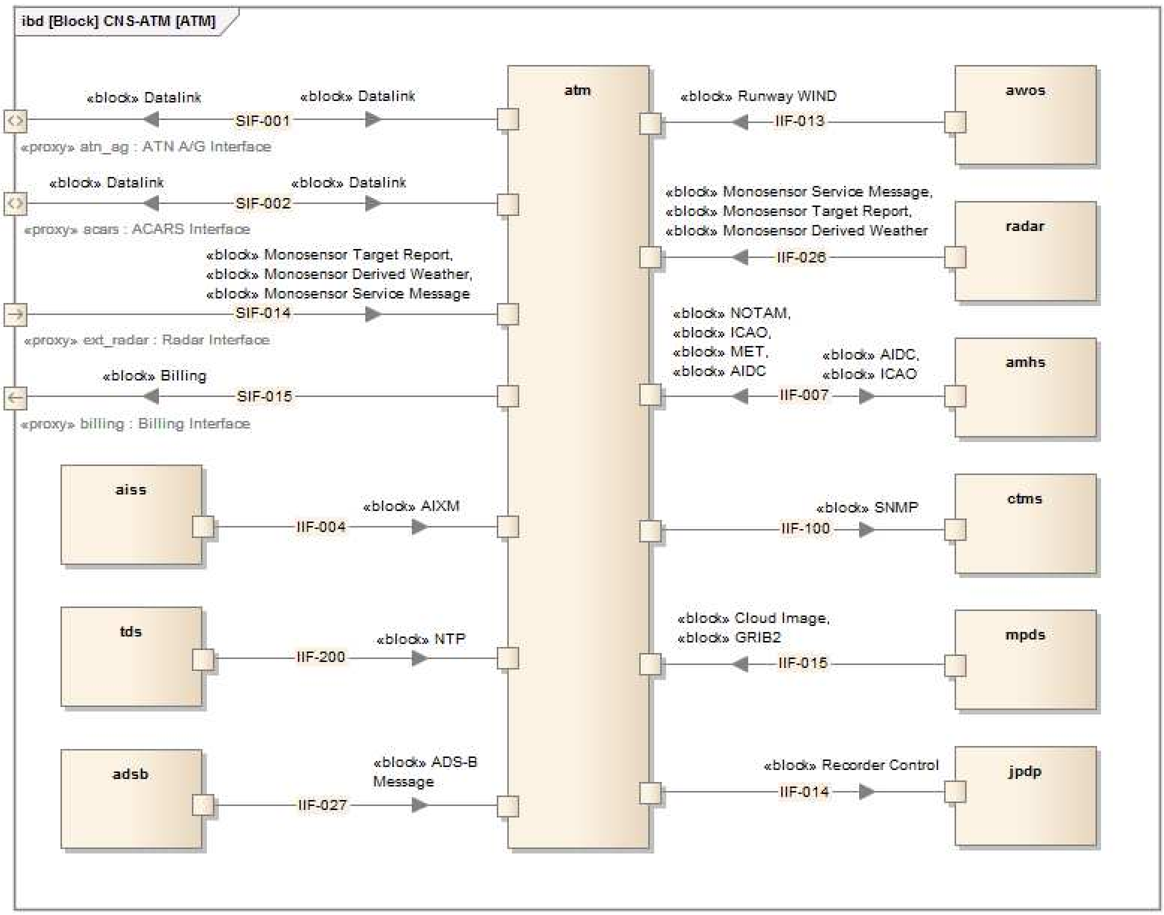


Figure 19 TopSky - ATC External Interfaces

The following Table describes the External Interfaces to the ATM system. The External Interfaces are provided to the Manila ATMC partition during normal operation.

Table 13 TopSky - ATC External Interfaces

Node ID	Interface Description	TopSky - ATC CSCI
MSTS	The Multi Sensor Tracking System node interfaces to external surveillance radars transmitting data in various formats to the TopSky - ATC Air Traffic Control automation system. The formats supported on this interface are: - ASTERIX CATEGORY 001, Monoradar target reports. For further information refer to [P_01]. - ASTERIX CATEGORY 002, Monoradar service messages. For further information refer to [P_01]. - ASTERIX CATEGORY 008, Monoradar Weather Data. For further information refer to [P_01]. - ASTERIX CATEGORY 034, Monoradar service messages (supersedes ASTERIX CATEGORY 002). For further information refer to [P_01]. - ASTERIX CATEGORY 048, Monoradar target reports (supersedes ASTERIX CATEGORY 001). For further information refer to [P_01] The Interface Control Document (ICD) defines the physical, protocol and application level, of the interface.	MSTS
SGW	The Sensor Gateway node interfaces to external ADS-B sensors transmitting data to the TopSky - ATC Air Traffic Control automation system. The formats supported on this interface are: – ASTERIX CATEGORY 021, ADS-B Messages. For further information refer to [P_02].	SGW
RTP	The Radar Bypass Processing node interfaces to external surveillance radars transmitting data in various formats to the TopSky - ATC Air Traffic Control automation system. The bypass data is presented to the operator when the main radar processing has failed, i.e. MSTS. The formats supported on this interface are: - ASTERIX CATEGORY 001, Monoradar target reports. For further information refer to [P_01]. - ASTERIX CATEGORY 002, Monoradar service messages. For further information refer to [P_01]. - ASTERIX CATEGORY 008, Monoradar Weather Data. For further information refer to [P_01]. - ASTERIX CATEGORY 034, Monoradar service messages (supersedes ASTERIX CATEGORY 002 for MODE-S radar). For further information refer to [P_01]. - ASTERIX CATEGORY 048, Monoradar target reports (supersedes ASTERIX CATEGORY 001 for MODE-S radar). For further information refer to [P_01] The Interface Control Document (ICD) defines the physical, protocol and application level, of the interface.	RTP

Node ID	Interface Description	TopSky - ATC CSCI
ADSBT-FP	The ADSBT-FP node interfaces to external ADS-B sensors transmitting data to the ADSB-MTP. The formats supported on this interface are: – ASTERIX CATEGORY 021, ADS-B Messages. For further information refer to [P_02].	AFP
ADSB-MTP	The ADSB-MTP node interfaces to external ADS-B sensors transmitting data via the ADSBT-FP node. The formats supported on this interface are: ASTERIX CATEGORY 021, ADS-B Messages. For further information refer to [P_02].	MTP
AGDP	The Air Ground Data Processor node interface links the AGDP server to the Datalink Service provider. This interface is used to transfer information between the AGDP node and the ACARS network or the ATN A/G network. The formats supported on the ACARS interface are: - Automatic Dependant Surveillance - Contract messages. For further information refer to [P_03]. - Controller Pilot Data Link Communication messages. For further information refer to [P_03]. - Pre-Departure Clearance messages. For further information refer to [P_03]. The formats supported on the ATN A/G interface are: - Automatic Dependant Surveillance - Contract messages. For further information refer to [P_04]. - Controller Pilot Data Link Communication messages. For further information refer to [P_04]. - Pre-Departure Clearance messages. For further information refer to [P_04]	AGDP
FDP	The Flight Data Processor node interfaces to 3 types of external interfaces, ATS Message Handling System (AMHS), Aeronautical Information Service System (AISS) and Meteorological Data Processing System (MDPS). Each external interface provides information in various formats to the TopSky - ATC Air Traffic Control automation system. The formats supported on the AMHS interface are: - ATS Message Handling System messages. For further information refer to [P_05]. o ICAO messages. For further information refer to [P_06]. o AIDC messages. For further information refer to [P_07]. - Aeronautical Information Service messages. For further information refer to [P_08]. The format supported on the MDPS interface is: - Gridded Binary (GRIB) messages. For further information refer to [P_09].	FDP

Node ID	Interface Description	TopSky - ATC CSCI
ASPB	The Air Situation Playback (ASPB) node interface to the Voice Recorder/Replayer of the Journaling and Playback Data Processing subsystem to synchronise voice data during a replay session. The formats supported on the ASPB interface are: - Voice Recorder/Replayer control messages. For further information refer to [P_011].	ASPB
DBM	The Java Assisted Data Analysis Environment tool provides a Billing file extracted from recorded data for the Billing Management System. The formats supported on the Billing interface is: - Billing data file. For further information refer to [P_013].	JADE
	The DBM node processes AIS Static Data received from AISS over AMHS. The formats supported on the DBM are: - AIS data file (only containing static data). For further information refer to [P_016].	DBM
	The DBM node can accept manual input of terrain data from the technical operator. The formats supported on the DBM are: - Terrain obstacle data. For further information refer to the DPR Operator Handbook [P_015].	DBM
	The DBM node can accept a maintenance link connection via VPN for external maintenance access. External analysis of the system traces can be done through this link.	DBM
HMI	HMI positions will interface to the Automated Weather Observation System (AWOS) subsystem to display aerodrome runway wind information. The format supported on the interface is: - HTTP data from the AWOS subsystem. For further information refer to [P_010].	HMI

6.5. ATC Availability

The design of the system achieves the high TopSky - ATC system availability requirement by building in redundancy at multiple levels:

- Dual H/W servers for all critical components
- Dual Networks for all critical data flows
- Separate Bypass functions for surveillance (radar, ADS-B) processing that provide reduced service on failure of a main function in the OPS.
- Redundancy level of the internal interfaces (interface equipment and data distribution LAN) consistent with the redundancy level of Global Surveillance LAN they are connected to,
- Segregation principle of the interface LANs and equipment between surveillance data and non-surveillance data using Virtual LAN.
- Distributed architecture with redundant nodes and redundant LANs to support operational data processing and distribution. Failover to the redundant component of the node is automatic, immediate and transparent in case of failure and provides uninterrupted service,
  - Functions are performed by Computer Software Configuration Items (CSCIs) running on separate servers, without overall centralized process or centralized data exchange management. A single failure has limited and controlled impact on the overall sub-system performances and capacity,
- Health status indication to operators and supervisors to report failure and maintain sub-system's capabilities awareness.

6.6. Commercial Off-The-Shelf Products

The design of the TopSky - ATC system is based on Commercial Off-the-Shelf (COTS) hardware components:

The use of COTS products facilitates:

- Access to the latest technologies maximising cost to performance ratios
- Compliance of H/W with open industry standards
- Availability of longer term support from major vendors

The selection of COTS products for use in the system takes into account the following design constraints:

- Performance
- Compatibility with operational environment
- Compatibility with ATC operating system (for servers and workstations)
- Production lifetime
- Supportability
- Lifecycle cost

6.7. ATC Networking

The ATC data transport design for both internal and external data flows is based on network open standard protocols such as IP networking for the network layer and TCP or UDP for the transport layer. Where external data flows are not IP based, for example serial radar data, router type interface devices are provided to convert the external data format to IP.

The design of data interconnectivity between ATC components is based on the use of Virtual Networks (VLAN). Separate Virtual Networks will be provided for different categories of ATC data flows to facilitate data control, monitoring and backup.

ATC LANs conform to a physical hierarchical tree topology with networked equipment individually connected back to centralised switches that are connected to routers for uplink connections. All system equipment are connected to access switches which are based on Fast Ethernet interfaces. Inter-site remote connections are through point-to-point links and are designed to be fault tolerant and redundant. Data links between the TopSky - ATC Networks Segment and the external systems are designed to be fault-tolerant and redundant.

6.8. Software and Hardware Components

The software resources are the applications, which implement the basic and complementary set of functions of TopSky - ATC. These applications are referred to as **Computer Software Configuration Items (CSCI)**.

CSCIs are hosted on Thalix based computer hardware systems, which are part of the suite of **Hardware Configuration Items (HWCI)** that make up a complete TopSky - ATC system. Included in the suite of HWCIs are all additional hardware components required to construct a complete system such as display screens, network switches, routers etc.

TopSky - ATC HWCIs are termed **Non-Development Items (NDI)** and all HWCIs are comprised of **Commercial Off The Shelf (COTS**) equipment.

The complement of CSCIs of TopSky - ATC also includes a number of software NDIs. Such NDI CSCIs include:

- Thalix - THALES ATM Operating System
- Thales Basic System Software (BSS), which provides the middleware used by and specifically designed for TopSky - ATC,

TopSky - ATC CSCIs are hosted on computer HWCIs Type and can be classified in either of the following groups:

- **Data Processing Systems (DPS)** for data processing requirements that do not involve human interface components, or
- **Operator Display Suites (ODS)** for data processing requirements do require human machine interface peripherals such as keyboard, mouse, display screen and printers.

The complement of either a DPS or ODS (HWCI) and the CSCIs it hosts represents a TopSky -ATC node.

Several TopSky - ATC functions are considered critical for the provision of TopSky - ATC functionality and the respective CSCIs that implement those functions are hosted on redundant HWCIs.

The mapping of CSCIs to HWCIs is described in 6.10.5 CSCI – HWCI Allocation.

6.9. Redundancy Principles

The system is designed with redundancy for every operationally critical function. This ensures that there is no single point of failure, so in case of a failure there is always a backup solution, which enables the system to maintain its operability. Full redundancy is achieved in three different levels: servers, network and system Servers and Network Levels

Part of the design principle is the provision of redundancy for critical functions. Redundancy is provided through the use of:

- One redundant Operational LAN, one redundant Surveillance LAN, and an additional Service LAN.
- Redundant HWCIs (DPS) for all critical functions.
- Multiple ODS HWCIs to provide redundancy

The TopSky- ATC design philosophy stipulates that operational data traffic is not to be impacted by non-operational network data traffic. For that reason, the TopSky - ATC architecture is made up of one redundant operational LAN (Operational LAN A and Operational LAN B) and a separate service LAN (Service LAN).

The Operational LANs handle all operational data traffic required for ATS, such as radar data, flight data and other operational data requirements, while the Service LAN handles all other communication requirements of the system. However, the Service LAN is also used to communicate radar bypass data.

In order to separate external data from operational data, TopSky - ATC architecture is also made up of redundant dedicated VLANs such as Surveillance, AGDP and FDP VLANs. These dedicated VLANs will directly traverse data traffic between external networks and required internal servers.

Service LAN network is used for off-line access for maintenance and software upgrade of the system, monitoring as well as surveillance bypass mode. Surveillance Bypass traffic will remain available in case of main surveillance redundant networks are not available and thus will be able to communicate radar data to required nodes via service LAN.

6.9.1. Server - Data Processing System (DPS)

Each redundant HWCI is connected to each Operational LAN. Depending on the function provided by a particular HWCI node, one of two redundancy configurations is used, either:

- Hot Standby Redundancy (HSR), where one node is the active primary node and the other node remains idle under normal operation. In the event of a failure of the primary node, the secondary DPS is activated.
- Multiple Computation Redundancy (MCR), where both DPS perform full data processing at all times.

As an example Flight Data Processing (FDP) is implemented using HSR, while Multi Sensor Tracking Processing (MSTP) is implemented using MCR.

The HSR and MCR applies to DPS HWCI and CSCI.

6.9.2. Workstations - Operational Display System (ODS)

The redundancy is provided by establishing multiple positions.

6.9.3. Network

Each partition has its own internal LAN infrastructure made up of a redundant Operational LAN interfaces (Operational LAN A and Operational LAN B). All interfaces to other TopSky - ATC partitions (if any) would go through a router and communication between partitions are through dedicated ATC nodes such as CDP server that would relay the information either via the WAN or directly to other partitions.
For external data interchange, dedicated redundant VLANs are configured and are responsible for carrying traffic to required servers within the ATC system such as Surveillance, AGDP, and FDP.
A separate non-redundant VLAN is configured as service VLAN responsible for carrying auxiliary traffic such as Off-line SW/HW upgrade, management, and surveillance bypass traffic.

6.9.4. Internetworking Sub-Systems

The inter-networking sub systems will allow the transfer of data within each partition. The inter-networking sub systems in the ACC and TWR partitions comprise the following:

- Dual Fast Ethernet Operational LAN (Operational LAN A, Operational LAN B);
- Fast Ethernet Service LAN (Service LAN);
- External communication network for external communication interfaces such as Radar Bypass data.
- Backbone and VSAT provided to interconnect remote partitions.

The inter-networking sub systems in the SIMULATOR (TES) partition are comprised of the following:

- Single Fast Ethernet Simulator LAN (Simulator LAN), and
- Fast Ethernet Service LAN (Service LAN).

6.9.4.1. Dual Fast Ethernet Operational LAN

The redundant operational LAN provides a primary and secondary network path for each HWCI (i.e. ODS or DPS) to eliminate single points of failure that could cause a "System Failure" (loss of system critical functionality).

The Fast Ethernet architecture employed in the Operational LAN is the Redundant implementation and is identified as Operational LAN A and Operational LAN B. It allows for high system level fault tolerance and recovery at both node and Switch levels by providing two network interfaces for each operational node. This is possible by implementing Channel Bonding.

This architecture ensures for each node a connection to either Operational LAN A or Operational LAN B regardless of a single cable fault, a single Switch fault or a single port fault. At the node level, when a break occurs in the active interface or upstream Switch, the node deactivates the primary interface and activates the secondary interface to the alternate Switch.

6.9.4.2. Dual LAN Switch Configuration

To provide physical redundancy within the operational network, at least two switches, Operational LAN A and Operational LAN B, are installed at the ACC, APP and Tower partitions. The functional requirements of the switches are to provide two physical operational connections for each node and a means to communicate between themselves.

6.9.4.3. Service LAN

The Service LAN will provide a single connection to each operational system node within the System. The main purpose of the Service LAN is to provide a network path to the Executive and Planner positions for the Radar Bypass information. The Service LAN is also available to provide software and technical maintenance access to each node without interruption to the operational LAN.

6.9.4.4. External Communication network

The External communication networks are used for transmitting and receiving data from external interfaces such as Meteorological Services, External Flight Data, Air Ground Communications and Communications to other FIR just as a few examples. Surveillance Data (Sensor LAN) and external interfaces (AMAN, FDP, AGDP LANs) networks are segregated into different VLANs

6.9.4.5. Simulator LANs (TES)

In the SIMULATOR partition, each HWCI is connected internally to other HWCIs via Simulator LAN A, Simulator LAN B and a Simulator Service LAN. The setup simulates the same configuration as the operational partition. The Service LAN is used for software and technical maintenance.

6.10. Description of the System Elements

6.10.1. System Servers

TopSky - ATC is a distributed system. The full set of system functionalities is divided into independent Computer Software Configuration Items (CSCIs). This way each CSCI can be developed and maintained independently, and can be executed independently. This distributed architecture allows for reducing the impact of newly introduced features on the overall system, while not being constrained by CPU processing power, as the execution is divided across several machines.

CSCIs are hosted on Thalix based server systems to establish the various nodes make up a complete TopSky - ATC system. Each CSCI is responsible for a specific set of functionalities. The servers are responsible for the background processing, while the input/output is performed through the HMI positions.

A number of TopSky - ATC functions are considered critical to provide ATM functionality and are therefore provided through redundant nodes. Redundant configuration enables the continuous operating of the system even in a situation that one of the redundant servers stops operating. For more information regarding redundancy see section 6.9 Redundancy Principles.

The TopSky - ATC main functions comprise the set of functionality, which supports Air Traffic Management services and include:

- Flight Data Processing function (FDP)
- Surveillance Data Processing Function (MSTS, MSTP, Radar, ADSB, QNH)
- Fall back Radar Processing function (RTP)
- Safety Net and Monitoring Aids Processing Function (SNMAP)
- Human Machine Interface (JHMI)
- Air Ground Data Link Processing function (AGDP)
- Communication Data function (CDP)
- Operational Data Analysis Facilities Function (JADE/DART)
- System Parameter Management (DPR)
- Flight Plan Conflict Function (FPCF)
- Recording and Replay function (REC/ASPB/EHMIR)
- Inter-Operability and Data Exchange (IODE)
- Monitoring and Control function (TKSUP)

6.10.2. System Modes

The TopSky - ATC system has several system modes that automatically switch in when any of the major processing server's fails. The objective is that the controller will always have some functionality available, despite the degradation of the main processing function. Some of the system modes can be accessed manually.

6.10.3. CSCI Identification

The system consists of several CSCIs, some of which are used operationally on-line, while others are used offline either for data preparation, or for simulation purposes.

6.10.3.1. Operational CSCIs

The following CSCIs are used in the Operational Partitions:

- Multi-Sensor Tracking System (MSTS)
- ADS-B Front Processor (ADSB-FP)
- Multi-Sensor Track Processing (MSTP)
- Fall back Radar Track Processor (RTP)
- Bypass Automatic Dependant Surveillance Broadcast Track Processor (ADSB-TP)
- Automatic Dependant Surveillance Broadcast Track – Front Processor (ADSBT-FP)
- Automatic Dependent Surveillance Broadcast Track – Multi Track Processor (ADSBT-MTP)
- QNH Processor (QNH)
- Flight Data Processor (FDP)
- Air Ground Data Processor (AGDP)
- Safety Net and Monitoring Aids Processing (SNMAP)
- Flight Plan Conflict Function (FPCF)
- Segregated Airspace Probe (SAP)
- Communication Data Processor (CDP)
- Recording (REC)
- Air Situation Playback (ASPB)
- Human Machine Interface (JHMI)
- Monitoring and Control (TKSUP)
- Inter-Operability and Data Exchange (IODE)
- Exact Video HMI Recording (EHMIR)

6.10.3.2. Simulator specific CSCIs

The following CSCIs are specifically used in the Simulator Partitions:

- Air Traffic Generator (ATG)
- Leader Human Machine Interface (JLDR)
- Pilot Human Machine Interface (JPIL)

6.10.3.3. Offline Data preparation CSCI

The following CSCIs are used in Offline Data Preparation:

- Data Preparation (DPR)

6.10.3.4. Offline Data Analysis CSCIs

The following CSCIs are used in Offline Data Analysis:

- Java Assisted Data Analysis Environment (JADE)
- Display Analysis and Replay Tool (DART)
- Operational Data Export Processor (ODXP)

6.10.3.5. CSCI Redundancies

The following table indicates the redundancy principles, which are applicable by CSCI type:

Table 14 CSCI Redundancies

CSCI	HSR(1)	MCR(1)
OPS CSCIs		
ADS-B Front Processing (ADSB-FP)		X
Fall back ADS-B Tracking Processing (ADSB-TP) comprised of ADSBT-FP and ADSBT-MTP CSCIs		X
Arrival-Sequence Manager (AMAN)	N/A	N/A
Air Situation Playback (ASPB)	N/A	N/A
Communication Data Processing (CDP)	X	
Exact HMI Recording (EHMIR)	N/A	N/A
Flight Data Processing (FDP)	X	
Flight Plan Conflict Function (FPCF)	X	
Human Machine Interface (HMI)	N/A	N/A
Bypass Multi-Sensor Tracking Processing (MSTP)	N/A	N/A
Multi-Sensor Tracking System (MSTS)	X	
QNH Data Processing (QNH)		X
Bypass Mono Radar Tracking Processing (RTP)		N/A
Recording (REC)		X
Safety Nets and Alerts Processing (SNMAP)	X	
Segregated Airspace Probe (SAP)	X	
Air Ground Datalink Generator (AGDP)	N/A	N/A
SIM CSCIs		
Air Traffic Generator (ATG)	N/A	N/A
Exercise Editor (EED)	N/A	N/A
SIM leader HMI (JLDR) or Pilot HMI (JPIL)	N/A	N/A
OFFL CSCIs		
AFTN External Messages Simulator (AEMS)	N/A	N/A
Air Ground Communication Generator (AGCG)	N/A	N/A
Plot Track Generator (PTG)	N/A	N/A
Condition Group Testing (CGTEST)	N/A	N/A
Data Preparation OPS (DPR)	N/A	N/A
Display Analysis and Replay Tool (DART)	N/A	N/A
Java Aided Data Analysis Environment (JADE)	N/A	N/A
Monitor and Control (TKSUP)	N/A	N/A
Operational Data Export Function (ODXP)	N/A	N/A

CSCI	HSR(1)	MCR(1)
System Configuration Environment (SCEN_TOOLS)	N/A	N/A
Unix Based System Software (UBSS)	N/A	N/A
Inter Operability and Data Exchange (IODE)	X	

Note: (1) Refer to chapter 5.1.2.2.1 and 5.1.2.2.2 for definition of HSR and MCR.

6.10.4. CSCI Description

6.10.4.1. Multi-Sensor Tracking Processing CSCI (MSTP)

6.10.4.1.1. Purpose

Multi-sensor Tracking Processing CSCI (MSTP) combines all received data pertaining to a single aircraft into a single surveillance track. It receives pre-processed surveillance data from a Sensor Gateway and tracking (SGT) function, processes these data and distributes ASTERIX CAT 62 surveillance tracks (in IPM – IP Multicast protocol). These pre-processed data include primary Radar local tracks, secondary Radar local tracks and Mode-S SSR local tracks.

6.10.4.1.2. Main Functions

- Track correlation and track fusion
- Distribution of tracks in ASTERIX Category 62
- Coordinates conversion (for local tracks with no valid mode C)
- MSTP Training capabilities

6.10.4.1.3. External Interfaces

- Radar

6.10.4.1.4. Design Constraints

None.

6.10.4.2. ADS-B Track Processing CSCI (ADSB-TP)

6.10.4.2.1. Purpose

The ADS-B Track Processing (ADSB-TP) comprises the ADSBT-FP and ADSB-MTP CSCIs and is part of the surveillance data processing system. It receives ADS-B data coming from ADS-B ground stations. This data is processed and distributed to the other CSCIs of the System as ADS-B tracks in an ASTERIX CAT062 format.

6.10.4.2.2. Main Functions.

- ADS-B data reception handling including syntactic and semantic checks
- ADS-B site monitoring
- ADSB tracking
- ADS-B tracks distribution

6.10.4.2.3. External Interfaces

None

6.10.4.2.4. Design Constraints

None

6.10.4.4. ADS-B Track Front Processing CSCI (ADSBT-FP)

6.10.4.4.1. Purpose

The ADSBT-FP CSCI is part of the surveillance data processing system. It receives ADS-B data coming from ADS-B ground stations. This data is decoded and distributed to other CSCIs of the system such as the ADSB-MTP CSCI.

6.10.4.4.2. Main Functions.

- ADS-B data reception handling
- ADS-B site monitoring
- ADS-B tracking
- ADS-B tracks distribution

6.10.4.4.3. External Interfaces

None

6.10.4.4.4. Design Constraints

None

6.10.4.5. ADS-B Track Multi Track Processing CSCI (ADSB-MTP)

6.10.4.5.1. Purpose

The ADSB-MTP CSCI is part of the surveillance data processing system. It receives ADS-B data coming from ADS-B ground stations via ADSBT-FP. This data is processed and distributed as system tracks to the other CSCIs of the System such as MSTP as ADS-B tracks in an ASTERIX CAT062 format.

6.10.4.5.2. Main Functions.

- ADS-B data reception handling including syntactic and semantic checks
- ADS-B site monitoring
- ADSB tracking
- ADS-B tracks distribution

6.10.4.5.3. External Interfaces

None

6.10.4.5.4. Design Constraints

None

6.10.4.6. QNH Processing CSCI (QNH)

6.10.4.6.1. Purpose

The QNH Processing (QNH) CSCI is designed to receive QNH data and to store the QNH values for given areas so that QNH correction can be performed on level information provided by the aircraft.

6.10.4.6.2. Main Functions

- Reception of QNH messages.
- Management of QNH data (including wind data if any) within areas.
- Filtering of erroneous data, and distribution in CDC format.

6.10.4.6.3. External Interfaces

None.

6.10.4.6.4. Design Constraints

None

6.10.4.7. Safety Nets and Monitoring Aids Processing CSCI (SNMAP)

6.10.4.7.1. Purpose

The Safety Nets and Monitoring Aids Processing CSCI (SNMAP) performs coupling of surveillance system tracks with corresponding flight plans. This coupling allows Automatic Position Reporting, Route Adherence Monitoring and Cleared Level Adherence Monitoring. Furthermore, the system tracks are used to detect Short Term Conflict Alerts, Minimum Safe Altitude Warning, Danger Area Infringement Warning and Approach Path Monitoring.

6.10.4.7.2. Main Functions

1. Surveillance Alert Capabilities (SAC):

- Short Term Conflict Alert (STCA).

  The warnings resulting from STCA are distributed to HMI CSCI. The STCA areas are defined off-line. The STCA inhibition areas are defined off-line and can be activated/deactivated by the operator.

- Minimum Safe Altitude Warning (MSAW).

  The warnings resulting from MSAW are distributed to HMI CSCI. The MSAW areas are defined off-line. The MSAW inhibition areas are defined off-line and can be activated/deactivated by the operator.

- Danger Area Infringement Warning (DAIW).

  The warnings resulting from DAIW are distributed to HMI CSCI. The danger areas are defined on-line or off-line and can be activated/deactivated by the operator.

2. Track/Flight Plan Integrated Capabilities:

- Track/flight plan association.

  On establishment of the coupling, the callsign of the flight plan is appended to the system track information, which is sent to the HMI CSCI for display.

- Automatic Position Reporting (APR).

  APR capability sends reports to FDP CSCI for every eligible fix on the route of the aircraft (points from flight plan expanded route and sector transition points), when this fix has been over flown or periodically on cyclic APRs. The capability is executed after system track update.

- Route Adherence Monitoring (RAM).

  RAM capability is executed after each nth (as defined off line) system track update and checks the track deviation from the flight plan route against preset limits

- Cleared Level Adherence Monitoring (CLAM)

  CLAM is executed after each nth (as defined off line) system track update and checks the aircraft’s actual flight level versus its clearance.

- Actual Time of Arrival (ATA)

  Actual Time of Arrival (ATA) processing automatically fills the arrival time in the ATA field of the flight plan.

6.10.4.7.3. External Interfaces

None.

6.10.4.7.4. Design Constraints

None

6.10.4.8. Flight Data Processing CSCI (FDP)

6.10.4.8.1. Purpose

The purpose of the FDP CSCI is to build and maintain a database containing a flight plan data record for each relevant aircraft in the system. This database is shared by the CSCIs, which use flight plan information (e.g. JHMI, AGDP, REC, SNMAP).

The FDP CSCI also handles the external interfaces related to AMHS, which provide ICAO, AIDC and Meteorological message (GRIB meteorological messages) exchanges.

6.10.4.8.2. Main Functions

1. Flight plan acquisition, creation, checking and modification.

2. Flight plan evolution through all flight plan states.

3. Coordination with adjacent centres.

4. Flight plan trajectory computation.

    - Route analysis.
    - Profile computation.
    - Determination of the list of crossed sectors.
    - Estimated times computation.
    - Pilot Estimates functions.

5. SSR code management.

    - Automatic SSR code management.
    - Manual SSR code management.
    - SSR code assignment consequences and warnings

6. Processing of messages

    - Processing of ICAO messages.
    - Processing of AIDC Messages.
    - Processing of GRIB Meteorological messages.
    - Processing of AIS messages.
    - Processing of RPL messages.
    - Flex Tracks processing.
    - Messages management queue.

7. Local message recording

8. Repetitive flight plan (RPL) and Stereo plan (STE) management.

    - File switch
      The FDP CSCI can change on-line the RPL and STE database used, by means of a switching mechanism between the two available RPL versions (current and passive).

- RPL extraction and copy to flight plan database
  RPLs are extracted from AISS and imported via AMHS and when found erroneous, the operator is warned. The erroneous RPLs are queued and the operator can inspect and modify/correct them.
- STE search and create new flight plans
  STEs are searched and used as a template to create new flight plans

12. HMI Electronic Strips Posting.

12. HMI Paper Strips Printing.

13. Grouping / De-grouping of sectors.

14. Flight Plan Training capabilities.

15. AMAN messages processing (send/receive via FLP CSC).

16. AIF processing

    - AIF message handling
    - MET processing
    - NOTAM processing (manually entered NOTAM messages)
    - AIF database management
    - AIF request function

6.10.4.8.3. External Interfaces

The FDP CSCI handles reception and/or transmission of data:

- ICAO messages
- AIDC messages.
- Flex tracks messages.
- GRIB messages.
- NOT/MET messages.
- RPL updates.
- AMAN messages.
- NOTAM messages

6.10.4.8.4. Design Constraints

None

6.10.4.9. Flight Plan Conflict Function CSCI (FPCF)

6.10.4.9.1. Purpose

The purpose of the FPCF CSCI is the processing of the flight plan conflicts. Conflicts are detected in the flight plan conflict region (FPCR). This region is defined off-line. FPCF CSCI handles manual probe requests from HMI or automatic probe requests when the CDC flight plan is updated.

6.10.4.9.2. Main Functions

1. FPCF activation (manual and automatic)
2. FPCF modification
3. FPCF cancellation
4. FPCF limits computation
5. FPCF reports.

Conflict reports are provided to the relevant positions. The displayed information is:

- The two flight plans involved (callsigns),
- Time range during which the conflict is possible,
- For each flight plan, the points of the route where the conflict has been detected and where it finishes.

6. Inhibition of FPCF areas
7. Complete FPCF inhibition

6.10.4.9.3. External Interfaces

None.

6.10.4.9.4. Design Constraints

None

6.10.4.10. Segregated Airspace Probe (SAP) CSCI

6.10.4.10.1. Purpose

The SAP CSCI is a facility to identify possible infringement of restricted (segregated) airspace volume based on flight data record information. Similar to the FPCF CSCI, reference 6.10.4.9, flight data records are added based on particular flight plan events to the FPCF database for automatic probing. The operator can also initiate manual probing to check intended flight plan modification for possible airspace infringement.

6.10.4.10.2. Main Functions

Infringement is determined by computing the intersection of each route segment (comprising its leg, profile and ETOs, as calculated by the FDP) with the active Danger Area Infringement Warning (DAIW) areas.

DAIW areas are defined as polygons with a lower and an upper vertical bound. DAIW areas are created off-line as well as on-line. DAIW areas are associated with activity periods. SAP provides an aural and visual alert, including infringement details, if it detects an aircraft's flight profile to infringe a DAIW area within an off-line definable look ahead time, while this area is active.

DAIW areas are used to represent restricted areas, danger areas, prohibited areas or special use airspace within the FIR.

DAIW areas can be configured to automatically be activated and de-activated via off-line parameters or can be interactively activated and de-activated via the HMI by the controller.

SAP probing is event based and occurs whenever

- Flight plans become active
- The flight plan state changes
- Is manually initiated by the controller for a particular flight

SAP processing can be interactively disabled and re-enabled.

Whenever SAP detects an infringement the following information is provided to the jurisdiction controller for this aircraft:

- An alert is presented in the aircraft's track label
- An aural alert is provided
- The affected area is highlighted on the controllers ASD together with the route segments that cause the infringement
- A window can be opened by the controller, which contains:
    - The flight plan identification
    - The identification of the infringed DAIW area
    - The computed conflict entry time and position
    - The computed conflict exit time and position.

6.10.4.10.3. External Interfaces

None.

6.10.4.10.4. Design Constraints

None

6.10.4.11. Air Ground Data Processing CSCI (AGDP)

6.10.4.11.1. Purpose

The purpose of the AGDP CSCI is management of Datalink applications. Supported Datalink applications are ADS-C, CPDLC and PDC. Therefore, the AGDP is responsible for ADS-C contracts requests, reception of ADS-C reports, establishment of ADS-C tracks, management of CPDLC messages (sent and received), management of PDC communication.

6.10.4.11.2. Main Functions

1. Context Management

- Communication establishment.
- Communication transfer.
- Context Management termination.
- Logon/flight plan coupling

2. ADS-C Connection Management

- Initiation of ADS-C connection
- Termination of ADS-C connection
- Management of ADS-C errors

3. ADS-C Contracts Management

- Periodic contract management
- Event contract management
- Emergency contract management

4. ADS-C Track Management.

- ADS-C reports processing.
- ADS-C track creation.
- ADS-C track suppression.
- ADS-C track update.

5. ADS-C Alert Capabilities

- Danger Area Infringement Warning (DAIW).

6. ADS-C Track/Flight plan integrated capabilities.

- ADS-C Route conformance checking. (ARCW).
- Route adherence monitoring (ADS-C RAM).
- Cleared level adherence monitoring (ADS-C CLAM).
- Automatic position reporting (ADS-C APR).

7. CPDLC Connection Management

- Initiation of CPDLC connection.
- Transfer of CPDLC connection.
- Management of CPDLC errors.

8. Pilot Controller Messages Management

- Uplink/downlink message transmission/reception.
- Messages display.
- History management.
- Automatic update of Flight Plan Data from CPDLC messages.

9. PDC Messages Management

- PDC Messages to aircraft
- PDC Messages to airline host

6.10.4.11.3. External Interfaces

The AGDP CSCI handles an ACARS line on which all the ADS-C, CPDLC, PDC data are received and transmitted.

6.10.4.11.4. Design Constraints

None

6.10.4.12. Communication Data Processing CSCI (CDP)

6.10.4.12.1. Purpose

The Communication Data Processing (CDP) CSCI performs the selective distribution of CDC's, BNS's, diffusion FIFO's, and FIFO messages between partitions (e.g. between the Centre partition and the Approach partition or between the Approach partition and the Tower partition). Datastores are shared via a Basic System Software service (CDC), based on update broadcastings.

The CDP CSCI subscribes to specific datastores, receives the corresponding data updates, filters them and transmits them when relevant to the other partition via point to point communications. On the other hand, in the receiving partition, the CDP CSCI re-builds the datastore with the received messages and re-broadcasts them to the CSCIs in this partition.

The CDP CSCI is also responsible for the distribution of any point-to-point messages relay (IPC messages) that is transmitted between processes located on separate partitions.

6.10.4.12.2. Main Functions

1. Send mode

- Filter data
- Pack data
- Send data

2. Receive mode

- Receive data
- Distribute data

6.10.4.12.3. External Interfaces

Remote CDP (via WAN) for inter-partition data transfer

This is an internal TopSky - ATC interface, but it can be routed through an external WAN connection.

6.10.4.12.4. Design Constraints

None

6.10.4.13. Recording CSCI (REC)

6.10.4.13.1. Purpose

The purpose of the REC CSCI is to record data in the system to be used for replay and analysis purposes.

6.10.4.13.2. Main Functions

The REC CSCI shall perform the following functions:

1. Data collection and storage:

- Dynamic datastores to be recorded are time stamped with the time of collection and saved to the central storage at regular intervals. Datastores with faster update rates, like tracks, will be collected by update recordings, while slowly changing data will be collected by both update recordings and periodic snapshots.

2. Recording of data snapshots

- The recording function shall store at regular intervals complete snapshots of data.

3. Recording of data updates (CDC updates)

- Collection and storage of local recording files created by the FDP, HMI, AGDP, SNMAP CSCIs. Local recording is relating to data that are not in CDCs and must be recorded locally on the node where the concerned CSCI runs.

4. Producing archives

- At each archiving interval or on operator request, this capability produces an archive, on removable media, of data recorded during that interval.

5. Producing scratchpad

- This capability produces a copy of recorded data currently stored in the central storage, for operator requested time interval, on a smaller capacity removable media.

6. Recording training capabilities.

6.10.4.13.3. External Interfaces

None.

6.10.4.13.4. Design Constraints

When REC starts up as salve, it shall compare and copy the recording data from the master. The time taken for the slave insertion and equalization will be, at a minimum, until about two minutes after the end of the next period (VSP: REC_RECORDING_PERIOD). It could take longer if the slave has been stopped for a long period of time and if a lot of data has to be synchronised. Final equalisation usually occurs in approximately two minutes after the end of a period.

6.10.4.14. Air Situation Playback CSCI (ASPB)

6.10.4.14.1. Purpose

The purpose of the ASPB CSCI is to perform an air situation replay on a given operational position or on the simulator controller positions composing the exercise group, based on recordings made by the REC CSCI.

Note: During playback, the only resource, which is used, is the position selected to run the replay.

6.10.4.14.2. Main Functions

1. Replay preparation

- To download recorded data.

  This capability reads recorded data, from the selected media according to the replay mode (data or exact video recording). Data emanating from REC are downloaded via the service LAN.

2. Replay Control

- To handle operator commands (e.g. freeze, resume, start, stop, speed).

3. Handling of the voice replayer interface for synchronisation

- To handle a join replay session in progress (OPS and Offline only)

4. Data replay

- This capability replays the data according to the time stamp of the recorded data and a predefined accuracy.

5. Air Situation playback training capabilities

- An exercise can be replayed from a given moment until the frozen time and for a given speed. The inputs of controller positions and of pilot positions are frozen.

A group can replay an exercise while the other group is working normally.

6. Join a Replay Session in progress

- To handle a join replay session in progress (OPS and Offline only).

7. Intercommunication with EHMIR

- To handle communication with EHMIR via IODE to start/stop/pause, change speed of exact video recording.

8. Intercommunication with ATG (TopSky-ATC Simulation) via OPC/IODE

- Communication with TopSky-ATC Simulation via OPC/IODE to start/stop/pause, change speed of replay.

6.10.4.14.3. External Interfaces

- Voice Recorder/Replayer

6.10.4.14.4. Design Constraints

None.

6.10.4.15. Fall Back Radar Track Processing CSCI (RTP)

6.10.4.15.1. Purpose

The Radar Bypass Processing (RBP) CSCI receives local radar data coming from different radar heads via the bypass radar sub-LAN. These data are processed and distributed to the other CSCIs of the System via the Service LAN by means of local radar tracks.

6.10.4.15.2. Main Functions

1. **Radar data handling.**
   - Radar data reception and processing.
   - Track Management and Site Monitoring processing.

2. Mono-radar Tracking of primary/secondary plots.

3. Coordinate Conversions.

4. Barometric Correction.

5. Local radar and weather data distribution.

8. Filtering of erroneous data, and distribution in CDC format.

6.10.4.15.3. External Interfaces

- Radar data link via surveillance sub LAN or fall back radar feeds at Remote Towers

6.10.4.15.4. Design Constraints

None.

6.10.4.16. Multi-Sensor Tracking System CSCI (MSTS)

6.10.4.16.1. Purpose

The Multi-Sensor Tracking System (MSTS) CSCI receives information from the different sensor front processing CSCIs, and process the information in order to create systems tracks from the entire set of plots/reports received. MSTS is also able to process data from radars directly. The process of creating system tracks consists of separate sensor tracking as well as multi sensor tracking. The MSTS is also responsible to combine plots/reports information that is not directly used in the tracking process, to its output system tracks.

6.10.4.16.2. Main Functions

1. Radar Front Processing

- Radar Data Handling:
    - o Processes tracks, tracked plots, plot and weather data from the different radar sensors connected to the system. These radars can be long range or approach radar and can deliver primary, secondary or combined data. The radar input is monitored in order to detect the quality of received radar data. The following functions are performed:
- Radar Connection
- Radar message reception
- Incoming Data Error Filtering
- Radar state management
- Error Reporting
- Radar head status management
- Radar Period Assessment
- Data Counting
- Target Error Detection
- Overload Processing
- Test Target Processing
- Mode-S Site Monitor Processing
- Radar Failure based on Test Target and Site Monitors
- Radar North Correction
- Plot and Tracked Plots Filtering
- Time Stamping
- Time Drift Management
- Radar Data Distribution
- Radar Collimation Function
- Radar Weather Management
    - o Performs the coordinates conversion and calculates the resolution of the radar weather data. The following functions are performed:

- Weather data coordinate conversion
- Weather Data Distribution

2. **Radar Pre-Processing**
3. **ADS-B Pre-Processing**
4. **DAPs Pre-Processing**
5. **Tracking Area Processing**
6. **Multi-Sensor Tracking:**
    - The multi-sensor tracking function aims to associate reports of an aircraft detected from Radar or ADS-B sensors to a unique surveillance track.
    - Multi Sensor Pre-Correlation Function
    - Multi Sensor Correlation Function
    - Association Function
    - Multi Sensor Track Update Function
    - Multi Sensor Initiation Function
    - Track Management Function
    - Track Cancellation
    - Clutter Mapping Function
    - Overload Protection
    - Radar Systematic Error Estimation Function
7. **QNH Correction.**
8. **Data Distribution**
9. **SMR Track Distribution**
10. **Radar Training Capabilities.**

6.10.4.16.3. External Interfaces

- Radars

6.10.4.16.4. Design Constraints

None.

6.10.4.17. ADS-B Front Processing CSCI (ADSB-FP)

6.10.4.17.1. Purpose

The ADS-B Front Processing (AFP) CSCI is designed to receive ADS-B data from ADS-B ground stations, to decode them and to distribute them to the Multi Sensor Tracking System.

6.10.4.17.2. Main Functions

1. ADS-B data reception

The ADS-B data reception supports the reception of two redundant feeds. The data is received in an ASTERIX CAT 021 format.

2. ADS-B data filtering

3. ADS-B state management

4. ADS-B Site Monitoring and Test tracks management

5. ADS-B data distribution

The ADS-B reports are distributed in ASTERIX CAT 021 format to other CSCIs.

6.10.4.17.3. External Interfaces

ADS-B ground stations via surveillance Sub-LAN.

6.10.4.17.4. Design Constraints

None.

6.10.4.18. Human Machine Interface CSCI (HMI)

6.10.4.18.1. Purpose

The HMI CSCI shall provide the interface between the operational users (executive controller, planning controller, operational supervisor, area supervisor, observer, and flight data operator position types) and the TopSky - ATC system.

6.10.4.18.2. Main Functions

- Time facilities
- Windowing facilities including the display of windows and menus, resizing, moving, minimizing.
- Graphic facilities including the display of maps, weather (real-time) and ATC tools such as bearing and range tools, zoom, pan, history dots.
- Aircraft dependent facilities including real-time display of tracks and their respective information (labels, warnings and alerts)
- Display facilities including the ability to select different (ACC vs. APP vs. bypass) surveillance track information as well as the ability to manage filters on tracks.
- Flight plan management facilities including tools to create, modify, transfer, couple/de-couple and delete flight plans and Flight List facilities
- ADS contract and controller-pilot data link facilities
- Transmission of messages via FDP to other ATC centres or via CPDLC to aircraft
- Operational data management including the ability to change sectorisation, enabling/disabling warnings, manual input of ATC-related data.
- Operational data display facilities
- RPL database version management
- Playback session management
- Verification of physical configuration facility
- Paper strip printing facilities
- ATC messages de-queue management
- Local flight plan management
- Local QNH handling
- CAIP display window hosting
- AMAN window hosting
- Configuration of contrast, brightness, transparency, font size, leader line orientation and length, pointer sizes
- Command availability and eligibility

6.10.4.18.3. External Interfaces

None.

6.10.4.18.4. Design Constraints

The JHMI CSCI shall be implemented on one machine. Data files used by JHMI CSCI, if any, have to be present on local disk storage of the processor it runs on.

6.10.4.19. Monitor and Control CSCI (TKSUP)

6.10.4.19.1. Purpose

The purpose of the TKSUP CSCI is to provide technical monitoring and control capabilities to the equipment used within the TopSky - ATC system.

6.10.4.19.2. Main Functions

1. Monitoring capabilities
2. Alarm management and on line alerting capabilities
3. Control capabilities
4. Display capabilities
5. Logging and report capabilities
6. On-line customisation capabilities
7. Off-line customisation capabilities

6.10.4.19.3. External Interfaces

None

6.10.4.19.4. Design Constraints

None

6.10.4.20. Operational Data Export Processor CSCI (ODXP)

6.10.4.20.1. Purpose

The purpose of ODXP is to convert recorded operational data into XML files for export. The main receiver of these files is the JADE CSCI but can be used for other data export purposes.

6.10.4.20.2. Main Functions

1. **Conversion of recorded data into XML files**
   - Periodic and on request data downloading:
     Reads data recorded by the REC CSCI from RECS disk or from removable media (from SERVLAN or locally)
   - Conversion of recorded data into XML data files for export.
2. **Transmission of XML files to other CSCIs or systems**
   - Transmits XML files for use by JADE
   - Transmits XML files to other destinations if so configured

6.10.4.20.3. External Interfaces

None.

6.10.4.20.4. Design Constraints

None.

6.10.4.21. Inter Operability and Data Exchange CSCI (IODE)

6.10.4.21.1. Purpose

The IODE CSCI captures and forwards selected TopSky - ATC data to internal systems and vice versa. Output Messages are built or forwarded from IODE sources (TopSky - ATC CDCs, BNS, Point to Point FIFOs, multicast FIFOs, and TCP/IP links). When predefined triggers (changes in IODE sources) are set, Output Messages are sent on predefined TCP/IP links or other media outputs. IODE has multiple instances in the system. Each instance has a unique purpose. To provide the necessary data, IODE subscribes to selected CDCs, BNSes, Point to Point FIFOs and multicast FIFO messages and also makes local recording files available. IODE is also capable of logging messages exchanged with internal systems to trace files.

6.10.4.21.2. Main Functions

- Syntax checking
- Data capture, and buffering
- Convert captured data to the format required by recipient
- Hot Standby Redundancy Handling
- Output message handling (unicast and multicast transmission mode)
- Link monitoring
- Offline configurable
- Data logging to trace files

6.10.4.21.3. External Interfaces

None.

6.10.4.21.4. Design Constraints

When the owner of any of the IODE sources fails, the data will not be available for sending to recipient.

6.10.4.22. Exercise Editor CSCI (EED)

6.10.4.22.1. Purpose

The Exercise Editor (EED) CSCI is used to create, modify and validate the simulated aircraft database and configuration of training exercise scenarios to be executed by the training/simulator ATG function.

6.10.4.22.2. Main Functions

- Configuration of training exercise scenarios
- Create, modify and validate simulated aircraft database

6.10.4.22.3. External Interfaces

None.

6.10.4.22.4. Design Constraints

None

6.10.4.23. Simulator: Pilot Human Machine Interface CSCI (JPIL)

6.10.4.23.1. Purpose

The purpose of the JPIL CSCI is to provide human machine interface between pilot positions and the training system in order to maintain realistic air traffic situations and simulate the pilot-to-controller communications.

6.10.4.23.2. Main Functions

- Pilot actions including aircraft creation/deletion, aircraft piloting, take off, landing, switch from manual to automatic piloting and transfer of aircraft to other pilots
- Pilot interface including the display of maps, tracks, command tools and message areas
- Send commands to the ATG
- Capability to handle multiple aircraft
- Performing orbits and holds
- Input speed in Knots or Mach
- Requests and display of routine reports of crossed points or triggered by events
- Request aircraft to intercept ILS or perform Visual Approach

6.10.4.23.3. External Interfaces

None.

6.10.4.23.4. Design Constraints

None.

6.10.4.24. Simulator: Supervisor Human Machine Interface CSCI (JLDR)

6.10.4.24.1. Purpose

The purpose of the JLDR CSCI is to provide human machine interface between supervising positions (exercise or session leader, pilot) and the training system in order to manage a session and to manage exercises played during the session.

6.10.4.24.2. Main Functions

- Sectorisation of airspace
- Simulation of degraded modes
- Allocation of (CWP & PILOT) positions to groups for exercise execution
- Modification of the status of recording and/or archiving for the designated group
- Exercise leader commands including starting/ freezing/ replaying/ restarting/ speeding-up/ slowing down/ stopping of an exercise, and simulated start/stop of radar, ADS-B
- Leader interface including the display of exercise information, command tools and message areas
- Send commands to the ATG

6.10.4.24.3. External Interfaces

None.

6.10.4.24.4. Design Constraints

None

6.10.4.25. Plot Track Generator CSCI (PTG)

6.10.4.25.1. Purpose

The purpose of the Plot Track Generator CSCI is to generate radar and ADS-B Tracks as an input for testing ATC functions such as primary and secondary tracking as well as multi radar tracking and display.

6.10.4.25.2. Main Functions

- Generate ADS-B and radar tracks
- Simulates radar detection characteristics of aircraft movement, clutter and weather information.
- Output is formatted according to the standard tracking format.

6.10.4.25.3. External Interfaces

None.

6.10.4.25.4. Design Constraints

None.

6.10.4.26.

6.10.4.27. Automatic External Message Simulator CSCI (AEMS)

6.10.4.27.1. Purpose

The purpose of the Automatic External Message Simulator (AEMS) is to test flight plans. All messages sent to the ATC centre, as well as those received by the centre can be handled with AEMS. Communication between the simulator and the flight plan process is made either via IPC or front processor links. Messages are sent to the flight plan function instantaneously or grouped in disk files in order to play predefined scenarios without direct human interaction. Messages emitted by the flight plan function shall be stored in files to allow an offline viewing.

6.10.4.27.2. Main Functions

Simulated messages belong to three classes:

- AFTN ICAO format messages either in reception
- AIDC ICAO format messages either in reception of emission
- Specific meteo messages in emission

6.10.4.27.3. External Interfaces

None.

6.10.4.27.4. Design Constraints

None.

6.10.4.28. Simulator: Air Traffic Generator CSCI (ATG)

6.10.4.28.1. Purpose

The purpose of the ATG CSCI is to provide simulated data for the other CSCIs in the training system and to provide means for controlling exercises and simulated tracks.

6.10.4.28.2. Main Functions

- Flight and track Creation
- Flight Plan messages generation
- Wind data generation
- Aircraft simulation
- Simulated QNH changes
- Pilot report generation
- Radar data handling in ASTERIX format (categories 01, 02, 34 and 48)
- Radar weather data generation in ASTERIX format (category 08)
- ADS-B Data handling in ASTERIX format (category 21)
- ADS-C Data and reports handling
- CPDLC message handling
- AIF data handling
- Simulation control (including subsystems)
- Air Situation Restart
- Time management
- Handle received commands from exercise leader, session leader or pilots
- Send messages to pilot or leader (Requests and reports)
- Handle several exercises in parallel

6.10.4.28.3. External Interfaces

None

6.10.4.28.4. Design Constraints

None

6.10.4.30. Data Preparation CSCI (DPR)

6.10.4.30.1. Purpose

The purpose of the DPR CSCI is to provide a means for preparing and distributing system parameters for the TopSky - ATC system. These parameters comprise “data” as well as graphic maps.

The DPR CSCI manages different sets of static data for all CSCIs except for the ASPB CSCI.

6.10.4.31. Main Functions

1. System parameters Preparation

- Management of menus, according to the current dialogue sequence
- Management of the graphic interface specific to graphic maps handling
- Syntactic and semantic checking to prevent database inconsistencies

A complete parameter configuration for the ACC is called a data “set”. It is composed of the following data:

- Aircraft performance
- Characteristic points
- Airports with runways
- Airways
- SID
- STAR
- Flight categories
- Meteorological grid definition
- QNH areas
- Graphic maps
- MSTP parameters
- FDP parameters
- HMI parameters
- AIF parameters
- RPL file
- Alerts

Data sets in the simulator partition correspond to exercises. In addition to the above parameters, they comprise the following:

- Exercise parameters
- Exercise parameters
- ATG parameters

  DPR ensures the consistency of each data set with respect to the relationships between the data items.

- Management of data sets

  The DPR database is composed of several independent sets. A whole set can be duplicated or removed.

2. Radar Mosaic Generation

3. **Printing of prepared data:**
    - Conflict inhibition zones
    - Maps
    - MSAW, DAIW areas
    - QNH areas
    - Radar mosaic
    - Radar positions
    - Sector volumes
4. **Maps generation**
5. **Repetitive Flight Plans Preparation**
6. **System Parameter Delivery and Utilization**
    - System parameter file generation for the CSCIs of the system
    - A specific process extracts from a designated set the data necessary and generates the system parameter files to be used by each CSCI.
    - System parameter file distribution
    - All the system parameter files are generated from the same set and are distributed to relevant CSCIs
    - One exception is RPL: RPL files can be transmitted separately from the other system parameter files.
    - AIF Graphic Data Preparation
7. **Backup and Recovery**

6.10.4.31.1. External Interfaces

None

6.10.4.31.2. Design Constraints

None.

6.10.4.32. Java Assisted Data Analysis Environment CSCI (JADE)

6.10.4.32.1. Purpose

The purpose of the JADE CSCI is to provide statistical data analysis capability and pre-billing data processing. JADE is part of the Data Base Management System of the TopSky - ATC system and is accessible by users through a standard web browser.

6.10.4.32.2. Main Functions

1. **Data Selection for Analysis:**
    - Data downloading
      To download data recorded by the REC and processed by the ODXP CSCI from REC node disk or from removable media (from SERVLAN or locally) onto the local disk of the DBM node.
    - Data pre-selection
      To handle JADE database loading with specific categories among the downloaded data (e.g., system tracks and/or flight plans and/or warnings).
2. **Data Selection for Statistics and Billing File Generation:**
    - Requires “Data downloading” (see item above) to be performed
3. **Statistics Calculation**
4. **Billing File Generation**
5. **Data Analysis**
    - Handles retrieval in JADE database of data corresponding to various criteria. Both predefined and user defined queries are available:

      - Statistical reports.

      - Traffic reports.

      - System environmental reports.

      - Statistical system environmental report.

      - Output reports definition.

      - Data collection and transmission for billing purposes

6.10.4.32.3. External Interfaces

None.

6.10.4.32.4. Design Constraints

None.

6.10.4.33. Display Analysis and Replay Tool CSCI (DART)

6.10.4.33.1. Purpose

The purpose of the Display Analysis and Replay Tool is to visualize aerial situations, and to analyse alerts generated by an alert server.

6.10.4.33.2. Main Functions

The DART CSCI shall perform the following functions:

1. Display tracks/plots data coming from different sources.
2. Display alert data, from different sources, related to these tracks/plots.
3. Extrapolate chosen aerial positions with a chosen extrapolation hypothesis.
4. Launch an alert server in bench mode with chosen tracks data and offline, gather the results, and compare them with reference data.
5. Edit an alert server offline.

6.10.4.33.3. External Interfaces

None.

6.10.4.33.4. Design Constraints

None.

6.10.4.34. Exact HMI Recording CSCI (EHMIR)

6.10.4.34.1. Purpose

To record and replay the graphical image generated by the graphics card of the display processor for display on the operator position screen.

6.10.4.34.2. Main Functions

Frame grabbing, which represents the screen capture activity, at a given sampling rate.

Screen image data encoding/decoding, in a dedicated movie format that comprises static compression of individual frames but also dynamic compression of successive frames, through a differential algorithm, in order to provide high compression ratios.

- Recording and Playback API, that provides services similar to videotape or movie players and recorders.
- Transfer of local recorded data from operator positions for playback purposes.

6.10.4.34.3. External Interfaces

None.

6.10.4.34.4. Design Constraints

The EHMIR limitations are as follows:

- The AVI conversion can only be performed on a MS-Windows PC via the stand-alone EHMIR Player.
- The AVI conversion module has only been qualified for records issued a CWP running the TopSky-ATC MMI i.e. in a different graphical environment than TopSky - ATC (PseudoColor + Overlays vs. TrueColor).
- The resulting AVI files are big in size (about 20 times bigger than EHMIR records), therefore conversion should be limited to a maximum of 300 seconds of recording (EHMIR offline defined configuration parameter).
- The AVI files use the MPEG4 video codec, which is lossy. As a result, video might blurry and some colours might not be rendered exactly as they appeared at the time of recording.

6.10.4.35. Maestro Arrival Manager CSCI (AMAN)

6.10.4.35.1. Purpose

The Arrival Manager (AMAN) CSCI provides the following functions:

- Aircraft sequences for flow management purposes at a specific airport
- HMI functions for the Maestro Arrival Manager hosted TopSky - ATC CWPs.
- Record and Replay function, Hot Standby redundancy management and Supervision
- Offline Data management

Note: AMAN is an external system, which is integrated within TopSky - ATC.

6.10.4.35.2. Main Functions

- Aircraft sequence creation
- HMI interface
- Replay capability with TopSky - ATC synchronisation
- Hot Standby Redundancy handling

6.10.4.35.3. External Interfaces

None.

6.10.4.35.4. Design Constraints

None.

6.10.5. CSCI – HWCI Allocation

6.10.5.1. Operational Systems

6.10.5.1.1. Manila A and B Servers

Table 15 Manila A and B Servers - CSCI and COTS Mapping per HWCI

HWCI function	CSCIs	SYSMNG CSCI_NAME	SYSMNG 1 (OPS) CSCI_NUMBER	Other Software Items
OPS (A Servers)				
FDP-A	FDP	TBD	TBD	UBSS, SYSMNG, TMH
AGP- A	AGDP	TBD	TBD	UBSS, SYSMNG, TMH
AWS	AWOS	TBD	TBD	UBSS, SYSMNG, TMH
ASP-01	ASPB IODE	TBD	TBD	UBSS, SYSMNG, TMH
CDP-A	CDP	TBD	TBD	UBSS, SYSMNG, TMH
SGW-A	ADSB-FP	TBD	TBD	UBSS, SYSMNG, TMH
AMA-A	AMAN	TBD	TBD	UBSS, SYSMNG, TMH
FCP-A	FPCF SAP	TBD	TBD	UBSS, SYSMNG, TMH
SNM-A	SNMAP	TBD	TBD	UBSS, SYSMNG, TMH
REC-A	REC	TBD	TBD	UBSS, SYSMNG, TMH
MST- A	MSTS ADSB-FP QNH	TBD	TBD	UBSS, SYSMNG, TMH
OPS (B Servers)				
FDP-B	FDP	TBD	TBD	UBSS, SYSMNG, TMH
AGP-B	AGDP	TBD	TBD	UBSS, SYSMNG, TMH
CDP-B	CDP	TBD	TBD	UBSS, SYSMNG, TMH
AMA-B	AMAN	TBD	TBD	UBSS, SYSMNG, TMH
FCP-B	FPCF SAP	TBD	TBD	UBSS, SYSMNG, TMH
SNM-B	SNMAP	TBD	TBD	UBSS, SYSMNG, TMH
REC-B	REC	TBD	TBD	UBSS, SYSMNG, TMH

HWCI function	CSCIs	SYSMNG CSCI_NAME	SYSMNG 1 (OPS) CSCI_NUMBER	Other Software Items
SGW-B	ADSB-FP	TBD	TBD	UBSS, SYSMNG, TMH
MST-B	MSTS ADSB-FP QNH	TBD	TBD	UBSS, SYSMNG, TMH
Bypass				
AFP	ADSB-FP	TBD	TBD	UBSS, SYSMNG, TMH
RTP	RTP	TBD	TBD	UBSS, SYSMNG, TMH
MTP	MSTP	TBD	TBD	UBSS, SYSMNG, TMH
AMP	ADSB-TP	TBD	TBD	UBSS, SYSMNG, TMH

Note: (*)RADAR-FP CSCs are part of MSTS CSCI

6.10.5.1.2. NAIA Remote Tower

Table 16 NAIA Remote Tower - Server CSCI and COTS Mapping per HWCI

HWCI function	CSCIs	SYSMNG CSCI_NAME	SYSMNG (OPS) CSCI_NUMBER	Other Software Items
OPS (A Servers)				
RTP	RTP	RTP	TBD	UBSS, SYSMNG, TMH
REC	CDP REC	REC CDP	TBD	UBSS, SYSMNG, TMH

6.10.5.1.3. Clark Remote Tower

Table 17 Clark Remote Tower - Server CSCI and COTS Mapping per HWCI

HWCI function	CSCIs	SYSMNG CSCI_NAME	SYSMNG (OPS) CSCI_NUMBER	Other Software Items
OPS (A Servers)				
RTP	RTP	RTP	TBD	UBSS, SYSMNG, TMH
REC	CDP REC	REC CDP	TBD	UBSS, SYSMNG, TMH

6.10.5.1.4. Kalibo Remote Tower

Table 18 Kalibo Remote Tower - Server CSCI and COTS Mapping per HWCI

HWCI function	CSCIs	SYSMNG CSCI_NAME	SYSMNG (OPS) CSCI_NUMBER	Other Software Items
OPS (A Servers)				
RTP	RTP	RTP	TBD	UBSS, SYSMNG, TMH
REC	CDP REC	REC CDP	TBD	UBSS, SYSMNG, TMH

6.10.5.1.5. Iloilo Remote Tower

Table 19 Iloilo Remote Tower - Server CSCI and COTS Mapping per HWCI

HWCI function	CSCIs	SYSMNG CSCI_NAME	SYSMNG (OPS) CSCI_NUMBER	Other Software Items
OPS (A Servers)				
RTP	RTP	RTP	TBD	UBSS, SYSMNG, TMH
REC	CDP REC	REC CDP	TBD	UBSS, SYSMNG, TMH

6.10.5.1.6. Mactan Remote Tower

Table 20 Mactan Remote Tower - Server CSCI and COTS Mapping per HWCI

HWCI function	CSCIs	SYSMNG CSCI_NAME	SYSMNG (OPS) CSCI_NUMBER	Other Software Items
OPS (A Servers)				
RTP	RTP	RTP	TBD	UBSS, SYSMNG, TMH
REC	CDP REC	REC CDP	TBD	UBSS, SYSMNG, TMH

6.10.5.1.7. Bacolod Remote Tower

Table 21 Bacolod Remote Tower - Server CSCI and COTS Mapping per HWCI

HWCI function	CSCIs	SYSMNG CSCI_NAME	SYSMNG (OPS) CSCI_NUMBER	Other Software Items
OPS (A Servers)				
RTP	RTP	RTP	TBD	UBSS, SYSMNG, TMH
REC	CDP REC	REC CDP	TBD	UBSS, SYSMNG, TMH

6.10.5.1.8. Davao Remote Tower

Table 22 NAIA Remote Tower - Server CSCI and COTS Mapping per HWCI

HWCI function	CSCIs	SYSMNG CSCI_NAME	SYSMNG (OPS) CSCI_NUMBER	Other Software Items
OPS (A Servers)				
RTP	RTP	RTP	TBD	UBSS, SYSMNG, TMH
REC	CDP REC	REC CDP	TBD	UBSS, SYSMNG, TMH

6.10.5.1.9. Caticlan Remote Tower

Table 23 NAIA Remote Tower - Server CSCI and COTS Mapping per HWC

HWCI function	CSCIs	SYSMNG CSCI_NAME	SYSMNG (OPS) CSCI_NUMBER	Other Software Items
OPS (A Servers)				
RTP	RTP	RTP	TBD	UBSS, SYSMNG, TMH
REC	CDP REC	REC CDP	TBD	UBSS, SYSMNG, TMH

6.10.5.1.10. OPS CWPs

6.10.5.1.10.1 Manila A

Table 24 Manila - CWP CSCI and COTS Mapping per HWCI

HWCI Function	CSCIs	SYSMNG CSCI_NAME	SYSMNG 1 (OPS) CSCI_NUMBER	Node Name (Host Name)	Physical Position (PPos)	Other Software Items
OPS (A Servers)						
FDO	JHMI	MMI	TBD	MNOPFDO01LI	TBD	UBSS, SYSMNG, TMH, java, Ace, Jogle, EHMIR
	JHMI	MMI	TBD	MNOPFDO02LI	TBD	UBSS, SYSMNG, TMH, java, Ace, Jogle, EHMIR
TKSUP	TKSUP	MMI	TBD	MNOPTKS01LI	TBD	UBSS, SYSMNG, TMH, java, Ace, Jogle, EHMIR
	TKSUP	TBD	TBD	MNOPTKS02LI	TBD	UBSS, SYSMNG, TMH, java, Ace, Jogle, EHMIR
	TKSUP	TBD	TBD	MNOPTKS03LI	TBD	UBSS, SYSMNG, TMH, java, Ace, Jogle, EHMIR
ATFM	FLP	PLP	TBD	MNOPAFM01LI	TBD	UBSS, SYSMNG, TMH, java, Ace, Jogle, EHMIR
ASM	JHMI	MMI	TBD	MNOPASM01LI	TBD	UBSS, SYSMNG, TMH, java, Ace, Jogle, EHMIR
WSUP	JHMI	MMI	TBD	MNOPWSP01LI	TBD	UBSS, SYSMNG, TMH, java, Ace, Jogle, EHMIR
	JHMI	MMI	TBD	MNOPWSP02LI	TBD	UBSS, SYSMNG, TMH, java, Ace, Jogle, EHMIR
EXE	JHMI	MMI	TBD	MNOPEXC01LI	TBD	UBSS, SYSMNG, TMH, java, Ace, Jogle, EHMIR
	JHMI	MMI	TBD	MNOPEXC02LI	TBD	UBSS, SYSMNG, TMH, java, Ace, Jogle, EHMIR
	JHMI	MMI	TBD	MNOPEXC03LI	TBD	UBSS, SYSMNG, TMH, java, Ace, Jogle, EHMIR
	JHMI	MMI	TBD	MNOPEXC04LI	TBD	UBSS, SYSMNG, TMH, java, Ace, Jogle, EHMIR
	JHMI	MMI	TBD	MNOPEXC05LI	TBD	UBSS, SYSMNG, TMH, java, Ace, Jogle, EHMIR

HWCI Function	CSCIs	SYSMNG CSCI_NAME	SYSMNG 1 (OPS) CSCI_NUMBER	Node Name (Host Name)	Physical Position (PPos)	Other Software Items
	JHMI	MMI	TBD	MNOPEXC06LI	TBD	UBSS, SYSMNG, TMH, java, Ace, Jogle, EHMIR
	JHMI	MMI	TBD	MNOPEXC07LI	TBD	UBSS, SYSMNG, TMH, java, Ace, Jogle, EHMIR
	JHMI	MMI	TBD	MNOPEXC08LI	TBD	UBSS, SYSMNG, TMH, java, Ace, Jogle, EHMIR
	JHMI	MMI	TBD	MNOPEXC09LI	TBD	UBSS, SYSMNG, TMH, java, Ace, Jogle, EHMIR
	JHMI	MMI	TBD	MNOPEXC10LI	TBD	UBSS, SYSMNG, TMH, java, Ace, Jogle, EHMIR
	JHMI	MMI	TBD	MNOPEXC11LI	TBD	UBSS, SYSMNG, TMH, java, Ace, Jogle, EHMIR
	JHMI	MMI	TBD	MNOPEXC12LI	TBD	UBSS, SYSMNG, TMH, java, Ace, Jogle, EHMIR
	JHMI	MMI	TBD	MNOPEXC13LI	TBD	UBSS, SYSMNG, TMH, java, Ace, Jogle, EHMIR
	JHMI	MMI	TBD	MNOPEXC14LI	TBD	UBSS, SYSMNG, TMH, java, Ace, Jogle, EHMIR
	JHMI	MMI	TBD	MNOPEXC15LI	TBD	UBSS, SYSMNG, TMH, java, Ace, Jogle, EHMIR
	JHMI	MMI	TBD	MNOPEXC16LI	TBD	UBSS, SYSMNG, TMH, java, Ace, Jogle, EHMIR
PLC	JHMI	MMI	TBD	MNOPPLC01LI	TBD	UBSS, SYSMNG, TMH, java, Ace, Jogle, EHMIR
	JHMI	MMI	TBD	MNOPPLC02LI	TBD	UBSS, SYSMNG, TMH, java, Ace, Jogle, EHMIR
	JHMI	MMI	TBD	MNOPPLC03LI	TBD	UBSS, SYSMNG, TMH, java, Ace, Jogle, EHMIR
	JHMI	MMI	TBD	MNOPPLC04LI	TBD	UBSS, SYSMNG, TMH, java, Ace, Jogle, EHMIR
	JHMI	MMI	TBD	MNOPPLC05LI	TBD	UBSS, SYSMNG, TMH, java, Ace, Jogle, EHMIR
	JHMI	MMI	TBD	MNOPPLC06LI	TBD	UBSS, SYSMNG, TMH, java, Ace, Jogle, EHMIR

HWCI Function	CSCIs	SYSMNG CSCI_NAME	SYSMNG 1 (OPS) CSCI_NUMBER	Node Name (Host Name)	Physical Position (PPos)	Other Software Items
	JHMI	MMI	TBD	MNOPPLC07LI	TBD	UBSS, SYSMNG, TMH, java, Ace, Jogle, EHMIR
	JHMI	MMI	TBD	MNOPPLC08LI	TBD	UBSS, SYSMNG, TMH, java, Ace, Jogle, EHMIR
	JHMI	MMI	TBD	MNOPPLC09LI	TBD	UBSS, SYSMNG, TMH, java, Ace, Jogle, EHMIR
	JHMI	MMI	TBD	MNOPPLC10LI	TBD	UBSS, SYSMNG, TMH, java, Ace, Jogle, EHMIR
	JHMI	MMI	TBD	MNOPPLC11LI	TBD	UBSS, SYSMNG, TMH, java, Ace, Jogle, EHMIR
	JHMI	MMI	TBD	MNOPPLC12LI	TBD	UBSS, SYSMNG, TMH, java, Ace, Jogle, EHMIR
	JHMI	MMI	TBD	MNOPPLC13LI	TBD	UBSS, SYSMNG, TMH, java, Ace, Jogle, EHMIR
	JHMI	MMI	TBD	MNOPPLC14LI	TBD	UBSS, SYSMNG, TMH, java, Ace, Jogle, EHMIR
	JHMI	MMI	TBD	MNOPPLC15LI	TBD	UBSS, SYSMNG, TMH, java, Ace, Jogle, EHMIR
	JHMI	MMI	TBD	MNOPPLC16LI	TBD	UBSS, SYSMNG, TMH, java, Ace, Jogle, EHMIR
EXC (Spare)	JHMI	MMI	TBD	MNOPEXC17LI	TBD	UBSS, SYSMNG, TMH, java, Ace, Jogle, EHMIR
	JHMI	MMI	TBD	MNOPEXC18LI	TBD	UBSS, SYSMNG, TMH, java, Ace, Jogle, EHMIR
TKSUP	TKSUP	TBD	TBD	MNOPTKS02LI	TBD	UBSS, SYSMNG, TMH, java, Ace, Jogle, EHMIR
BRF	JHMI	MMI	TBD	MNOPBRF01LI	TBD	UBSS, SYSMNG, TMH, java, Ace, Jogle, EHMIR
AMS	JHMI	MMI	TBD	MNOPAMS01LI	TBD	UBSS, SYSMNG, TMH, java, Ace, Jogle, EHMIR
	JHMI	MMI	TBD	MNOPAMS02LI	TBD	UBSS, SYSMNG, TMH, java, Ace, Jogle, EHMIR
FSS	JHMI	MMI	TBD	MNOPFSS01LI	TBD	UBSS, SYSMNG, TMH, java, Ace, Jogle, EHMIR

HWCI Function	CSCIs	SYSMNG CSCI_NAME	SYSMNG 1 (OPS) CSCI_NUMBER	Node Name (Host Name)	Physical Position (PPos)	Other Software Items
	JHMI	MMI	TBD	MNOPFSS01LI	TBD	UBSS, SYSMNG, TMH, java, Ace, Jogle, EHMIR
MON	JHMI	MMI	TBD	MNOPMON01LI	TBD	UBSS, SYSMNG, TMH, java, Ace, Jogle, EHMIR
DBM	DART DPR JADE	MMI	TBD	MNOPDBM01LI	TBD	UBSS, SYSMNG, TMH, java, Ace, Jogle, EHMIR
JADE	JADE	TBD	TBD	MNOPJDE01LI	TBD	UBSS, SYSMNG, TMH, java, Ace, Jogle

6.10.5.1.10.2 NAIA Remote Tower

Table 25 NAIA Remote Tower - CWP CSCI and COTS Mapping per HWCI

HWCI Function	CSCIs	SYSMNG CSCI_NAME	SYSMNG 1 (OPS) CSCI_NUMBER	Node Name (Host Name)	Physical Position (PPos)	Other Software Items
OPS (A Servers)						
TWR-EC	JHMI	MMI	TBD	NIRTTWR01LI	TBD	UBSS, SYSMNG, TMH, java, Ace, Jogle, EHMIR
	JHMI	MMI	TBD	NIRTTWR02LI	TBD	UBSS, SYSMNG, TMH, java, Ace, Jogle, EHMIR

6.10.5.1.10.3 Clark Remote Tower

Table 26 Clark Remote Tower - CWP CSCI and COTS Mapping per HWCI

HWCI Function	CSCIs	SYSMNG CSCI_NAME	SYSMNG 1 (OPS) CSCI_NUMBER	Node Name (Host Name)	Physical Position (PPos)	Other Software Items
OPS (A Servers)						
TWR-EC	JHMI	MMI	TBD	CRRTTWR01LI	TBD	UBSS, SYSMNG, TMH, java, Ace, Jogle, EHMIR

6.10.5.1.10.4 Kalibo Remote Tower

Table 27 Kalibo Remote Tower - CWP CSCI and COTS Mapping per HWCI

HWCI Function	CSCIs	SYSMNG CSCI_NAME	SYSMNG 1 (OPS) CSCI_NUMBER	Node Name (Host Name)	Physical Position (PPos)	Other Software Items
OPS (A Servers)						
TWR-EC	JHMI	MMI	TBD	KLRTTWR01LI	TBD	UBSS, SYSMNG, TMH, java, Ace, Jogle, EHMIR

6.10.5.1.10.5 Iioilo Remote Tower

Table 28 Iioilo Remote Tower - CWP CSCI and COTS Mapping per HWCI

HWCI Function	CSCIs	SYSMNG CSCI_NAME	SYSMNG 1 (OPS) CSCI_NUMBER	Node Name (Host Name)	Physical Position (PPos)	Other Software Items
OPS (A Servers)						
TWR-EC	JHMI	MMI	TBD	ILRTTWR01LI	TBD	UBSS, SYSMNG, TMH, java, Ace, Jogle, EHMIR

6.10.5.1.10.6 Mactan Remote Tower

Table 29 Iioilo Remote Tower - CWP CSCI and COTS Mapping per HWCI

HWCI Function	CSCIs	SYSMNG CSCI_NAME	SYSMNG 1 (OPS) CSCI_NUMBER	Node Name (Host Name)	Physical Position (PPos)	Other Software Items
OPS (A Servers)						
TWR-EC	JHMI	MMI	TBD	CERTTWR01LI	TBD	UBSS, SYSMNG, TMH, java, Ace, Jogle, EHMIR
	JHMI	MMI	TBD	CERTTWR02LI	TBD	UBSS, SYSMNG, TMH, java, Ace, Jogle, EHMIR

6.10.5.1.10.7 Bacolod Remote Tower

Table 30 Bacolod Remote Tower - CWP CSCI and COTS Mapping per HWCI

HWCI Function	CSCIs	SYSMNG CSCI_NAME	SYSMNG 1 (OPS) CSCI_NUMBER	Node Name (Host Name)	Physical Position (PPos)	Other Software Items
OPS (A Servers)						
TWR-EC	JHMI	MMI	TBD	BCRTTWR01LI	TBD	UBSS, SYSMNG, TMH, java, Ace, Jogle, EHMIR

6.10.5.1.10.8 Davao Remote Tower

Table 31 Bacolod Remote Tower - CWP CSCI and COTS Mapping per HWCI

HWCI Function	CSCIs	SYSMNG CSCI_NAME	SYSMNG 1 (OPS) CSCI_NUMBER	Node Name (Host Name)	Physical Position (PPos)	Other Software Items
OPS (A Servers)						
TWR-EC	JHMI	MMI	TBD	DVRTTWR01LI	TBD	UBSS, SYSMNG, TMH, java, Ace, Jogle, EHMIR

6.10.5.1.10.9 Caticlan Remote Tower

Table 32 Caticlan Remote Tower - CWP CSCI and COTS Mapping per HWCI

HWCI Function	CSCIs	SYSMNG CSCI_NAME	SYSMNG 1 (OPS) CSCI_NUMBER	Node Name (Host Name)	Physical Position (PPos)	Other Software Items
OPS (A Servers)						
TWR-EC	JHMI	MMI	TBD	MPRTTWR01LI	TBD	UBSS, SYSMNG, TMH, java, Ace, Jogle, EHMIR

6.10.5.2. Simulator And Training Systems

6.10.5.2.1. Manila Training and Evaluation System (TES) Servers

Table 33 Manila TES (SIM) - Server CSCI and COTS Mapping per HWCI

HWCI function/Node	CSCIs	SYSMNG CSCI_NAME	SYSMNG 1 (OPS) CSCI_NUMBER	Other Software Items
PDG-01	FDP ADGP QNH ADSB-FP MSTS JLDR FPCF SAP AMAN ATG SNMAP REC ASPB	FDP AGP QNH AFP MST JLDR FCP SAP AMAN ATG SNM REC ASPB	TBD TBD TBD TBD TBD TBD TBD TBD TBD TBD TBD TBD TBD	UBSS, SYSMNG, TMH, java
PDG-02	TBD TBD MSTP TBD	AFB AMB MTP RBP	TBD TBD TBD TBD	UBSS, SYSMNG, TMH, java

HWCI function/Node	CSCIs	SYSMNG CSCI_NAME	SYSMNG 1 (OPS) CSCI_NUMBER	Other Software Items
FDP-01	FDP	FDP	TBD	UBSS, SYSMNG, TMH, java
	ADGP	AGP	TBD	
	QNH	QNH	TBD	
	ADSB-FP	AFP	TBD	
	MSTS	MST	TBD	
	JLDR	JLDR	TBD	
	FPCF	FCP	TBD	
	SAP	SAP	TBD	
	AMAN	AMAN	TBD	
	ATG	ATG	TBD	
	SNMAP	SNM	TBD	
	REC	REC	TBD	
	ASPB	ASPB	TBD	
AGP-01	TBD	AFB	TBD	UBSS, SYSMNG, TMH, java
	TBD	AMB	TBD	
	MSTP	MTP	TBD	
	TBD	RBP	TBD	
MST-01	FDP	FDP	TBD	UBSS, SYSMNG, TMH, java
	ADGP	AGP	TBD	
	QNH	QNH	TBD	
	AFP	AFP	TBD	
	MSTS	MST	TBD	
	JLDR	JLDR	TBD	
	FPCF	FCP	TBD	
	SAP	SAP	TBD	
	AMAN	AMAN	TBD	
	ATG	ATG	TBD	
	SNMAP	SNM	TBD	
	REC	REC	TBD	
	ASPB	ASPB	TBD	
SGW-01	TBD	AFB	TBD	UBSS, SYSMNG, TMH, java
	TBD	AMB	TBD	
	MSTP	MTP	TBD	
	TBD	RBP	TBD	
EXE-01	FDP	FDP	TBD	UBSS, SYSMNG, TMH, java
	ADGP	AGP	TBD	
	QNH	QNH	TBD	
	ADSB-FP	AFP	TBD	
	MSTS	MST	TBD	
	JLDR	JLDR	TBD	
	FPCF	FCP	TBD	
	SAP	SAP	TBD	
	AMAN	AMAN	TBD	
	ATG	ATG	TBD	
	SNMAP	SNM	TBD	
	TEC	REC	TBD	
	ASPB	ASPB	TBD	

HWCI function/Node	CSCIs	SYSMNG CSCI_NAME	SYSMNG 1 (OPS) CSCI_NUMBER	Other Software Items
EXE-02	TBD TBD MSTP TBD	AFB AMB MTP RBP	TBD TBD TBD TBD	UBSS, SYSMNG, TMH, java
EXE-03	FDP ADGP QNH ADSB-FP MSTS JLDR FPCF SAP AMAN ATG SNMAP REC ASPB	FDP AGP QNH AFP MST JLDR FCP SAP AMAN ATG SNM REC ASPB	TBD TBD TBD TBD TBD TBD TBD TBD TBD TBD TBD TBD TBD	UBSS, SYSMNG, TMH, java
EXE-04	TBD TBD MSTP TBD	AFB AMB MTP RBP	TBD TBD TBD TBD	UBSS, SYSMNG, TMH, java

Note: (*)RADAR-FP and CSCs are part of MSTS CSCI

Note: (*)TBD to be updated at installation

6.10.5.2.2. Manila Training and Evaluation System (TES) CWPs

Table 34 Manila TES (SIM) - CWP CSCI and COTS Mapping per HWCI

HWCI Function	CSCIs	SYSMNG CSCI_NAME	SYSMNG 1 (OPS) CSCI_NUMBER	Node Name (Host Name)	Physical Position (PPos)	Other Software Items
EED	EED	EED	TBD	MNTEEED01LI	TBD	UBSS, SYSMNG
DBM	DPR	DPR	TBD	MNTEDBM01LI	TBD	UBSS, SYSMNG
TKSUP	TBD	TBD	TBD	MNTETKS01LI	TBD	UBSS, SYSMNG
WSUP	JLDR	JLDR		MNTEWSP01LI	TBD	UBSS, SYSMNG
EC	JHMI	MMI	TBD	MNTEEXC01LI	TBD	UBSS, SYSMNG
				MNTEEXC02LI	TBD	UBSS, SYSMNG
				MNTEEXC03LI	TBD	UBSS, SYSMNG
				MNTEEXC04LI	TBD	UBSS, SYSMNG
PLC	JHMI	MMI	TBD	MNTEPLC01L	TBD	UBSS, SYSMNG
				MNTEPLC01L	TBD	UBSS, SYSMNG
				MNTEPLC01L	TBD	UBSS, SYSMNG
				MNTEPLC01L	TBD	UBSS, SYSMNG

HWCI Function	CSCIs	SYSMNG CSCI_NAME	SYSMNG 1 (OPS) CSCI_NUMBER	Node Name (Host Name)	Physical Position (PPos)	Other Software Items
PIL	JPIL	PIL	TBD	MNTEPIL01LI	TBD	UBSS, SYSMNG
				MNTEPIL02LI	TBD	UBSS, SYSMNG
				MNTEPIL03LI	TBD	UBSS, SYSMNG
				MNTEPIL04LI	TBD	UBSS, SYSMNG
				MNTEPIL05LI	TBD	UBSS, SYSMNG
LDR	JLDR	LDR	TBD	MNTEPIL06LI	TBD	UBSS, SYSMNG

6.10.5.3. Computer Based Training (CBT) Systems

6.10.5.3.1. Computer Based Training System Servers

Table 35 CBT - Server CSCI and COTS Mapping per HWCI

HWCI function/Node	CSCIs	SYSMNG CSCI_NAME	SYSMNG 1 (OPS) CSCI_NUMBER	Other Software Items
CBT	TBD	TBD	TBD	TBD

6.10.5.3.2. Computer Based Training (CBT) System CWPs

Table 36 CBT - CWP CSCI and COTS Mapping per HWCI

HWCI Function	CSCIs	SYSMNG CSCI_NAME	SYSMNG 1 (OPS) CSCI_NUMBER	Node Name (Host Name)	Physical Position (PPos)	Other Software Items
OPS (A Servers)						
CBT	TBD	TBD	TBD	MNCTSTD01LI	TBD	TBD
				MNCTSTD02LI	TBD	
				MNCTSTD03LI	TBD	
				MNCTSTD04LI	TBD	
				MNCTSTD05LI	TBD	
				MNCTSTD06LI	TBD	
				MNCTSTD07LI	TBD	
				MNCTSTD08LI	TBD	
				MNCTSTD09LI	TBD	
				MNCTSTD10LI	TBD	
				MNCTSTD11LI	TBD	
				MNCTSTD12LI	TBD	
				MNCTSTD13LI	TBD	
				MNCTSTD14LI	TBD	
				MNCTSTD15LI	TBD	

6.10.6. Middleware

The TopSky - ATC system is designed using middleware components as described in the following chapters.

6.10.6.1. Thales Basic System Software

The Thales Basic System Software (BSS) middleware toolbox consists of the following components:

- Front Processor Basic System Software (FPBSS), managing external interfaces,
- System Modes Management software (SYSMNG), essentially managing the start-up of the system, as well as different recovery scenarios at node and system level.
- Unix Based System Software (UBSS) provides services for interfacing the application and the THALiX Operating System,
- Time Management Handling (TMH)

6.10.6.1.1. Interaction between the Basic System Software components and ATC CSCI

The ATC software is grouped into ‘run-time’ applications that can be started, stopped, monitored and failed as an atomic whole.

A run-time application can be built up from one Linux process to several Linux processes included in one or several process groups (refer to section 4.6.4 for UBSS description). This set of processes can be part of different CSCIs.

The CSCIs are mapped on to the HWCIs as defined in section 4.5.4.

A run-time application is virtually defined by means of the UBSS Configuration and managed by SYS_MNG via UBSS which provides a related link between those processes.

The following figure shows the relations between UBSS, UBSS Configuration, SYS_MNG, Linux processes and process groups.

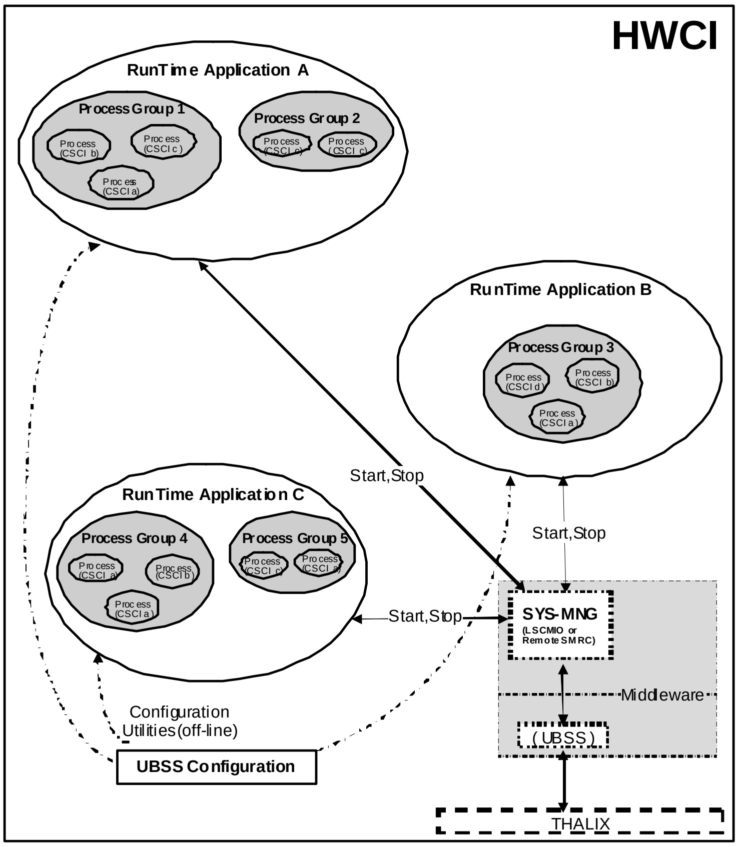


Figure 20 Relation between run-time application/UBSS/SYS_MNG

The main functions of the Thales BSS are described in the following sub-sections.

6.10.6.2. SYSMNG

An instance of this application is installed on each hardware node to manage each CSCI according to

- its environment
- The partitions
- The start-up parameters

6.10.6.3. UBSS

Thales Air Operations software is based on a Linux over-layer called UBSS (Unix Based System Software) providing all necessary services to build an ATC application. UBSS is based on Linux mechanisms that are either just interfaced in a uniform way for application use, or improved if necessary. The UBSS middleware includes a number of applications that are described briefly below (refer to Appendix 2 for more details on UBSS services).

- Basic Name Server (BNS) provides a facility to map logical symbols onto values that can be distributed in a multi-node system
- Consistent Datastore Copies (CDC) performs the management of replicated information in a multi-node system, i.e. distributed data processing by means of replicated datastores in a Local Area Network environment

- Dual Node Control (DNC) allows two nodes, connected to the same LAN, to form a redundant configuration for fault tolerant applications by assigning states to these two nodes
- Node and Process Management (NPM) controls nodes and dual nodes in a pre-defined way (start/restart, shutdown, control and monitoring of each node)
- Input/Output Calls (IOC) provides all the necessary facilities to manage files on disk or archive media, to access the files and to transfer them from one node to another
- Inter-Process Communication (IPC) handles the communication between processes in a multi-node system as transparent inter-process/inter-node point-to-point communications
- System Control and Monitoring (TKSUP) offers a facility for a technical operator to monitor and control the status of the technical part of the system from a technical operator position (status acquisition of node, processes, process groups, devices and datastore)
- Time and Clock Management (TCM) provides functionalities regarding time and clock related aspects (extensive set of time related services such as high resolution timers, different times, support for clock synchronization over node boundaries) within a network-based system

6.10.6.4. Time Management Handling – TMH

The TMH facility is used for maintaining the virtual times in all connected software items.

7. Acronyms

A

ACC	-	Area Control Centre
ADS-B	-	Automatic Dependent Surveillance - Broadcast
ADS-C	-	Automatic Dependent Surveillance - Contract
AFP	-	Automatic Dependent Surveillance Broadcast Front Processing
AFT	-	Aeronautical Fixed Telecommunication
AGDP	-	Air Ground Data Processing
AMHS	-	Air Traffic Services Message Handling System
AMS	-	Automatic Message Switch
APP	-	Approach Control
APR	-	Automatic Position Reporting
ASPB	-	Air Situation Playback
ATA	-	Actual Time of Arrival
ATC	-	Air Traffic Control
ATCC	-	Air Traffic Control Center
ATFM	-	Air Traffic Flow Management
ATG	-	Air Traffic Generator
ATM	-	Air Traffic Management
ATS	-	Air Traffic Services

B

BMS	-	Billing Management System
BNS	-	Basic Name Server
BOM	-	Bureau of Meteorology
BSS	-	Basic System Software

C

CAA	-	Civil Aviation Authority
CDC	-	Consistent Data store Copies
CDP	-	Communication Data Processing
CKB	-	Common Keyboard
CLAM	-	Cleared Level Adherence Monitoring
CMAP	-	Conformance Monitoring and Adherence Processing
CNS	-	Communication Navigation Surveillance
COTS	-	Commercial Off-The-Shelf
CPDLC	-	Controller Pilot Data Link Communication
CPU	-	Central Processing Unit
CS	-	Clock Synchronization
CSCI	-	Computer Software Configuration Item

D

D-ATIS	-	Digital Automatic Terminal Service
D-VOLMET	-	Digital Meteorological Information for Aircraft in Flight
DAIW	-	Danger Area Infringement Warning
DART	-	Display Analysis Replay Tool
DBM	-	Database Management
DC	-	Departure Clearance
DEP	-	Departure
DNC	-	Dual Node Control
DP	-	Data Processor
DPR	-	Data Preparation
DPS	-	Data Processing System
DVCSS	-	Digital Voice Communications Switching System

E		
EC	-	Executive Controller
ETI	-	External Time Injection
ETMS	-	Enhanced Traffic Management System
F		
FDO	-	Flight Data Operator
FDP	-	Flight Data Processing
FIFO	-	First In First Out
FIR	-	Flight Information Region
FLP	-	Flow Control Processing
FPASD	-	Flight Plan Air Situation Display
FPBSS	-	Front Processor Basic System Software
FPC	-	Flight Path Calculation
FPCF	-	Flight Plan Conflict Function
FPCR	-	Flight Plan Conflict Region
FPL	-	Flight Plan
FPSUP	-	Front Processor Supervision
FPT	-	Flight Plan Track
FSR	-	File Server Repository
FTP	-	File Transfer Protocol
G		
GCN	-	General Computing Network
GP	-	Geographical Point
GPS	-	Global Positioning System
GRIB	-	GRIdded Binary
H		
HMI	-	Human Machine Interface
HRT	-	High Resolution Timers
HSR	-	Hot Stand-by Redundancy
HWCI	-	Hardware Configuration Item
I		
ICAO	-	International Civil Aviation Organisation
ICD	-	Interface Control Document
IFR	-	Instrument Flight Rule
IOC	-	Input/output Calls
IPC	-	Inter Process Communication
IRS	-	Interface Requirements Specification
ISO	-	International Standards Organisation
J		
JADE	-	Java Assisted Data Analysis Environment
L		
LAN	-	Local Area Network
LCT	-	Local Control Terminal
LDR	-	Leader

M

M&C	-	Monitor and Control
MCR	-	Multiple Computation Redundancy
MLT	-	Multilateration
MOD	-	MODification
MRT	-	Multi-Radar Tracking
MSAW	-	Minimum Safe Altitude Warning
MSG	-	Message
MSTP	-	Multi Source Tracking Processing

N

NDI	-	Non-Development Item
NFS	-	Network File System
NIS	-	Network Information Service
NPM	-	Node & Process Management
NTP	-	Network time Protocol

O

OCP	-	Open Communication Processor
OCPSUP	-	Open Communication Processor Supervision
ODS	-	Operator Display Suite
ODXP	-	Operational Data eXport Processor
OPSUP	-	Operational Supervisor
OSF	-	Open Software Foundation
OSI	-	Open Systems Interconnection

P

PDC	-	Pre-Departure Clearance
PIL	-	Pilot
PILMMI	-	Pilot Human Machine Interface
PLC	-	Planner Controller
PSR	-	Primary Surveillance Radar

Q

QNH	-	Barometric air pressure (in hPa)

R

RAC	-	Radar Alert Capabilities
RADIUS	-	Remote Authentication Dial-In User Service
RAIM	-	Receiver Autonomous Integrity Monitoring
RAM	-	Route Adherence Monitoring
RBP	-	Radar Bypass Processing
RDPS	-	Radar Data Processing System (HWCI)
RDS	-	Radar Distribution System
REC	-	Recording
RMA	-	Reliability Maintainability Availability
RPL	-	Repetitive Flight Plan
RTP	-	Radar Track Processing

S

SAP	-	Segregated Airspace Probe
SCM	-	System Control & Monitoring
SDF	-	Surveillance Data Processing Function
SDU	-	Software Development Unit
SID	-	Standard Instrument Departure
SIM	-	SIMulator partition

SNAP	-	Safety Nets and Alerts Processing
SRS	-	Software Requirement Specification
SSDD	-	System Segment Design Document
SSR	-	Secondary Surveillance Radar
ST	-	Slot Time
STA	-	Scheduled Time of Arriva
STCA	-	Short Term Conflict Alert
STE	-	Stereo Plans
SUPMMI	-	Supervisor Human Machine Interface
SYSMNG	-	System Modes Management

T

TAS	-	True Air Speed
TBC	-	To Be Confirmed
TCC	-	Terminal Control Centre
TCM	-	Time and Clock Management
TCU	-	Terminal Control Unit
TFC	-	Track Flight plan Coupling
TFMS	-	Traffic Flow Management System
TM	-	Time Management
TMA	-	Terminal Manoeuvre Area
TMH	-	Time Management Handling
TMP	-	Technical Maintenance Position
TSM	-	Technical System Manager
TWR	-	Tower

U

UBSS	-	UNIX Basic System Software
UTC	-	Universal Time Coordinated

V

VFR	-	Visual Flight Rules
VGI	-	Virtual Graphic Interface
VREC	-	Voice Recorder/Replayer

W

WAN	-	Wide Area Network

ANNEX A: TRACEABILTY MATRIX

A. 1 Traceability Matrix

Refer to PH-ATM ATMS RVM.

APPENDIX A: UBSS SERVICES

A.1 Node And Process Management (NPM)

A.1.1 Main Function

The services offered by the NPM are as follows:

To Pre-process and interpret node configuration information

NPM pre-processes the Node Configuration File (NCF), describing the software content of the node, by performing syntactic and semantic checks. NPM create a complete run-time environment and start-up the processes in the way specified in the NCF. NPM introduces the concept of “process name” and of “process groups” not existing in UNIX.

The Node Configuration File contains data enabling the definition of:

- All the shared memory segments and semaphores which are used on the nodes,
- All the processes which use BSS library functions and other processes which participate in the start-up sequence of the node,
- The environment in which the processes have to run,
- A list of process names for the start-up or shutdown sequence to enable an orderly application start-up or shutdown,
- Synchronization moments during the start-up phase,
- Recovery definition specifying the action of NPM when processes stop or crash.

To control and monitor a node

to control child processes and process groups: create a process, set up its environment, terminate a process, wait for a child reply and control its state.

to control the node: execute node start, node restart, node resume, node shutdown and node stop according to the node life cycle.

To control a dual node

To handle DNC counterpart: establish a connection with the DNC counterpart, perform consistency checks on its start-up parameters during start-up phase, control the status of the DNC counterpart, broadcast the state of the node to the DNC counterpart.

To control DNC states: maintain the DNC state, report all DNC state changes to SCM, execute the switch between the node according to the quality of the nodes or the failures

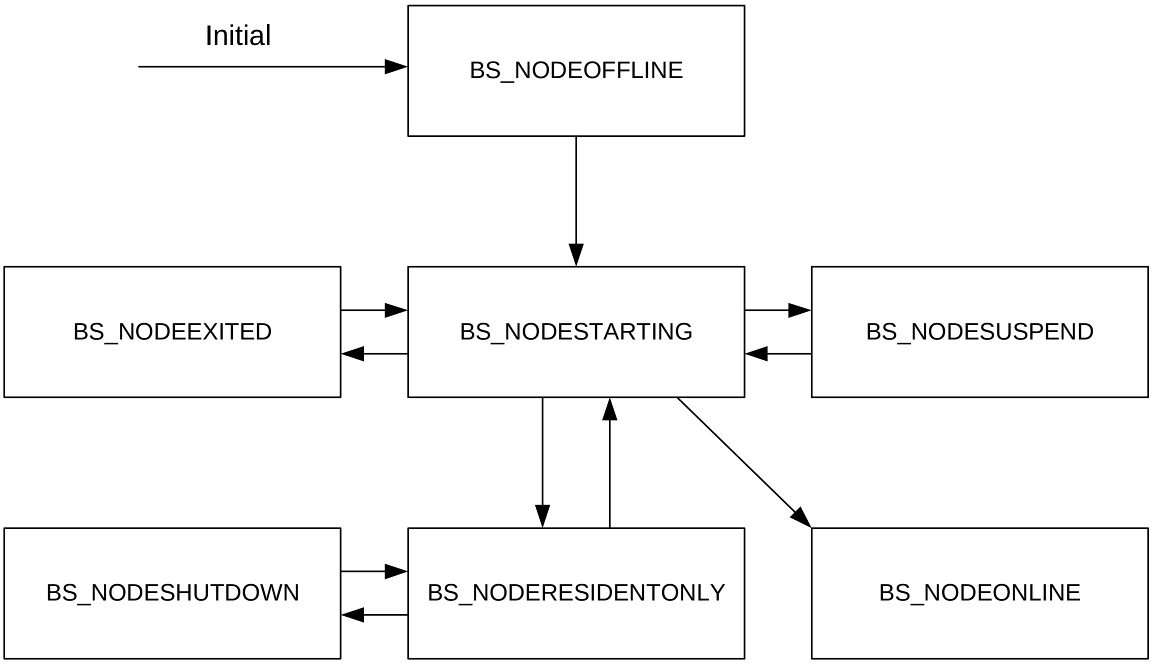


Figure 21 Node State Transition Diagram

For details about State Transitions, refer to UBSS SUM [P_04].

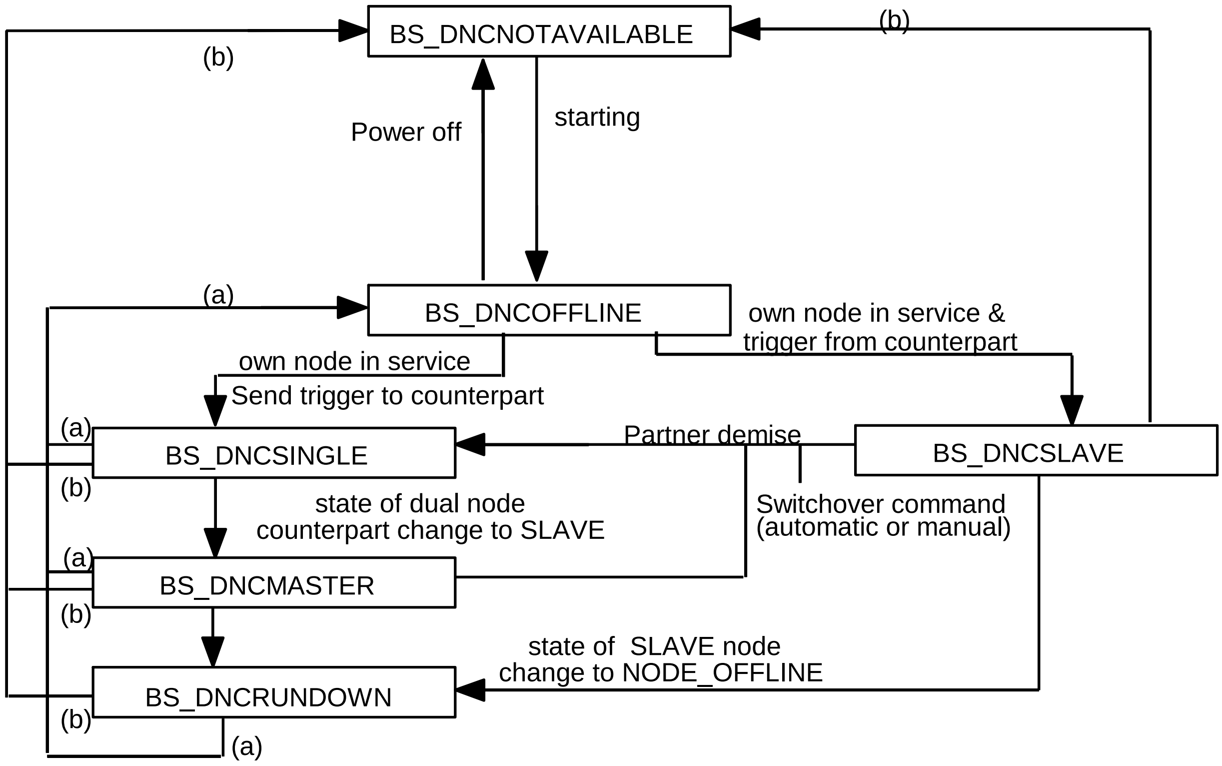


Figure 22 Dual Node State Transition Diagram

(a) No trigger from partner, no LAN connectivity, O.S. crash, or request from system.

(b) Power Off.

To evaluate Quality

- To perform quality evaluation throughout the life cycle of a node and each time the quality or a weighting factor of an item changes.
- To report the quality evaluation to the SCM.
- To stop master node if the node quality is under a predefined value or the slave value.

NPM functions request and reply

Among available functions, the following are listed:

- To subscribe to BSS: initialize the process and create its running environment.
- To exit the process: detaches the process from BSS and exits the process. The entire environment created during the initialization is then removed.
- To notify to BSS the application initialization is ready. NPM can create other processes mentioned in the node configuration file.
- To get the process identification assigned by OS at creation time.
- To get the process name corresponding to a specified process identification.
- To allocate a memory area for BSS services. This area is attached to the calling process.
- To wait for node in service. This function will not return until the node status is set to NODE_INSERVICE.
- To get process group name. This function returns the name of the group to which the named process belongs.

- Set process identification. A process under control of NPM (BSS) can specify its identification. This identification is reported to the SCM. Each time a process changes, the status is reported to the SCM.

A.1.2 Design Constraints

- NPM uses the facilities of IPC and, when needed, SCM (for processing Technical Operator commands and reporting errors).

A.2 Time And Clock Management (TCM)

A.2.1 Main Function

High Resolution Timers (HRT)

This function allows application processes to start multiple high-resolution timers and notify the application when a timer is expired. The services offered are the following:

- To start a timer with a relative time. After this relative time is elapsed, a timer expiry event is generated for a process.
- To cancel a timer: no expiration event will be generated.
- To process sleep: this function allows a process to be inactive for a given time.

Time Management

This function provides functionalities to work with different time bases. Different time bases, running with different speeds are supported:

Internal time base. The corresponding functions are the following ones:

- To get current internal time,
- To compute the difference of 2 internal times,
- To compute the addition / subtraction of an internal time and a delta,
- To compare 2 internal times.

Universal time base. The corresponding functions are as follows:

- To instantiate a universal time base,
- To reset an instantiated time base,
- To get current universal time,
- To compute the difference of 2 universal times,
- To compute the addition / subtraction of an universal time and a delta,
- To compare 2 universal times,
- To get current speed: for the standard universal time base, the speed is constant,
- To set a new speed,
- To set a new time base time,
- To set a time base to standard universal time.

Miscellaneous functions are also provided:

Timestamp / Date functions:

- To get current timestamp / date,
- To compute the difference of 2 timestamps /date,
- To compute the addition / subtraction of a timestamp / date and a delta,
- To compare 2 timestamps / dates,
- To check the validity of a date.

Conversion routines for a date or a timestamp into an universal time, week day, year day and universal time into date, weekday and year day.

A.3 Open Communication Processor Supervision (OCPSUP)

The main purpose of OCPSUP is to supervise the OCPs.

A.3.1 Main Function

The main functions performed by the OCPSUP are as follows:

- Update of the OCP state in the SCM database.
- Update of BNS items containing the SAP (Service Access Point) addresses
- Reporting of serial ports events to SCM.
- Reporting of OPEN/CLOSE line state.
- Reporting of I/O lines statistics BNS database.
- LOG messages storing. (Note: Cyclical file updates when the maximum size reached)
- Management of attach and detach of I/O lines.

A.4 Basic Name Server (BNS)

The BNS is a facility used to provide a mapping from a set of names to a set of corresponding items.

A name can be either local or global:

- A local name is known within the node. Identical local names can be used without conflict in different nodes.
- A global name is unique in a set of node where the same name server is active. In each of those nodes, the global names yield the same item.

A name can also be mapped onto an alias.

A.4.1 Main Function

The services offered by BNS are:

Set of library procedures, to perform operations

- To retrieve items of a specific local or global name,
- To modify the content of a specified name (either local or global),
- To notify the application on a change of a name,
- Transparent usage of alias name for names.

Operator interface (via SMS functions at the SMRC position)

- To initialize a BNS store: pre-processing of the name server file for testing the syntax,
- To inspect or modify the BNS stores.

System-wide distribution and processing of BNS item updates

A.4.2 Design Constraints

The BNS uses the following components:

- 1 global database (CDC store): global names are copied into the CDC datastore and distributed via the CDC datastore.
- 1 local database in each node: the BNS store for local and global names.

A.5 Inter Process Communication (IPC)

Inter Process Communication (IPC) provides point to point message transmission facilities between processes, located either on the same node, or on different nodes connected to a LAN.

A.5.1 Main Function

1. Management of incoming messages.
2. Management of out-going messages.
3. Management of events.

   An event can be either:

   - timers indicating to the user process that a certain amount of time has been elapsed,
   - timers indicating to the user process that an absolute time has been reached,
   - output streams to other FIFOS, devices or CDC stores have been performed,
   - input from files or tapes have been performed,
   - an event indicating to the IPC user process that something has happened: O.S. (THALiX) signals handling or other interrupt mechanism,
4. Debugging facilities
   - To show information on messages queues,
   - To show information on waiting process,
   - To show information on remaining free space on IPC FIFOS,
   - To inspect interactively incoming messages before their delivery,
   - To generate IPC messages interactively,
   - To intercept messages,
   - To redirect messages,
   - To show internal parts of messages data structures (actual values),
   - To retrieve statistics on messages.

A.5.2 Design Constraints

The IPC uses the facilities of the BNS tool in order to translate the logical address of a fifo into its corresponding physical address, to notify FIFO address modification and to modify the address mapping.

A.6 Input / Output Calls (IOC)

A.6.1 Main Function

The services offered by the IOC are:

1. Application interface

- Functions for general management such as:
  - File management (e.g. rename, read / modify the access rights, get file status, get current mode),
  - Directory management (e.g. change the working directory, list entries, read / modify the access rights),
  - External file management (e.g. create / delete, associate a given file to an existing external file, obtain the name that identifies the file,
  - File transfer (on tape or on disk),
  - Printer handling.
- Functions specific to byte stream file access:
  - To access a non-constrained set of bytes,
  - To access a set of bytes of fixed length,
  - To access a set of bytes terminated by a terminator.
- Functions specific to direct file access.
- Functions specific to sequential indexed file access.
- Functions specific to text file management:
  - Column, line and page management,
  - Integer, real and enumeration type management.

A.6.2 Design Constraints

The IOC uses the facilities of the IPC.

A.7 Consistent Datastore Copies (CDC)

The ATC environment leads to a distributed system concept, requiring replication of data in order to enable local processing. Furthermore, the data updates can be generated in more than one computer (this is due to operational procedures). Producers of data do not know anything about the consumers of the data.

A.7.1 Main Function

A Consistent Datastore Copy (CDC) is an implementation of an algorithm for managing replicated information on several nodes: the CDC is a service supporting the concept of subscription to data. The elementary type of information managed by the CDC is named a CDC datastore. Each CSCI, which wants to use a CDC datastore, must register itself as a user and specify if it is the master. The CDC is failsafe against node failures and node insertions.

The services offered by the CDC are:

Library functions

- To access a CDC datastore by record (e.g. create/update/remove a record, read sequentially by record number, get collision record content).
- To get information about a CDC datastore, such as:
  - Event generation (e.g. record updated, master alive detected, master not alive detected, collision detected),
  - Record information (e.g. updated record number, collision record number),
  - CDC information (e.g. access status, number of records),
  - CDC statistics,
  - Sequence event reporting control: reports are errors and events detected by CDC which are not caused by a CDC user (and must be reported to SCM).
- To access a CDC datastore by indexed sequential access (e.g. create/remove environment for indexed sequential access, check for existence of a key, get record contents by key, delete all records with a specified key).
  - Update distribution and processing.
  - Periodic consistency checking and recovery (when needed).
  - Debugging facilities.

A.7.2 Design Constraints

The CDC uses the facilities of the IPC, NPM and SCM (when needed for processing technical operator commands and reporting errors).

A.8 Multiple Telecommunication Management (MTM)

The MTM process is dedicated to manage communication between equipment (in heterogeneous environment or not) through a Local Area Network (LAN), a Wide Area Network (WAN), serial line or non-typical hardware. So UBSS facilities such as the Mailbox protocol or Basic Name Server Information which could not be used, are not needed to manage such type of communications.

As the aim of the MTM CSCI is to handle multiple protocols (connection oriented or not) belonging to multiple layers (session, transport or network for instance in the ISO/OSI model), a generic API is defined which enable a MTM user to use all protocols in the same way.

A.8.1 Main Function

The following protocols are currently implemented in MTM:

- OSI Transport Class 4 (OSI TP4) protocol (ISO 8073)
- PDC protocol over OSI TP4
- PDC protocol over TCP/IP (since UBSS V3.6.2)
- IP Multicast (since UBSS V3.5)
- TCP/IP (since UBSS V3.6.3)

The MTM library provides a set of protocol-independent library functions (C or Ada) which can be used to manage different type of communication. The only protocol-specific object at user level is the Service Access Point (SAP) which defines the application entity and the access means to reach it.

A local SAP (i.e. the Service Access Point is located on the node) defines a local protocol endpoint on which the MTM user is able to do the following:

- Receive messages: the local SAP has to be associated with a receiving FIFO. A FIFO can be related to more than one local SAP but a local SAP can be related to only one FIFO.

- Send messages: the user has to make a relationship between the local SAP and a remote SAP. This relationship is called an association.

The core of the MTM process contains protocol-independent modules while the low level modules are protocol-specific. Its design and its API allow to add easily any future protocols. The choice of a process has been made for the following reasons:

- Ability to manage complex protocols (such as PDC)
- Possibility to manage non fd-based protocols (which is impossible or really inefficient in select-based
- Library such as FIFO or Mailbox
- Ability to handle an efficient bufferisation scheme at sending and receiving side and to manage flow control
- (Particularly on WAN) without user application interactions
- Ability to use efficient asynchronous mechanisms
- Possibility of multi-threading.

A.9 System Control And Monitoring (TKSUP)

The purpose of TKSUP is to enable a technical operator to monitor and control the status of the technical part of the system. TKSUP is a generic service. It consists of a local part in every node (LSCM) and a central part (CSCM) located in one node. In case of failure of the node supporting the CSCM capabilities, these capabilities are switched to another node according system configuration.

A.9.1 Main Function

The services offered by the TKSUP are as follows:

To operate on local node

To get and update node status. This function accepts reports, processes reports and software events from node processes and captures THALiX errors.

To handle command input from a technical operator position. They are:

- Commands to force the re-initialization of the SCM global data.
- Requests for information. This information concerns the data defined in the SSS.

To format and display data on technical operator position. Those data can be either:

- Technical node status,
- Software version, status and changes of a nodes' processes, process groups,
- Devices status,
- Process reports,
- Software events,
- Errors generated by the application software.

To update the system status. Update the SCM data and for this:

- Get device initialization,
- Get the device open and closed,
- Handle and filter the basic errors reported by application software,
- Elaborate and survey the status,
- Distribute the status throughout the node and the other nodes of the system.

To return status information to calling processes

To establish system configuration (CSCM)

Maintain the status of:

- Processes,
- Process groups,
- Node (single or dual),
- Devices,
- Inter processor links,
- Data stores,
- Operational LAN, Front Dual LAN and service LAN.

1: The front processor middleware reports status to SCM for each node.

2: Dual Front LAN

To execute system functions

- From application software to LSCM / CSCM:
    - Report software process status change,

    - Report software process group status change,
    - Report node status change,
    - Report hardware device error,
    - Report data store status change,
    - Report dual node status change,
    - Report LAN status change,
    - Generate application / error messages,
    - Present OS and BSS call error (on technical operator position),
  - From LSCM / CSCM to application software in order to:
    - Get item status.
  - Between LSCM and CSCM:

Node event report.

A.9.2 Design Constraints

The SCM uses the facilities of the CDC, IPC and NPM.

APPENDIX B: SYSTEM MODES MANAGEMENT

B.1 System Modes Management (SYSMNG)

SYSMNG acts as an intermediate software layer between UBSS and the following CSCIs:

- MSTP
- AFP
- QNH
- SNMAP
- FDP
- FPCF
- SAP
- AGDP
- CDP
- REC
- ASPB
- RTP
- JHMI
- ODXP
- IODE
- JPIL
- JLDR
- ATG
- DPR
- JADE
- DART

SYSMNG handles the management of the CSCIs according to their environment, to the partition (operational, simulator, replay) and to start-up parameters.

It takes care of:

- System parameter updates (sys_manage facility),
- Starting the CSCI in relevant state (handle_CSCI_status facility),

Handling and distribution of alerts and statuses (handle_alert facility).

B.1.1 Main Function

1) handle_ CSCI_ status facility

1. The function determines at startup whether it is started-up as master (single) or slave.
2. This function manages external lines attached to the node. I.E. it collects the lines status and it opens and closes the lines.

Each time the line status change, the function transmits an alert to the handle_alert facility if necessary.

The text of the alert messages is line dependent, and is described in appendix 3 of the SRSs.

2) sys_manage facility

This function groups all actions useful for CSCI management i.e.:

1. Handles at startup the arguments as listed in the configuration file.
2. Checks the presence of the system parameter files on the local disk.
3. Checks validity of the system parameter files present on the local disk.
4. Retrieves the relevant system parameter files on the reference node, in the case where the validity dates are different from those of the file located on the local disk.
5. Copies the new set of system parameter files to the current directory so that they can be taken into account during a subsequent restart phase.
6. Restarts the node when a system parameter file discrepancy is detected.
7. Initializes the starting up of all the relevant processes of the node.
8. Data management
9. Stops and restarts all the remaining application processes when one of them is reported as exited.

3) Handle_alerts facility

For various events or threshold detection, the CSCIs issue alert messages. This function handles them, and either distributes these messages to the relevant operator, or prints them. The main connected capabilities are:

1. Collecting of alert messages coming from local functionalities.
2. Alert messages which must be displayed on a position are queued and time stamped.
3. Depending on the event type, the message is stored as high or low priority category.
4. At storage of each message, the counter corresponding to the category of alert event is incremented.
5. A time stamp corresponding to the oldest item of high priority category if any, or of the oldest one of the low priority category is maintained.
6. Local technical alerts are sent to the control and monitoring functions.
7. Print out of dedicated alert messages is provided.
8. On a dequeue request from HMI, the text of the highest priority message is sent.
9. On a re-enqueue request from HMI, the currently active message is put at the end of the list. The time stamps of the message is updated to the re-enqueue time.
10. On a deletion request from HMI, the currently active message is removed from the queue.
11. After either re-enqueue or deletion processing is performed, the time stamps of the oldest item is set to the time of the following item of the queue.
12. On an abort request from HMI, the records are restored to the state they have before the previous dequeue request.
13. After re-enqueue, deletion and abort processing an acknowledgement message is sent to HMI.

After each action involving a modification of the queues, the partner CSCI (if any) is informed of the change, and performs the equivalent action on its own queue.

APPENDIX C: TIME MANAGEMENT

C.1 Time Management Handling (TMH)

TMH runs on every node of the system. It allows automatic time synchronization between nodes with respect to the time and speed of the partition it belongs to.

TMH contains only one process "P_TMH". Since the node is started, TMH is started.

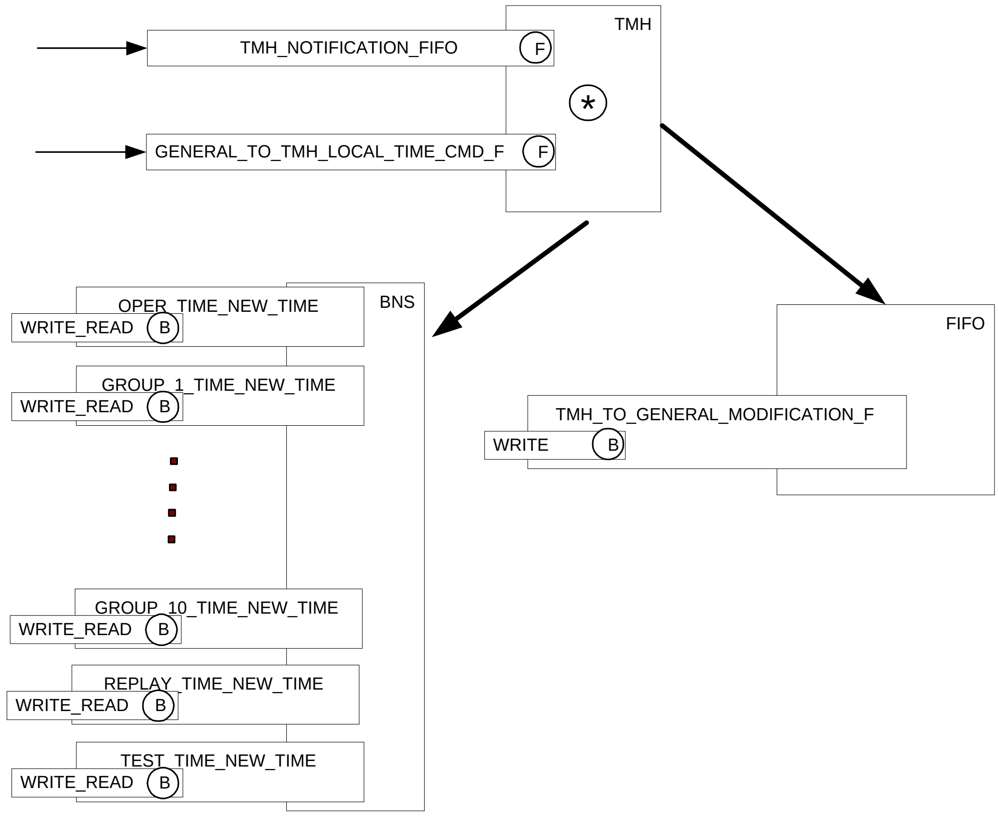


Figure 23 TMH Context Diagram

The diagram in the above figure presents the different interfaces between TMH and its external world.