BAGGAGE HANDLING SYSTEM (BHS)
HLC FUNCTIONAL DESIGN SPECIFICATION
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1. PREFACE

1.1 DOCUMENT OBJECTIVE

This document provided the control system description of BHS high level control system, Pteris Airport Logistic Suite (PALS), a standard BHS control solution from Pteris Global Limited (PGL), supplied to Mumbai Chhatrapati Shivaji International Airport.

PALS facilitates the High Level Control (HLC) system in an airport BHS. It includes a series of software components for BSH resource planning, baggage tracking and tracing, baggage automatic sortation control, baggage manual encoding, early baggage management, BHS conveyor system monitoring and control, interface to airport host systems, etc.

The approval of this design specification by client is required before the commencement of PGL in-house development work.

1.2 SCOPE

This software design specification provides the function descriptions of each PALS components, the definitions and concepts of baggage sortation and its rules. The details of each PALS component please refer to their detail design specifications of respective sub systems:

- HLC Configuration DDS – Refer to specification [DDS – HLCCS, Code: MIAL-LT-O-N55B-BG-DOC-DDD-001];
- BHS Departure Allocation – Refer to specification [DDS – DA, Code: MIAL-LT-O-N55B-BG-DOC-DDD-002];
- Monitoring & Diagnostic System – Refer to specification [DDS – MDS, Code: MIAL-LT-O-N55B-BG-DOC-DDD-003];
- Manual Encoding System – Refer to specification [DDS – MES, Code: MIAL-LT-O-N55B-BG-DOC-DDD-004];
- Early Baggage Storage System – Refer to specification [DDS – EBS, Code: MIAL-LT-O-N55B-BG-DOC-DDD-005];
- Baggage Identification System – Refer to specification [DDS – BIS, Code: MIAL-LT-O-N55B-BG-DOC-DDD-006];
- Baggage Handling Information Display System – Refer to specification [DDS – BHIDS, Code: MIAL-LT-O-N55B-BG-DOC-DDD-007];
- Management Information System – Refer to specification [DDS – MIS, Code: MIAL-LT-O-N55B-BG-DOC-DDD-008];
- HLC Security – Refer to specification [DDS – Security, Code: MIAL-LT-O-N55B-BG-DOC-DDD-009];

1.3 AUDIENCE

This design specification is intended for decision-makers of Mumbai Chhatrapati Shivaji International Airport and Pteris Global Limited (PGL). This document will serves as the primary foundation for PGL developers to implement the SAC.

1.4 DOCUMENT LIMITATIONS

This document is limited to the design of the PGL Sortation Allocation Control system. There is no any other external system will be described.

The document contains various GUI examples of HLC component applications. These examples are provided for assisting the perception of a given function or subsystem only.

1.5 DOCUMENT MAINTENANCE

This document is the one of the PGL document management document suites and maintained by PGL.

2. ABBREVIATIONS AND ACRONYMS

Item	Meaning
Airport Host	An external system that is not supplied by PGL. A airport host system is used for sending information (e.g. flight schedule, BSM, aircraft information, time clock information, etc) to BHS for baggage sortation control and/or to collecting the status and statistical data from the BHS.
AODB	Airport Operational Database
ATD	Actual Time of Departure
ATR	Automatic Tag Reader
BHS	Baggage Handling System
BHIDS	Baggage Handling Information Display System
BIS	Baggage Identification System
BRS	Baggage Reconciliation System
BSI	Baggage System Interface
BSM	Baggage Source Message
CUTE	Common Used Terminal Equipment
DA	Departure Allocation
DCS	Departure Control System
DDS	Detail Design Specification
EBS	Early Baggage Storage
EDS	Explosive Detection System
ETD	Estimated Time of Departure
ETD Device	Explosive Trace Detection Device
FIS	Flight Information System
FIDS	Flight Information Display System
Final Sort Destination	The end point of baggage travelling in the BHS, e.g. Departure Make-up Carousel. From there the baggage is ready to be transported to airplane.
GID	Global Identifier. Generated and used by PLC for internal baggage tracking purpose.
GUI	Graphical User Interface
HBS	Hold Baggage Screening
HLC	High Level Control
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization
ITD	Internal Time of Departure
LAN	Local Area Network
MDS	Monitoring & Diagnose System

MES	Manual Encoding System
MIS	Management Information System
MMIS	Maintenance Management Information System
NTP	Network Time Protocol
OOG	Out of Gauge. Bags whose size is too bag for passing through the automatic part in the BHS, e.g. X-ray machine.
OS	Operating System. E.g Windows XP, etc.
OWS	Operator Workstation
PALS	Pteris Global Airport Logistic Suite
PGL	Pteris Global Limited
RMS	Resource Management System
SAC	Sortation Allocation Control. A major component of PALS. SAC consist series of sub systems to facilitate the baggage handling functions.
SDO	Scheduled Date of Operation
STD	Scheduled Time of Departure
STO	Scheduled Time of Operation
UTC	Coordinated Universal Time. The date and time in the GMT (Greenwich Mean Time) time-zone. The local time must include a time-zone offset to UTC

3. BHS CONTROL PROCESS FLOW

The picture shown in **Figure 3-1** is the layer diagram of BHS outbound conveyor system in Mumbai Chhatrapati Shivaji International Airport.

From the HLC point of view, the baggage process flow in the BHS can be described in following 7 sections:

- Check-in and Transport Lines - From check-in counter to scanner and dimension check array;
- Level 1/2 HBS Security Screening Lines - From scanner and dimension check array to vertical sorter (VS) located after Level 1/2 X-ray machine;
- Level 3/4 HBS Security Screening Lines - From VS located after Level 1/2 vertical sorter to VS located after Level 3 EDS machine;
- Level 5 HBS Security Inspection, customs Reject and Reloading Lines - From VS located after Level 3 EDS machine to Level 5 screening area;
- Manual Encoding Line;
- Early Baggage Storage Line and Early Baggage Reloading Line;
- Sortation Tilt-Tray Sorter;

Note:

- The below descriptions are HLC control process flow. For the details of LLC control please refer to LLC design document.
- Since the arrival baggage is not involved in the automatic sortation control and it is solely handled by LLC layer, therefore, there is only process flow of departure BHS system is described in this document.

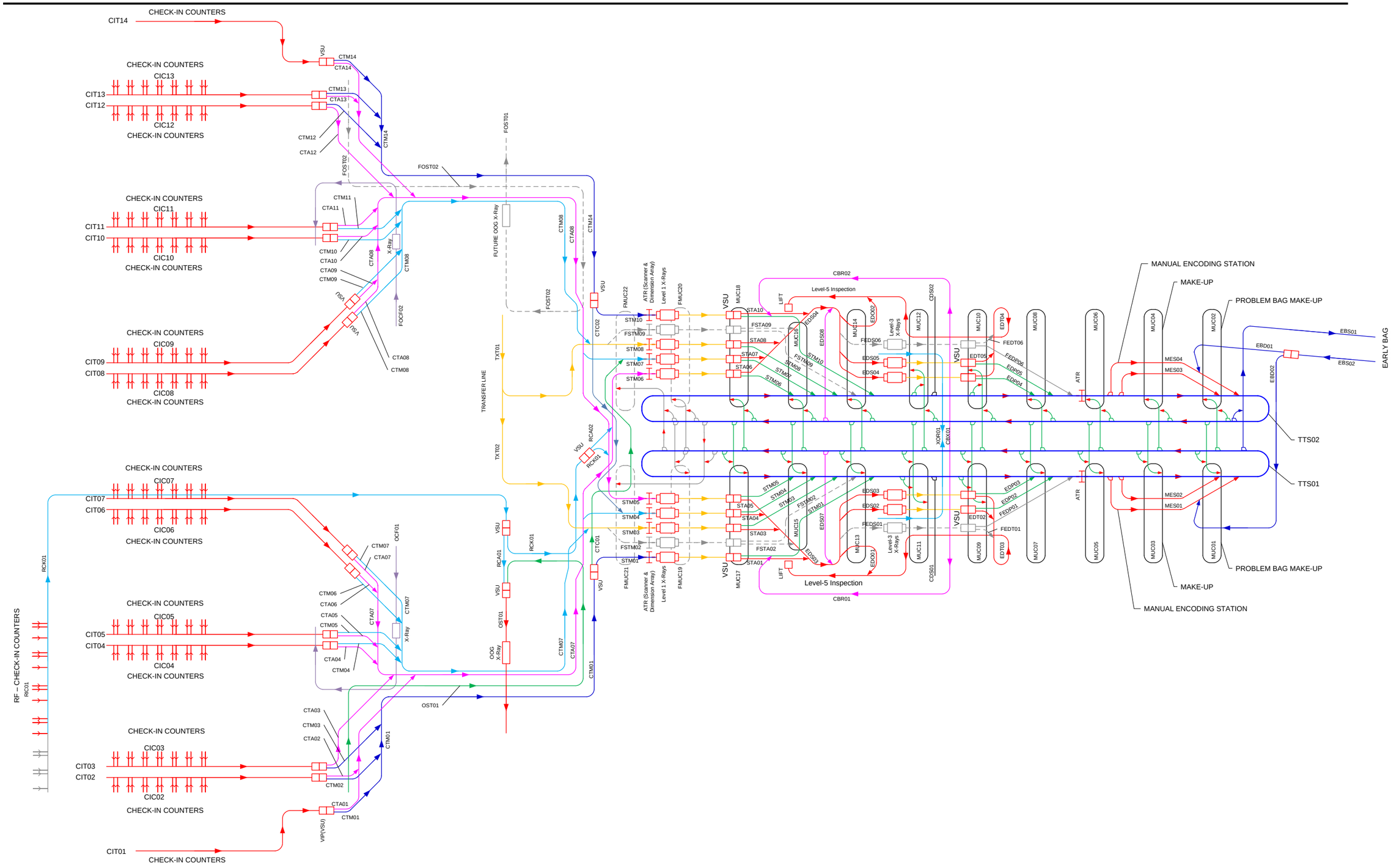


Figure 3-1: BHS Process Flow Diagram

3.1 CHECK-IN AND TRANSPORT LINES

The normal size bag enters into BHS system from the check-in counter. The oversize baggage will be identified by check-in operator and instructed to oversize check-in line. Due to the oversize baggage is not sent to Tilt-tray Sorter for sortation, below control process flow descriptions are solely for normal size baggage.

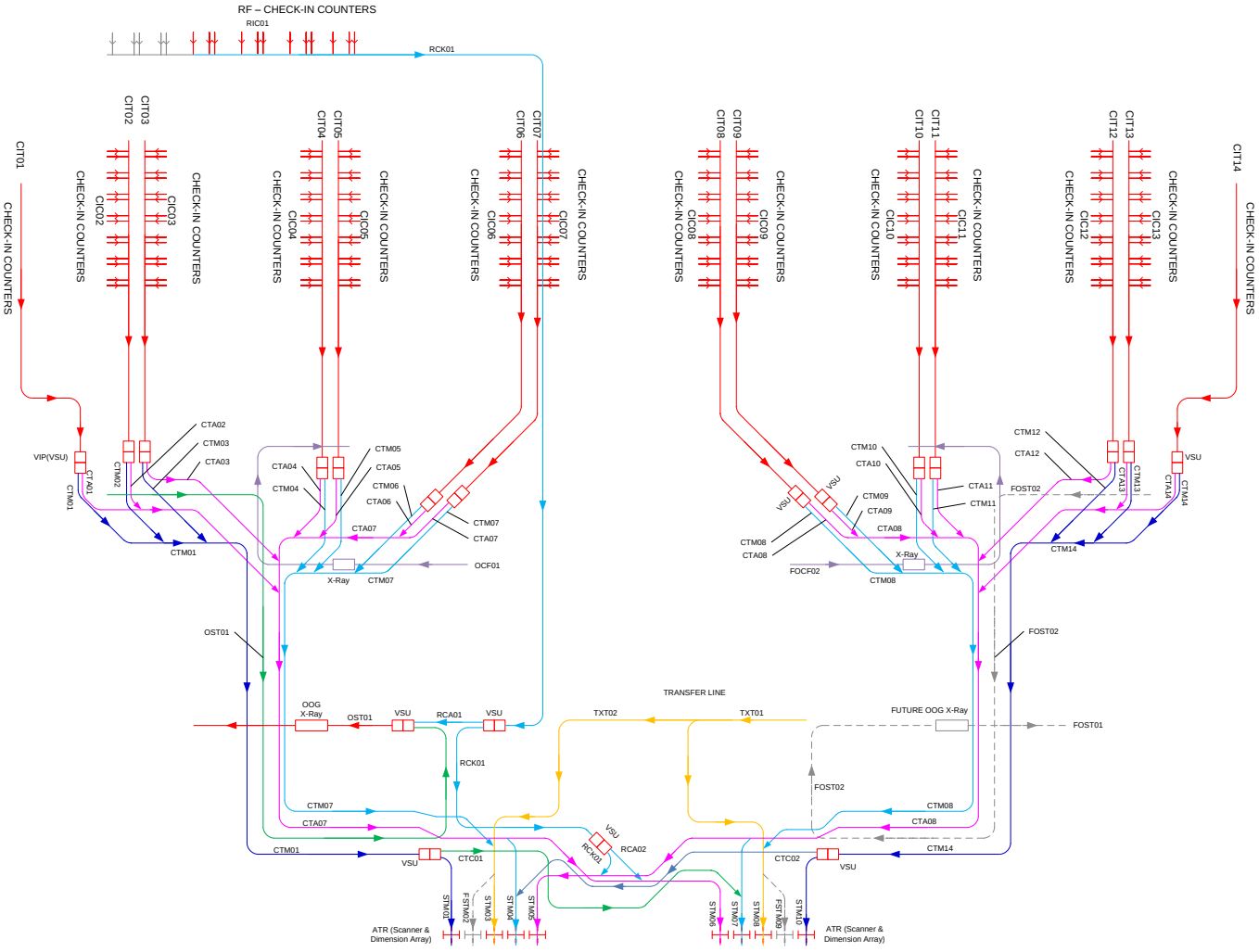


Figure 3-2: Check-in and Transport Lines

The normal size originating outbound bags are entered into check-in line from check-in counters located in the 8 check-in islands, which are consisted of 14 check-in rows (CIT01~14). Originating outbound bag will be transported from check-in area towards the scanner and dimension check arrays located on 8 screening transport mainlines (SMT01, STM03~08 and STM10). The transfer baggage will be loaded onto transfer lines (TXT01 and TXT02) and conveyed towards the scanner and dimension check array located on 2 screening transport mainlines (STM03 and STM08). The load balancing control is implemented at LLC PLC control level to distribute the bags come from 14 check-in line take-away conveyors and 2 transfer lines to 8 screening transport mainlines.

The baggage transportation control on check-in and transport lines indicated in **Figure 3-2** does not require HLC involvements. It is solely controlled by PLC in LLC level. But the MDS system in HLC is still involved in the equipment status monitoring. For the details of MDS please refer to [DDS – MDS].

3.2 LEVEL 1/2 HBS SECURITY SCREENING LINES

Bag tag will be scanned and the dimension will be measured when the physical bag passes the ATR (scanner and dimension measurement array) that is located before Level 1/2 X-ray machines on each screening transport mainline. PLC will forward the scanned bag tag number to HLC SAC system. The tag number and dimension check result will be tracked by PLC during the bag's travelling along the conveyor.

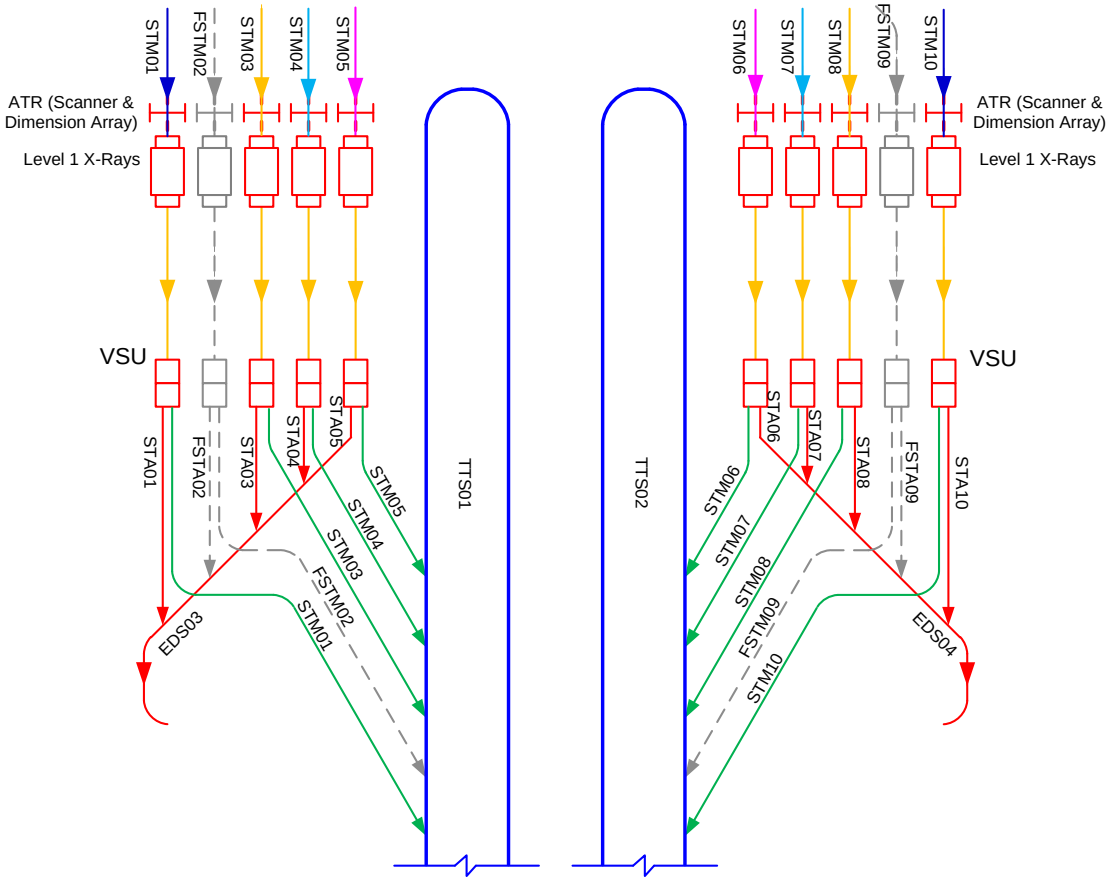


Figure 3-3: Level 1/2 HBS Lines

After receives the tag number, SAC will look up the minimum HBS screening level associated to the bag and return it to PLC. The minimum HBS screening level setting will then be tracked by PLC during the bag's travelling along the conveyor. Please refer to **Chapter 7.1.1** for the details about bag group security policy and minimum HBS Screening Level Requirement.

After the bag is screened by Level 1 X-ray machine, the screening result will be sent from X-ray machine to PLC, and then forwarded from PLC to SAC.

In HLC layer, the minimum screening level will be verified by SAC after it receives the Level 1 and Level 2 screening result from PLC. If the result is "Accepted" and the level of screening meets bag's minimum screening level requirement, then SAC will look up bag's sort destination (customs discharge, departure make-up carousel or MES) and returned to PLC. If the screening result is not "Accepted", e.g. the result is "Rejected", "Timeout", "No Picture", etc., or the result is "Accepted" but the screening level is below the minimum screening level requirement, then there is no bag sort destination is looked up by SAC and returned to PLC.

The purpose of returning bag sort destination from SAC to PLC is for forwarding the sort destination from PLC to TTS controller (CMC) via PLC-CMC direct data interface during the physical bag transferring from conveyor to TTS induction. So that the intelligence induction control can be performed by TTS controller for those bags with sort destination attached to reducing bag recirculation on TTS due to tray discharge sequence. The intelligence induction control is not applied to bags that do not have sort destination, e.g. no-read by ATR, no sort destination returned from SAC, or lost tracking by PLC after ATR, etc.

During the physical bag is transferred from conveyor to TTS or vice versa, the tracked sort destination, plus bag global identifier, up to 3 bag tag numbers, current HBS security screening status, required minimum security screening level, customs screening status, etc., will be transferred between conveyor PLC to TTS controller via PLC-CMC direct data interface.

At LLC layer, after receive bag's Level 1 and Level 2 screening result from AT machine, PLC will verify the screening result, bag's minimum screening level requirement, and bag's dimension check result tracked along with bag. If the result is "Accepted" and the level of screening meets bag's minimum screening level requirement, PLC will direct it to TTS via vertical sorter. If the screening result is not "Accepted", e.g. the result is "Rejected", "Timeout", "No Picture", etc., or the result is "Accepted", but the level of screening result is below the minimum screening level requirement, PLC will direct the bag to Level 3 EDS line (EDS03 and EDS04) via vertical sorter.

For those bags whose tag is not read by ATR, SAC is not able to return bag's minimum screening level to PLC. In this scenario, at HLC layer, there is no bag sort destination is looked up and returned to PLC. At LLC layer, PLC will control the vertical sorter based on the Level 1 or 2 screening result without verify the minimum screening level. If bag's Level 1 screening result is "Accepted" or Level 1 screening result is not "Accepted" but its Level 2 result is "Accepted", PLC will direct the bag to TTS. The bag's minimum screening result will be verified when bag tag is detected by TTS ATR or Manual Encoding Station and tilted to Level 3 discharge if minimum screening level is not met. If both Level 1 and Level 2 screening result of no-read bag are not "Accepted", the PLC will direct the bag to Level 3 EDS line (EDS03 and EDS04) via vertical sorter.

For those good read bags but lost track by PLC after ATR and before AT machine, after SAC receives bag's Level 1 or 2 screening result, PLC will direct them based on HBS screening result without verify the minimum screening level. If bag's Level 1 screening result is "Accepted" or Level 1 screening result is not "Accepted" but its Level 2 result is "Accepted", PLC will direct the bag to TTS. The bag's minimum screening result will be verified when bag tag is detected by TTS ATR or Manual Encoding Station and tilted to Level 3 discharge if minimum screening level is not met. If both Level 1 and Level 2 screening result of lost tracking bag are not "Accepted", the PLC will direct the bag to Level 3 EDS line (EDS03 and EDS04) via vertical sorter.

For those good read bags but lost track by PLC after AT machine and before vertical sorter, PLC will direct them to Level 3 HBS line directly.

All X-ray images (regardless of machine auto decision) generated by the Level 1 X-ray machines are sent to an HBS operator security workstation, and/or customs screening system (CSS) workstation (both are supplied by others). The customs screening will be performed by CSS operator, and the result will be sent from x-ray machine to BHS PLC, and then forwarded to SAC. SAC will review bag's sort destination base on both security screening result and customs screening result, and returned it to PLC. All baggage, as long as it has cleared the required minimum level security screening, will be sent to TTS regardless it customs screening result is received or not, cleared or rejected. Bag's customs screening result will be verified upon it is scanned by TTS overhead ATR and redirected to customs reject area if it is not or not yet cleared customs screening.

For those bags whose Level 1 or 2 HBS Security Screening result have not received at the time when bag reaches the predetermined diverting point of vertical sorter (VS) on Level 1/2 HBS lines, they will be classified by PLC as the HBS security screening not cleared bag and diverted to Level 3/4 HBS line.

3.3 LEVEL 3/4 HBS SECURITY SCREENING LINES

If bag is not cleared Level 1/2 screening, or cleared Level 1/2 screening but its minimum screening level requirement is higher than Level 2, then bag will be diverted from Level 1/2 HBS line to Level 3/4 HBS line.

As shown in **Figure 3-4** below, before bags reach the first plow diverter point, PLC will verify its dimension check result tracked along with the bag.

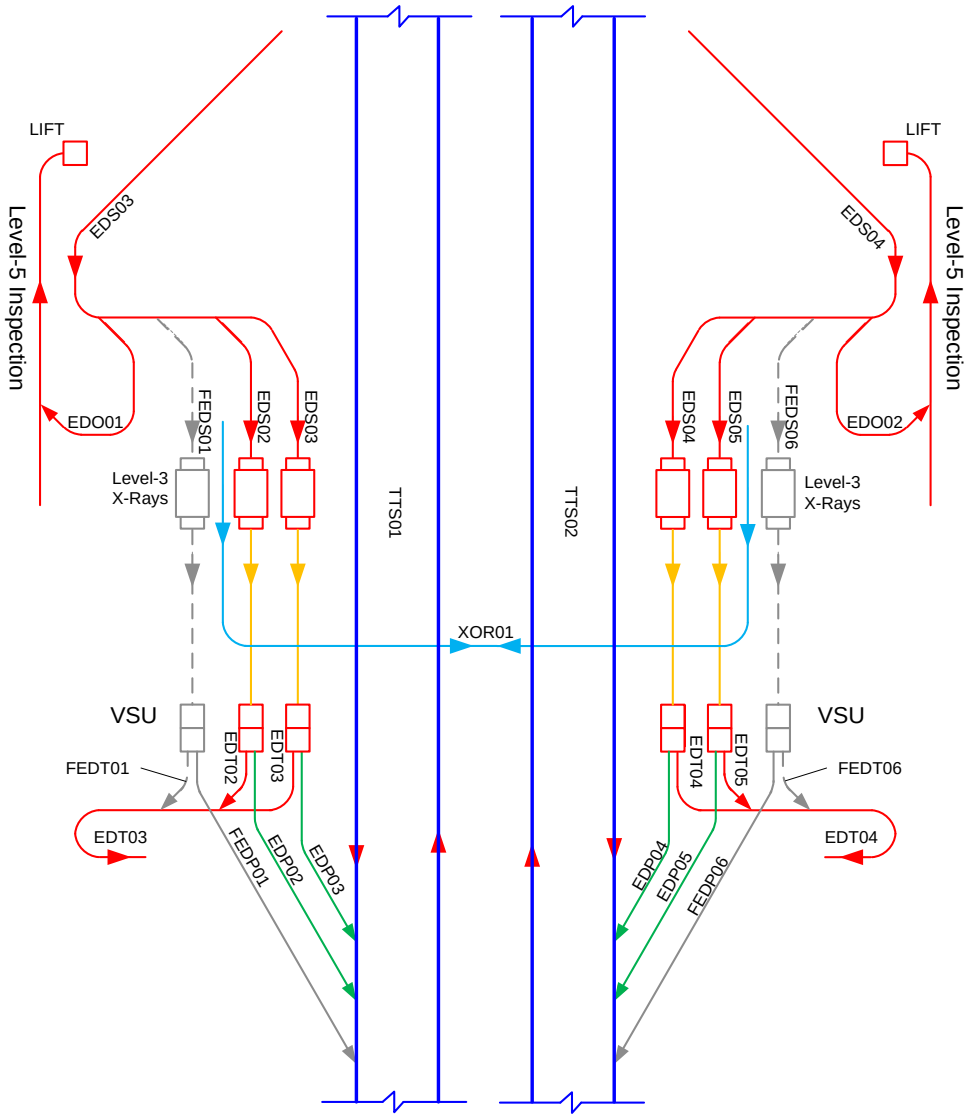


Figure 3-4: Level 3/4 HBS Lines

If bag failed the dimension check, it represents that it is Out-Of-Gauge (OOG) bag and cannot enter into Level 3 EDS machine. PLC will divert all OOG bags to Level 5 lines via EDO01 or EDO02 line for manual security check at Level 5 screening area.

The normal gauge bags entered into Level 3 line will be diverted by PLC to Level 3 EDS machines for screening. If bag fails the Level 3 screening, the level 4 on screen resolution determination will be performed by HBS operators. After the bag is screened by Level 3 EDS machine, or by Level 4 manual determination, the screening result will be sent to PLC from EDS machine, and then forwarded to HLC SAC by PLC.

Similar to the Level 1/2 HBS line process, In HLC layer, the minimum screening level will be verified by SAC after it receives the Level 3 and Level 4 screening result from PLC. If the result is “Accepted” and the level of screening result meets bag’s minimum screening level requirement, then SAC will look up bag’s sort destination (departure make-up carousel or MES) and returned to PLC. If the screening result is not “Accepted”, e.g. the result is “Rejected”, “Timeout”, “No Picture”, etc., or the result is “Accepted” but the screening level is below the minimum screening level requirement, then there is no bag sort destination is looked up by SAC and returned to PLC. After receives bag’s sort destination from SAC, PLC will track it with the bag and later forward it to TTS controller for intelligence induction control purpose.

At LLC layer, after receive bag’s Level 3 and Level 4 screening result from EDS machine, PLC will verify the screening result and bag’s minimum screening level tracked along with the bag. If the result is “Accepted” and the level of screening meets bag’s minimum screening level requirement, PLC will direct it to TTS via vertical sorter. If the screening result is not “Accepted”, e.g. the result is “Rejected”, “Timeout”, “No Picture”, etc., or the result is “Accepted”, but the level of screening is below the minimum screening level requirement, PLC will direct the bag to Level 5 HBS line (EDT03 and EDT04) via vertical sorter.

For those bags without IATA tag number attached in the tracking data, e.g. no-read by ATR or lost tracking by PLC before Level 3 EDS machine, at HLC layer, there is no sort destination will be returned from SAC to PLC. At LLC layer, PLC will direct the bag based on the Level 3 or Level 4 screening result without verify the minimum screening level. If the Level 3 screening result is “Accepted” or Level 3 screening result is not “Accepted” but its Level 4 result is “Accepted”, PLC will direct the bag to TTS. Otherwise, the bag will be directed to Level 5 HBS line.

For those bags lost track by PLC after EDS machine and before vertical sorter, PLC will direct them to Level 5 HBS line directly.

For those bags who’s Level 3 or 4 screening result have not received at the time when bag reaches the predetermined diverting point of vertical sorter (VS) on EDS lines, they will be classified by PLC as the HBS screening not cleared bag and diverted to Level 5 HBS line directly.

3.4 LEVEL 5 HBS SECURITY INSPECTION, CUSTOMS REJECT AND RELOADING LINES

If bag is not cleared Level 3/4 screening, or cleared Level 3/4 screening but its minimum screening level requirement is higher than Level 4, then bag will be diverted from Level 3/4 HBS line to Level 5 HBS line for next level screening.

As shown in **Figure 3-5** below, bags will be conveyed to Level 5 inspection area and then be searched manually by security agent using ETD device with combination of reviewing of HBS Level 2 image on the HBS workstation (provided by others) located at HBS Level 5 area, and/or review of HBS Level 4 imaged on the HBS workstation (provided by others) located at the same place.

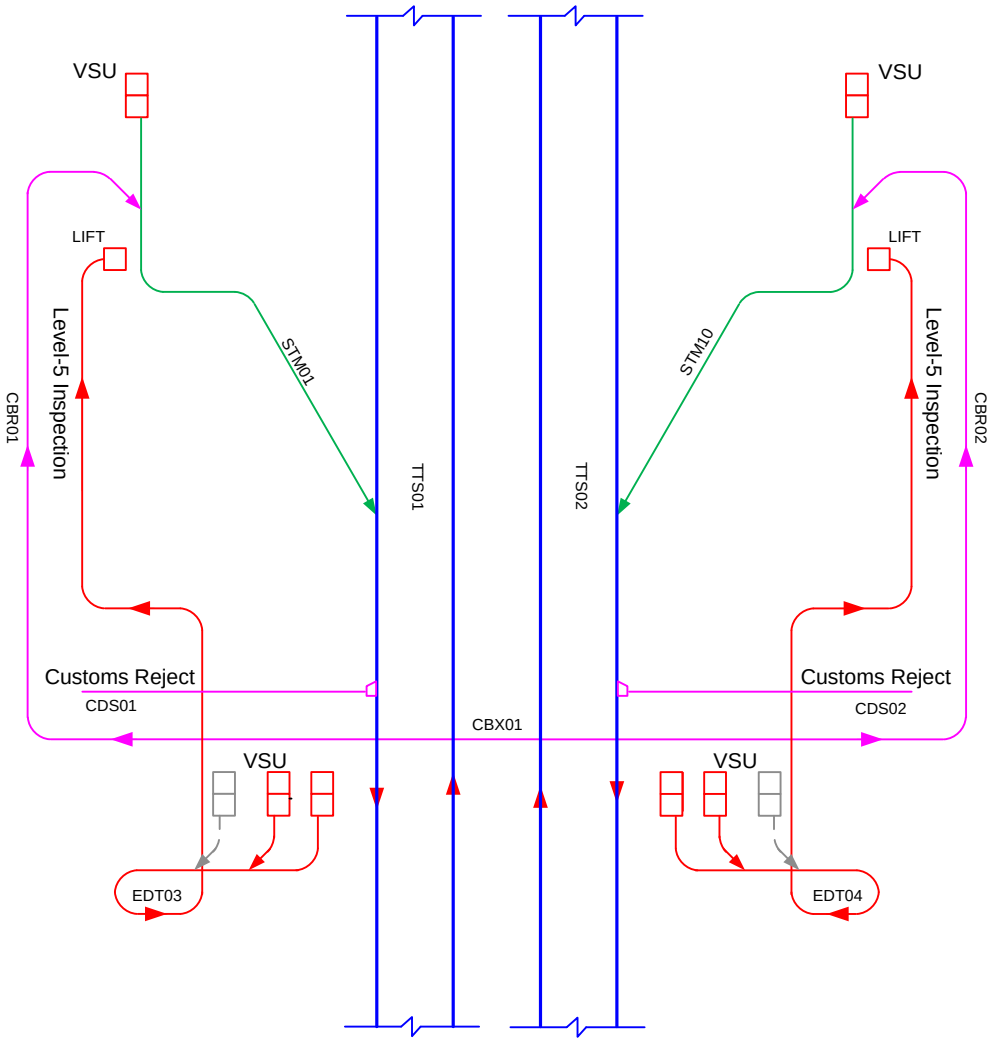


Figure 3-5: Level 5 HBS Lines

If bag cleared the Level 5 security checking, security agent will manually transfer it from Level 5 inspection conveyor line to the clear bag reloading line (CBR01 or CBR02) for reloading it back to TTS. If bag is not cleared Level 5 checking, then it will be directly transported to threat containment unit via left and then classified as out of BHS.

There is a BHS Baggage Identification System (BIS) workstation supplied by PGL at each Level 5 inspection area. BIS workstation provides the functionalities to security agent for them to identify information (Flight#, Passenger Name, L1~4 HBS Result, etc.) by entering the bag IATA tag number.

And also for updating the Level 5 manual checking result into BHS database for reporting purpose. For the details about BIS please refer to the [DDS – BIS].

There is one customs reject line located at both TTS side. Bags cleared minimum security screening but have not yet cleared customs screening will be sorted to these two reject lines from respective TTS. The manual customs check will be conducted at customs reject area. After bag is cleared manual customs check, it will be put on the clear bag reloading line and sent back to the TTS for sorting. Before bag is put on the reloading line, its customs check result needs to be updated into BHS database. There is a BHS BIS workstation supplied by PGL at each customs reject area for operator update customs screening results.

Only those bags that have cleared the minimum HBS security level screening level will be sorted to customs reject line. If bag is sent on the TTS and it has not cleared both HBS minimum level security screening and customs screening (e.g. no read or lost tracking after ATR bag), it will be sorted to Level 3 line from TTS for higher level HBS security screening, before it can be sorted to customs reject line for customs screening.

3.5 MANUAL ENCODING LINES

After bags are transferred to Tilt-Tray Sorter (TTS), it will be scanned by TTS 90 degree induction underneath ATR and 270 degree overhead ATR. The detected tag number will be forwarded to HLC SAC by TTS controller for looking up the sort destination. If bags are not read by either one of these 2 types of ATR, or bag is good read but its sort destination is not able to be identified by SAC, then TTS controller will redirect them to the MES line for manual handling.

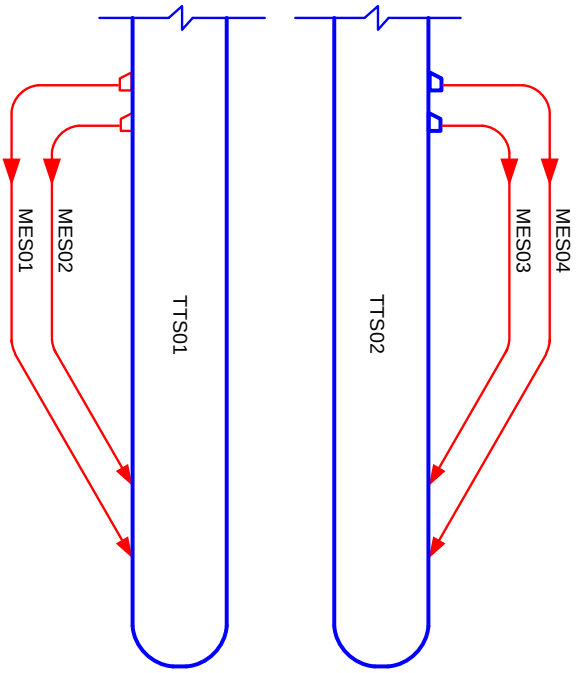


Figure 3-6: MES Lines

There is one set MES workstation that equipped with touch screen computer, wired hand-held barcode scanner and label printer supplied by PGL at each ME line. This MES workstation connects to PLC and SAC for MES operator to encode bag by bag tag number, flight number or make-up unit number. In the scenario of HLC (SAC) is not available, MES operator can still encode bag by fallback tag or make-up unit number.

When bag is successfully encoded at MES workstation, its sort destination will be sent from MES computer to PLC. PLC will track the sort destination with the physical bag and handed over to TTS controller during the bag transfer from conveyor to TTS induction unit. And then TTS will sort the bag to the destination encoded at MES.

Similar with the TTS inductions connected to the screening transport mainlines, the TTS inductions connected to ME lines shall also has the intelligence induction for bags come from MES with sort destination attached to reducing recirculation due to tray discharge sequence. The intelligence induction control is not applied to bags that do not have sort destination, e.g. lost tracking by PLC after MES, etc.

For the details about MES system please refers to the [DDS – MES].

3.6 EARLY BAGGAGE STORAGE LINES

After bags are sent to Tilt-Tray Sorter (TTS), it will be scanned by TTS 90 degree induction underneath ATR and 270 degree overhead ATR. The detected tag number will be forwarded to HLC SAC by TTS controller for looking up the sort destination. If the bag is identified as early checked in before the flight allocation is opened, then SAC will return EBS as the sort destination to TTS controller for TTS to tilt bag to early baggage storage line.

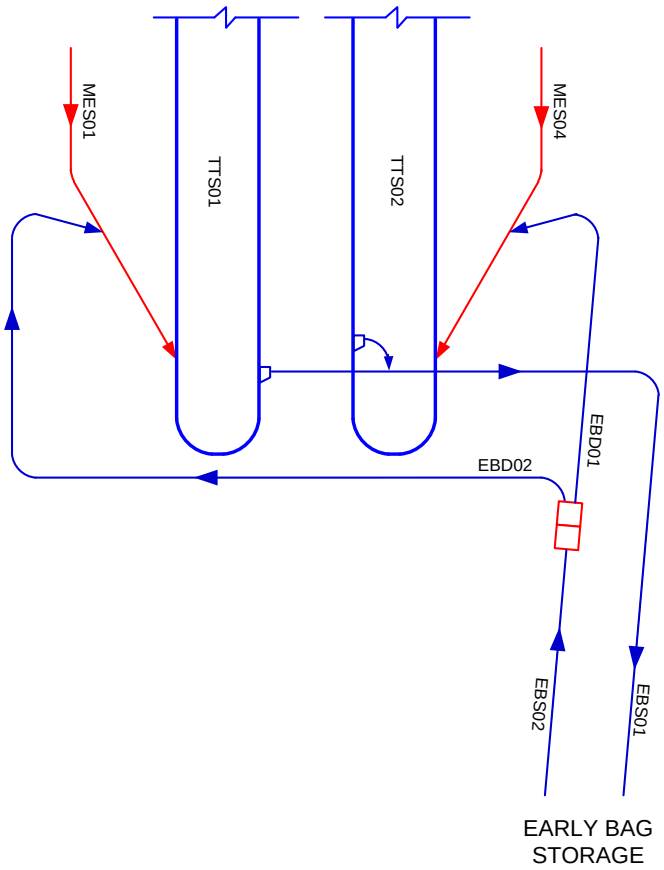


Figure 3-7: EBS Lines

There are total 4 set of workstations are supplied by PGL at the EBS area. Each EBS workstation equips with one wireless hand-held barcode scanner. When early bag arrive the EBS line (EBS01), operator will scan the bag tag and storage rack compartment ID barcode to register the bag into EBS inventory.

The EBS workstation will notify the operator to reload early bag back to TTS when the flight allocation is opened. Operator will transfer the desired bag from storage rack compartment onto the reloading line (EBS02) and scan the bag tag before release it to TTS. The EBS workstation will update the EBS inventory accordingly. Reloaded bags will be distributed to 2 early bag distribute lines (EBD01 and EBD02), and merged to ME lines (MES01 and MES04), and then transferred to TTS induction from these two ME lines. The distribution from EBS02 line to EBD01 and EBD02 lines via vertical sort is solely controlled by conveyor PLC at LLC level.

In the HLC system, there is a configurable system parameter to control sending all EBS retrieval bags to Level 3 EDS machines for screening. If this setting is enabled, SAC will inform TTS to tilt such bags to Level 3 EDS line discharge. Otherwise, SAC will inform TTS to tilt bag to make-up carousel allocated to their flight. For the details about BHS system parameter settings please refer to [DDS - DA].

Due to the security reason, all manually reloaded bags from the EBS reloading line are not allowed to have the sort destination manually given by EBS operator. Such bags have to be scanned by TTS 90 degree induction underneath ATR and 270 degree overhead ATR and then the tag number will be forwarded to HLC SAC by TTS controller for looking up the sort destination automatically. By the time, the flight allocation of reloaded baggage has been opened and the reloaded baggage will be sorted to make-up carousel or Level 3 HBS line, instead of back to EBS.

For the details about EBS system please refers to [DDS – EBS].

3.7 TILE-TRAY SORTER & MAKE-UP CAROUSELS

As shown in **Figure 3-8**, there are 2 Tilt-Tray Sorters (TTS) in BHS. Each TTS has 4 induction units connected to Level 1 and 2 clear lines, 2 induction units connected to Level 3 and 4 clear line and 2 induction units connected to ME lines.

Each TTS has 20 discharge chutes for discharge bags to 18 departure make-up carousels (MUC01 ~ MUC18), 2 discharge chutes for tilting bags to 2 separate ME lines connected to each TTS, 1 discharge chute for titling bags to the central EBS line, 1 discharge chute for tilting bags to Level 3 HBS line connected to each TTS, and 1 discharge chute for tilting bags to custom screening room located at one side of each TTS.

The bags transferred from conveyor to TTS induction units could have sort destination attached in the bag's PLC tracking data. The sort destination could be given to conveyor control PLC at following 4 scenarios:

- Given by SAC when bag's Level 1/2 HBS security screening result is received;
- Given by SAC when bag's Level 3/4 HBS security screening result is received;
- Given by SAC when bag's HBS customs screening result is received;
- Given by MES when bag is manual encoded.

During the physical bag is transferred from conveyor to TTS or vice versa, the tracked sort destination, plus bag global identifier, up to 3 bag tag number, current HBS security screening status, required minimum security screening level, customs screening status, etc., will be transferred between conveyor PLC to TTS controller via PLC-CMC direct data interface.

For those bags that is not read by ATR or lost track by conveyor PLC, there will not be any sort destination is attached in the PLC tracking data and therefore no sort destination be forwarded to TTS controller. When the bag is inducted from TTS induction unit onto trays, TTS controller shall has the intelligence induction control for those bags that have sort destination is attached to reducing recirculation due to tray discharge sequence.

There is one (1) 90 degree underneath ATR is located at each TTS induction unit, and one (1) 270 degree overhead ATR is located on the TTS loop. At LLC layer, when bag tag is detected by TTS 90 degree or 270 degree ATR, TTS controller will forward all detected bag tag numbers and the bag sort destination, which was forwarded to TTS controller by conveyor PLC during the item transferring, to HLC SAC for code conversion. But for manually encoded bags at MES, there is not code conversion will be done by SAC as it may conflict with the sort destination encoded at MES.

At HLC layer, if received ATR scanning result indicates No-Read or Multiple-Read, then SAC will return the sort destination that is attached in the ATR scanning result back to TTS controller, or return the MES as the destination to TTS controller if there was no sort destination attached in the ATR scanning result. Otherwise, SAC will look up the sort destination based on the received single tag number and return it to TTS controller for bag tilting control.

The minimum HBS screening level will be verified by SAC when it receives bag tag. If SAC detects that the bag has not passed the screening of required minimum HBS level, then SAC will return the HBS Level 3 lines (EDS07, EDS08) as the sort destination to TTS controller for sending bag to higher level screening.

There is one customs discharge (CDS01 and CDS02) per TTS for tilting customs screening failed bag to custom screening room. If SAC detects that the bag has passed required minimum level security screening but not yet passed the customs screening, SAC will divert this bag to customs discharge.

Only minimum HBS security screening level cleared baggage is allowed to be tilted to the customs discharge.

Bag will be diverted to its final sort destination (make-up carousel allocation to flight) only when its clearances of both HBS security and customs screening are received.

In the “LLC Only” operation mode, TTS controller has to determine bag’s minimum screening level requirement and sort destination using “Special” security tag and fallback tag when they are identified by TTS 90 degree induction underneath ATR or 270 degree overhead ATR. And then tilt bag accordingly.

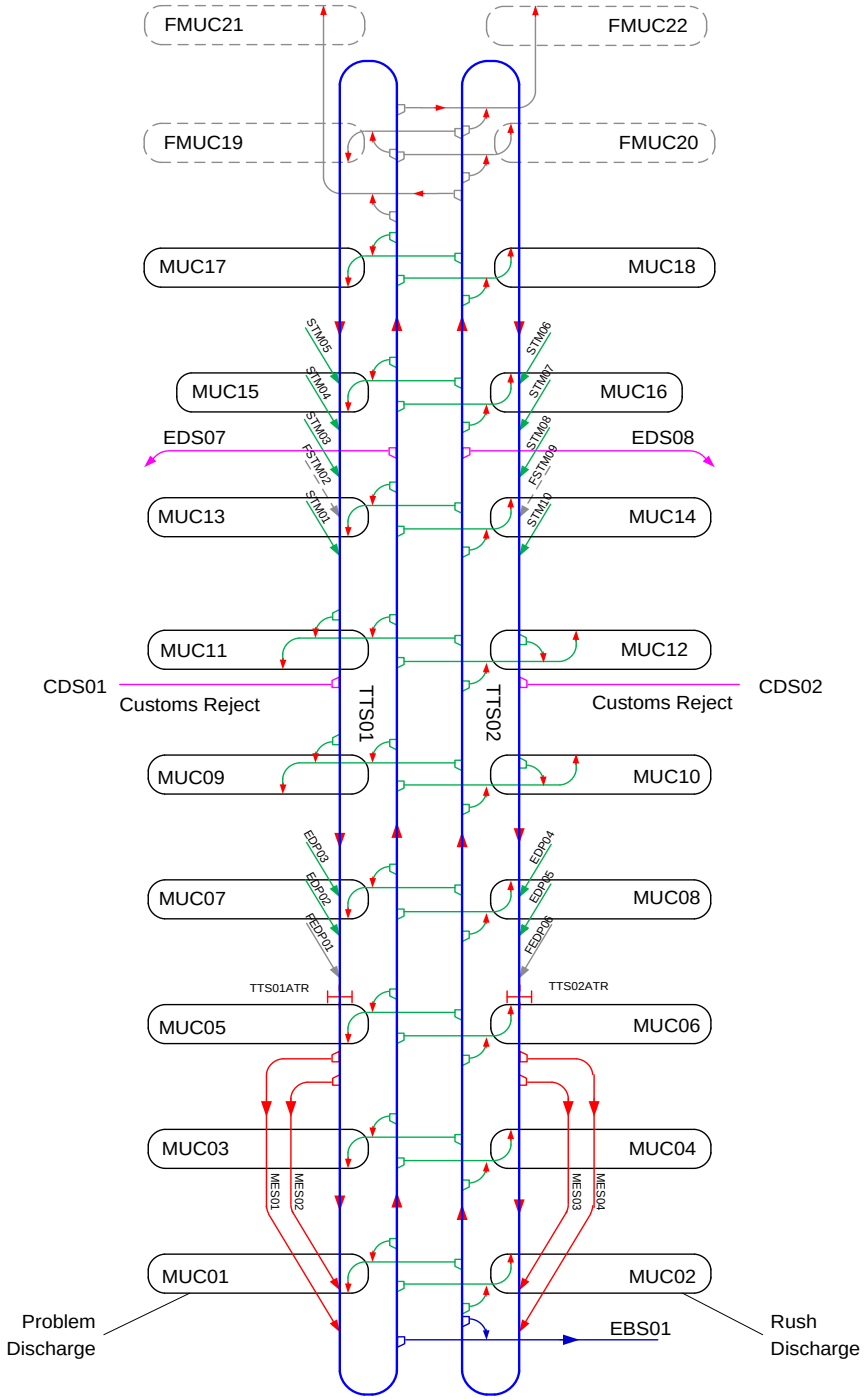


Figure 3-8: TTS & Make-up Carousels

4. BHS HLC SYSTEM OVERVIEW

Figure 4-1 illustrates the BHS HLC software components and their relationships:

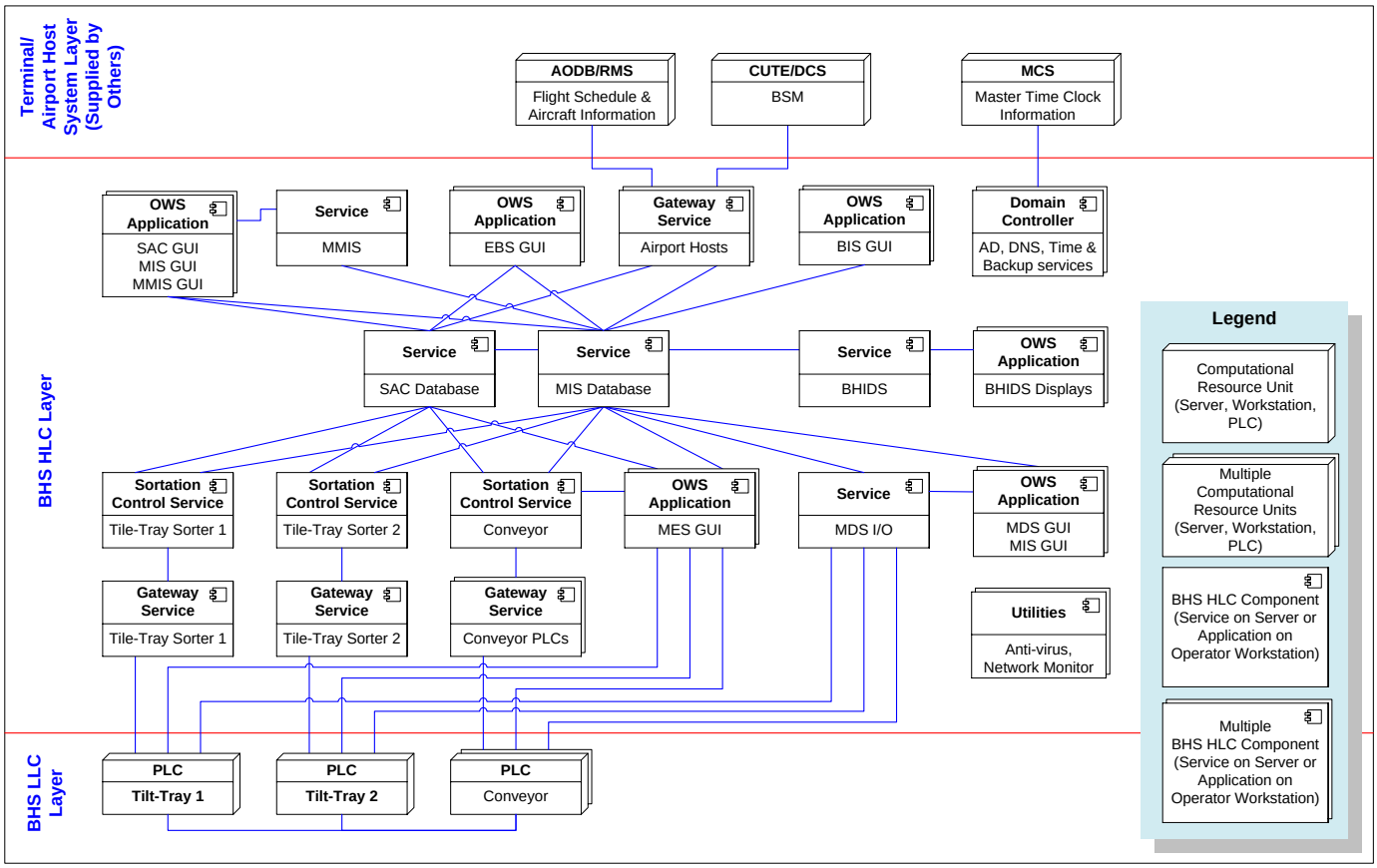


Figure 4-1: BHS HLC System Overview

4.1 SAC DATABASE

SAC database is the core component to provide the reliable and high performance database service to several of other HLC components, like BHS sortation control, BHS to external interface communications, manual encoding operations, early bag storage and BHS resource planning GUI components.

SAC database serves as the production database. It is used to store those data required by real time baggage sortation control. For example: current and future flight schedule data, current checked in baggage data (BSM), Current and future flight allocation data, airline allocation data, Fallback tag mapping data, current early baggage storage inventory data, etc. Once the data become no more valid, for example 3 days after departure date, it will be removed from production database. But its duplicated copy will be still available in the MIS database for reporting purpose.

The standard Microsoft SQL Server Database solution is used for building SAC database component and deployed on 2-node redundant clustering server hardware. For the details about HLC system configuration please refers to [DDS - HLCSC].

4.2 MIS DATABASE & REPORTING

MIS database is the core component to provide the reliable and high performance database service to most of the HLC components, like MDS, MIS, BIS, MMIS, BHIDS, workstation GUI components, etc. MIS database serves as the data warehouse to store all historical data, for example: expired flight schedule, baggage information (BSM), and flight allocation data, or BHS equipment fault or alarm data generated by MDS, system operation audit log data, etc.

The historical data will be stored in the MIS database for much longer time than data stored in the SAC (Production) database. The storage period is configurable from 1 month to 1 year.

MIS database also serves as the reporting server to provide web base reporting service to BHS operators. The BHS reports templates are deployed on MIS database server to allow generating, viewing, and printing BHS reports using Windows form or web browser from any workstation in the BHS control room. The generated reports can be exported to different format of files, e.g. PDF, Excel, etc. for the details about BHS reporting please refer to [DDS – MIS].

The standard Microsoft SQL Server Database and Reporting Service solution are used for building MIS database component and deployed on 2-node redundant clustering server hardware. For the details about HLC system configuration please refers to [DDS - HLCSC].

4.3 SORTATION CONTROL

The Sortation control component consists of Tilt-Tray Sorter (TTS) Sortation and Conveyor Sortation control modules. They are responsible for the code conversion when pre-determined bag events are reported to them by TTS controllers or conveyor control PLCs, for example, when bag is scanned by ATR on conveyor or TTS, when HBS screening result is received, etc. The code conversion is the process of looking up the sort destination of baggage based on the certain input information, e.g. bag IATA tag number, HBS screening result, time of scanning by ATR, and resource allocation of flight, etc. A number of pre-defined sortation rules will be followed by Sortation Control Component during the code conversion. Please refer to baggage scenarios and sortation rules chapter of this document for the sortation control details.

Sortation control component connects to SAC database and MIS database for querying production data during the code conversion and recording the bag tracking events into historical database for future reporting. It also communicates with several TTS and conveyor control PLC interface gateway components for receiving and sending data from/to them.

For the details about bag sorting control please refer to other sections later in this FDS document.

Sortation control component is one of the sub systems in PALS product, the standard BHS control solution from PGL. They are deployed on the primary and secondary SAC servers to provide the uninterrupted sortation control for baggage handling.

4.4 SAC GUI

SAC GUI application component provides functionalities and graphic user interfaces for BHS operator to perform the departure resource planning work, e.g. manage flight schedule, assign make-up unit to departure flight, and manage templates for automatic allocation, etc.

SAC GUI component is one of the sub systems in PALS product, the standard BHS control solution from PGL. They are deployed on the multiple workstation computers in the BHS control room.

For the details about SAC GUI application please refers to [DDS - DA].

4.5 INTERNAL PLC INTERFACE GATEWAY

Internal PLC interface Gateway Components consist of the interface gateway models for each TTS controller PLCs and individual conveyor control PLCs. They work as the communication gateway between distributed PLC hardware and centralized sortation control components, for handling the data communication between those parties.

PLC interface Gateway Component is one of the sub systems in PGL PALS product to handle the communication between BHS internal parties. They are deployed on the primary and secondary PLC gateway servers to provide the uninterrupted communication gateway service to HLC components.

4.6 EXTERNAL HOST INTERFACE GATEWAY

External Host Interface Gateway Components consist of the interface gateway models for each airport host systems, like AODB/RMS, CUTE/DCS, etc, from where the flight, aircraft and baggage information are sent to BHS for baggage handling. These interface gateway components connect to host system servers via airport building network to receive above information, convert them into BHS data format and save into BHS database for sortation control. These components are also responsible for sending data from BHS to host system, if it is needed.

External Host Interface Gateway Component is one of the sub systems in PGL PALS product to handle the communication between BHS to external system. They are deployed on the primary and secondary host gateway servers to provide the uninterrupted communication gateway service.

4.7 MDS I/O SERVER & GUI CLIENT

MDS I/O Server Component is the back-end of MDS system who is responsible for monitoring the real-time status of BHS equipment like conveyor, PLC, control panel, X-ray, ATR, fire door, TTS, etc. It is connected to all TTS controller and conveyor control PLCs via several communication drivers to collect BHS equipment real time status. When any system fault or equipment malfunction is occurred, for example, bag jam, motor trip, E-Stop, etc., MDS I/O Server will generate the alarms to notify the BHS operator through MDS graphic client components.

MDS I/O Server Component is also responsible for sending BHS system control commands, e.g. start/stop conveyor line, issues from MDS graphic client to PLCs for executing at LLC level.

MDS I/O Server Component is one of the sub systems in PGL PALS product. It is built on the standard industrial SCADA platform “Proficy iFix SCADA” from GE Intelligent Platforms, and PALS Visualization application from PGL. They are deployed on the primary and secondary MDS server to provide the uninterrupted BHS system monitoring and controls.

MDS GUI Client components are the front-end of MDS system that provides the graphic visualization of the entire BHS. There could be multiple client components with identical MDS functionalities running on different workstation computers. All MDS client components are connected to the same set redundant MDS I/O server to retrieve equipment real-time status and present them on graphic user interface screening.

MDS client provides virtual control buttons or menus on the graphic user interface screen for BHS operator to issue the control commands. And these control commands will be forwarded to PLC through MDS server to PLC interface connections.

MDS GUI Client Component is one of the sub systems in PGL PALS product. Same as the MDS I/O Server component, it is built on the standard industrial SCADA platform “Proficy iFix SCADA” from GE Intelligent Platforms, and PALS Visualization application from PGL. They are deployed on multiple MDS GUI client workstation computers.

For the details about MDS please refers to [DDS - MDS].

4.8 BHIDS SERVER & DISPLAY MONITORS

BHIDS Server Component is responsible for baggage information display content management, BHIDS display client configuration and management, etc. It is connected to MIS database server for retrieving baggage, flight and allocation information and distributing them to individual BHIDS display monitors.

BHIDS Server component is one of the sub systems in PGL PALS product to handle digital signage board display of baggage information. They are deployed on primary and secondary redundant server hardware to provide the uninterrupted BHIDS system control.

BHIDS display Component is the graphic display client for display baggage information retrieved from BHIDS server. It is one of the sub systems in PGL PALS product to handle digital signage board display of baggage information. They are deployed on multiple BHIDS display monitors.

For the details about BHIDS please refer to [DDS - BHIDS].

4.9 MES GUI

The MES components provide the graphic user interface to operators at manual encoding line for manual handling bags that cannot be automatically handled. For example, bags not read by scanner, No BSM bags, unknown flight bags, etc.

Each manual encoding station consists of one touch screen for displaying baggage information to operator and entering bag data, one wired hand-held barcode scanner for reading tag attached to the bag, and one tag printer for printing IATA Interline tag, IATA fallback tag or airport in-house tags from MES.

There are following ways to manual encode a bag at MES:

- Encode by bag tag - Lookup the sort destination from the tag number scanned by operator using hand-held scanner, or entered from keyboard or touch screen;
- Encode by flight - Lookup the sort destination from the flight number entered by operator from keyboard or touch screen;
- Encode by destination - Send bag to operator entered departure make-up carouse directly;
- Send to Problem - Send bags, which do not have enough information for lookup the sort destination, directly to dedicated problem discharge for special handling;
- Remove from BHS - Operator can choose to remove bag from MES conveyor. Once bag is removed from MES, it is considered out of BHS;

If bag arrives MES but the BSM of its IATA interline tag has not received by BHS, MES operator can create a “Pseudo BSM” for the tag. And then use the pseudo BSM for code conversion. The pseudo BSM of IATA Interline tag will always be overwritten by the actual BSM received from CUTE/DCS.

The airport in-house labeling tag could be produced at MES for bags that have no IATA Interline tag, fallback tag or special security tag attached. In-house labeling tag is 10-digit number tag that has the same format as IATA Interline tag, except the value of first digit is not 0 and 1. When in-house tag is printed out from MES tag printer, its “Pseudo BSM” is created by MES and saved into the SAC database. The pseudo BSM of in-house tag will be used for code conversion.

The MES component is one of the sub systems in PGL PALS product to handle manual code conversion. They are deployed on multiple MES workstation computers.

For the details about MES please refers to [DDS - MES].

4.10 EBS GUI

The EBS component is one of the sub systems in PGL PALS product to handle early baggage. They are deployed on multiple EBS workstation computers. The EBS components provide the graphic user interface to operators work at the early bag storage area for registering bags delivered to early baggage line into early baggage storage inventory. It monitors the operation opening status of early bag and notify operator if flight allocation of any early bags is opened. EBS component is also responsible for inventory updating when early bag is retrieved from early bag storage and reloaded back to BHS system for sortation.

For the details about EBS please refers to the [DDS - EBS].

4.11 BIS GUI

The BIS (baggage identification system) components provide the graphic user interface to operator work at HBS Level 5 screening area, security operator screening room, customs screening operator room, and departure make-up areas, for them to identify the bag via bag IATA tag number or passenger name. If bag is successfully identified, its information will be displayed BIS workstation screen. The Level 5 screening area and customs screening room BIS also provides the functions and user interface for operator update bag Level 5 screening result and manual customs screening result into BHS database for reporting purpose.

The BIS component is one of the sub systems in PGL PALS product for bag identification. They are deployed on multiple BIS workstation computers located at several places in the BHS.

For the details about BIS please refers to [DDS - EBS].

4.12 MMIS

The MMIS component addresses human resource requirements, management and the control of purchasing fixed assets and inventory control, maintenance log, repair log, and management of human resources including shifts. It interfaces to MIS database for collecting maintenance data, e.g.

MMIS component is built on the standard “off-the-shelf” maintenance management software product. It is web base software application and on a redundant server pair. BHS user can access the MMIS functionalities via web browser from any BHS workstations computers in the BHS control room.

For the details about MMIS please refers to [DDS - MMIS].

4.13 DOMAIN CONTROLLER

BHS Windows domain network controller provides Active Directory, DNS, and Time services to BHS network equipments for centralized user security management, computer name resolution, and time synchronization. It is also the centralized backup server in BHS network.

Domain controller provides centralized user authentication when they log on to BHS servers and workstations. And user privilege level will then be identified by each system and only authorized accesses will be granted to user. For the details about integrated HLC security please refer to [DDS – HLC Security].

BHS domain controller is consisted of primary and secondary physical servers to provide uninterrupted domain network services to other BHS network equipments.

4.14 UTILITY

The utility components are consisted of anti-virus and network monitoring components. They are deployed on the virtual server that is running on a redundant physical server pair.

5. BHS TO EXTERNAL INTERFACES

5.1 BHS TO AIRPORT FLIGHT INFORMATION SYSTEM INTERFACE

In order for BHS to do the resource planning for baggage sortation control, the departure flight schedule information must be sent to BHS from Airport Operational Database (AODB). AODB is one of the airport host system responsible for supplying flight and related information to other airport systems. BHS server is connected to AODB server via terminal/airport wide network.

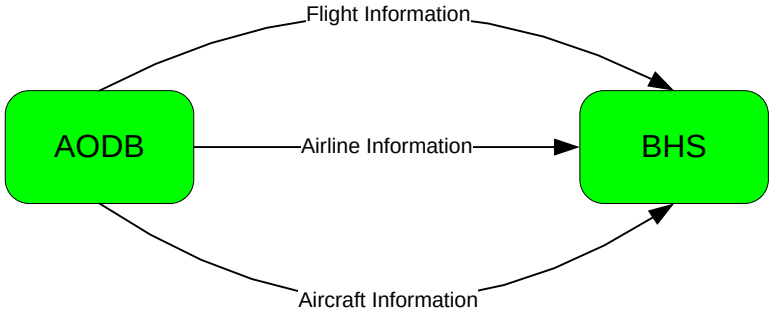


Figure 5-1: BHS-AODB Interface

As shown in Figure 5-1, there are 3 types of information are needed by BHS from AODB. They are:

- Flight Information;
- Airline Information;
- Aircraft Information

5.1.1 Flight Information

Flight information is required by BHS for creating allocation, baggage sortation control, etc. Following data fields could be included in the flight information provided by AODB:

- Flight identification (e.g. SQ123) – mandatory;
- Scheduled Time of Departure, STD (e.g. 2010-12-04 20:30) – mandatory;
- Flight final destination (e.g. SIN) – mandatory;
- Estimated Time of Departure, ETD (e.g. 2010-12-04 20:30);
- Flight status (cancelled);
- Flight stop over destinations;
- Aircraft IATA Code (e.g. 380);
- Gate (e.g. F07);
- Parking Stand;
- Ground Handler;
- Code share master flight identification;
- Code share master flight SDO;
- Flight exception data (e.g. 'RISK' for high risk flights);
- Departure make-up carousel allocated to the flight;
- Departure make-up carousel open time;
- Departure make-up carousel close time;

The flight information items marked as mandatory are essential for baggage handling in BHS. They are required to be presented in the data set of any flight information received from AODB.

If departure make-up carousel information in included in the flight information, they will be used to create flight allocation in the BHS database and displayed on the departure allocation Gantt chart GUI. If make-up allocation information is not provided by AODB, then the allocation can be also created in BHS by BHS departure allocation system.

Usually, the flight information is sent to BHS prior to the flight departure date. But AODB could send flight schedule updates to BHS during the BHS operation, e.g. changing flight STD, cancelling flight, etc. The existing flight allocation in BHS will be updated according to the received latest flight information.

BHS will store received flight information into BHS own database for sortation control.

In the case of AODB is unavailable, or the network connection between AODB and BHS is unavailable, the flight information could be created by BHS operator by using BHS Departure Allocation application GUI. The manual created flight information from BHS will not be uploaded to AODB. They will be overwritten by the new information of same flight received from AODB when the connection is recovered.

The Departure Allocation application also provide the functions for import flight information from XML or Excel format files on external data storage, e.g. CD, USB flash disk, etc. And it also provides the functions to export flight information from BHS database to external XML or Excel format files.

5.1.2 Airline Information

AODB system maintains the information of airlines that running the business in the airport. Airline information needs to be published to BHS for airline allocation (assigning departure make-up allocation to airline). The airline allocation data may be used for baggage sortation of no BSM bags.

Following data fields could be included in the airline information provided by AODB:

- Airline IATA code (e.g. SQ) – mandatory;
- Airline ICAO code (e.g. SIA)
- Prefix code / ticketing code (e.g. 618) – mandatory;
- Airline name (e.g. Singapore airline).

The flight information items marked as mandatory are essential for identification of one airline in BHS. They are required to be presented in the data set of any airline information received from AODB.

BHS will store received airline information into BHS own database for sortation control.

In the case of AODB is unavailable, or the network connection between AODB and BHS is unavailable, the Airline information could be entered by BHS operator by using BHS SAC GUI client application. The manual entered airline information from BHS will not be uploaded to AODB. They will be overwritten by the new information of same airline received from AODB when the connection is recovered.

5.1.3 Aircraft Information

AODB system maintains the information of aircraft that is used in the airport. Aircraft information needs to be published to BHS for determination of make-up carousel overloading by allocated flights against make-up capacity.

Following data fields could be included in the aircraft information provided by AODB:

- Aircraft IATA code (e.g. 380) – mandatory;
- Aircraft ICAO code
- Number of Seats (e.g. 600) – mandatory;
- Manufacturer and aircraft type/model (e.g. Airbus A380 pax).

The aircraft information items marked as mandatory are essential for identification of aircraft capacity in BHS. They are required to be presented in the data set of any aircraft information received from AODB.

BHS will store received aircraft information into BHS own database for sortation planning.

In the case of AODB is unavailable, or the network connection between AODB and BHS is unavailable, the aircraft information could be entered by BHS operator by using BHS SAC GUI client application. The manual entered aircraft information from BHS will not be uploaded to AODB. They will be overwritten by the new information of same aircraft received from AODB when the connection is recovered.

5.1.4 BHS-AODB Interface Protocol

The AODB is the airport host system to centrally provide information to other airport systems. The common interface communication protocol should provide by AODB and followed by all other systems that need interface with it.

An alternative communication protocol for BHS-AODB interface is proposed by PGL, too. It is PGL internal standard interface protocol for flight information system. It consists of transport and application layer protocols. Please refer to below 2 interface documents for the details:

- **Transport Layer Protocol**:
  Protocol Name: Frame-On-TCP
  Design Document: [PGL-102-01-1.03 IS_TP_FrameOnTCP]
- **Application Layer Protocol**:
  Protocol Name: SAC-FIS
  Design Document: [PGL-102-21-3.00 IS_AP_SAC2FIS]

BHS SAC will validate the data format, e.g. character range, field lengths, etc. of received information from AODB against the interface protocol. Data that do not comply with the interface protocol will be classified as invalid data and not be used by BHS. The alarm will be generated by SAC and displayed on MDS if more than 3 (configurable) consecutive invalid messages are received from AODB.

5.2 BHS TO AIRPORT BAGGAGE INFORMATION SYSTEM INTERFACE

Usually, the airport CUTE/DCS host system is responsible for distribution of baggage information to other systems, including BHS. BHS server is connected to CUTE/DCS server via terminal/airport wide network.

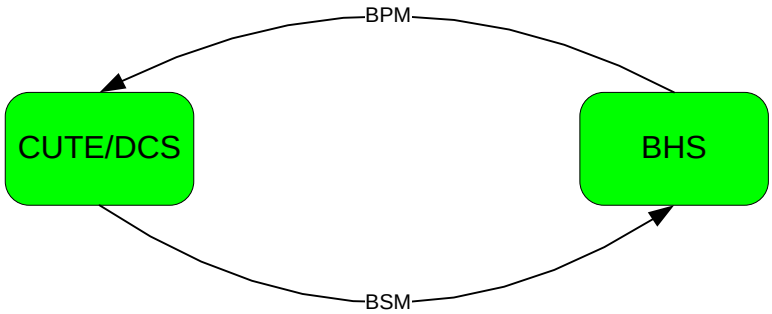


Figure 5-2: BHS-CUTE/DCS Interface

As shown in Figure 5-2, there are 2 types of information are exchanged between BHS and CUTE/DCS. They are:

- Baggage Source Message (BSM)
- Baggage Processed Message (BPM)

5.2.1 Baggage Source Message (BSM)

With referring to IATA RP 1745, Baggage Source Message (BSM) is designed to provide information for processing of baggage by automated baggage systems. A BSM is sent by the departing carrier from its departure control or check-in system, or that of its handling agent, to BHS at the point of departure.

A single BSM will be transmitted for each passenger or group of passengers, and must be received by the time the baggage has been conveyed from the check-in area to the sortation point.

If BSM is not available for a long period, IATA fallback tag could be attached to the bag at check-in counter. Bag will be sorted as per the fallback tag mapping, and therefore BSM is not needed to handle IATA fallback tag sortation.

The Departure Allocation application provide the functions for BSM from XML or Excel format files on external data storage, e.g. CD, USB flash disk, etc. And it also provides the functions to export BSM from BHS database to external XML or Excel format files.

5.2.2 Baggage Processed Message (BPM)

BPM contains data regarding the status of baggage for tracking and reconciliation. The transporting carrier or its handling agent to track the ground transportation may use this information. BHS will produce the BPM and sent to CUTE/DCS when below 3 bag events are happened:

- Bag is scanned by ATRs located on conveyor or TTS, or scanned by MES handheld scanner;
- Bag HBS screening result is received by SAC;
- Bag is sorted (location and time).

Similar with BSM, the BPM produced by BHS is compliant with the IATA RP1745 standard.

5.2.3 BHS-CUTE/DCS Interface Protocol

The CUTE/DCS is the airport host system to centrally provide baggage information to other airport systems. The common interface communication protocol should provide by CUTE/DCS and followed by all other systems that need interface with it.

An alternative communication protocol for BHS-CUTE/DCS interface is proposed by PGL, too. It is PGL internal standard interface protocol for flight information system. It consists of transport and application layer protocols. Please refer to below 2 interface documents for the details:

- **Transport Layer Protocol**:
  Protocol Name: Frame-On-TCP
  Design Document: [PGL-102-01-1.03 IS_TP_FrameOnTCP]
- **Application Layer Protocol**:
  Protocol Name: SAC-BSI
  Design Document: [PGL-102-22-1.02 IS_AP_SAC2BSI]

BHS SAC will validate the data format, e.g. character range, field lengths, etc. of received BSM from CUTE/DCS against the interface protocol. Data that do not comply with the interface protocol will be classified as invalid data and not be used by BHS. The alarm will be generated by SAC and displayed on MDS if more than 3 (configurable) consecutive invalid BSM are received from CUTE/DCS.

5.3 BHS TO AIRPORT MASTER TIME CLOCK SYSTEM INTERFACE

The airport Master Time Clock System (MTCS) is an IP-based, digital networked system. It will provide the primary source of accurate time throughout the terminal building. Using the terminal/airport wide network infrastructure, the MTCS solution will be used to synchronize integrated systems ensuring accuracy and consistency in time across systems.

The domain controller server in the BHS is responsible to synchronize its machine time with airport MTCS using Network Time Protocol (NTP).

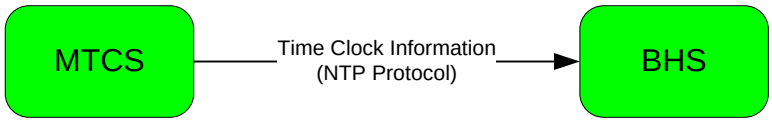


Figure 5-3: BHS-MCS Interface

BHS sortation control system is consisted of multiple servers and workstations. It is important to keep their machine time clock to be synchronized. In BHS Windows domain network environment, the domain control server serves as the BHS internal time clock server for all other BHS computers (servers and workstations) to synchronize their local time with it automatically by using Windows NTP (Network Time Protocol) service.

6. BHS RESOURCE ALLOCATION PLANNING

The main purpose of BHS resource allocation planning is setting up the relationship between BHS sort destinations (e.g. make-up carousel, EBS, MES, etc.) and departure flights, airlines, IATA and Airport fallback tags, etc.

6.1 BHS AVAILABLE ALLOCATION RESOURCES (SORT DESTINATIONS)

The allocation resources are also called as the sort destination of baggage travelling within the BHS. They are sort destination of baggage. They could be departure make-up carousel, early baggage storage, manual encoding stations, etc.

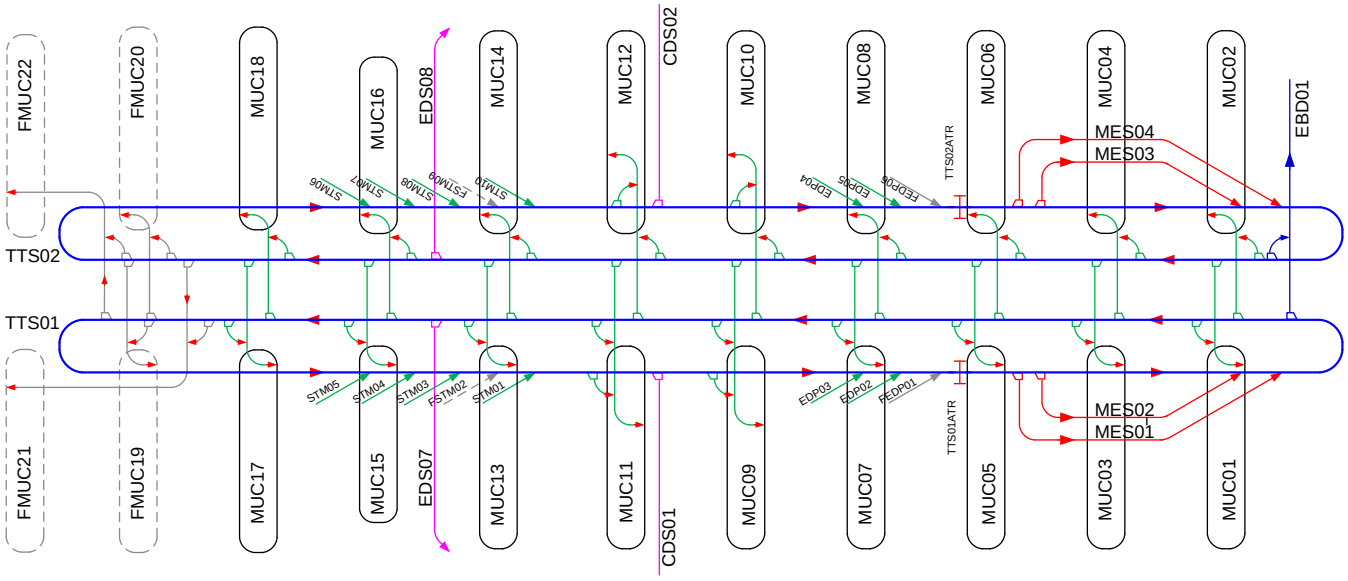


Figure 6-1: Allocation Resources (Sort Destinations)

As shown in the Figure 6-1, there are total 5 categories, 27 allocation resources are available in the Mumbai airport BHS:

No.	Resource Code	Category	Description
1	MUC01	MUC	Departure make-up carousel, bag final sort destination in the BHS.
2	MUC02	MUC	Departure make-up carousel, bag final sort destination in the BHS.
3	MUC03	MUC	Departure make-up carousel, bag final sort destination in the BHS.
4	MUC04	MUC	Departure make-up carousel, bag final sort destination in the BHS.
5	MUC05	MUC	Departure make-up carousel, bag final sort destination in the BHS.
6	MUC06	MUC	Departure make-up carousel, bag final sort destination in the BHS.
7	MUC07	MUC	Departure make-up carousel, bag final sort destination in the BHS.
8	MUC08	MUC	Departure make-up carousel, bag final sort destination in the BHS.
9	MUC09	MUC	Departure make-up carousel, bag final sort destination in the BHS.

10	MUC10	MUC	Departure make-up carousel, bag final sort destination in the BHS.
11	MUC11	MUC	Departure make-up carousel, bag final sort destination in the BHS.
12	MUC12	MUC	Departure make-up carousel, bag final sort destination in the BHS.
13	MUC13	MUC	Departure make-up carousel, bag final sort destination in the BHS.
14	MUC14	MUC	Departure make-up carousel, bag final sort destination in the BHS.
15	MUC15	MUC	Departure make-up carousel, bag final sort destination in the BHS.
16	MUC16	MUC	Departure make-up carousel, bag final sort destination in the BHS.
17	MUC17	MUC	Departure make-up carousel, bag final sort destination in the BHS.
18	MUC18	MUC	Departure make-up carousel, bag final sort destination in the BHS.
19	MES01	MES	Manual encoding station 1 connected to TTS 01.
20	MES02	MES	Manual encoding station 2 connected to TTS 01.
21	MES03	MES	Manual encoding station 3 connected to TTS 02.
22	MES04	MES	Manual encoding station 4 connected to TTS 02.
23	EBS01	EBS	Early bag storage.
24	EDS07	EDS	HBS Level 5 EDS line connected to TTS 01.
25	EDS08	EDS	HBS Level 5 EDS line connected to TTS 02.
26	CDS01	CDS	Custom detection screening line connected to TTS 01.
27	CDS02	CDS	Custom detection screening line connected to TTS 02.

Among above 5 categories resources, only departure make-up carousels are the final sort destination of bag travelling in the BHS and available on the BHS Departure Allocation (DA) application Gantt chart graphic user interface (as shown on Figure 6-2) for displaying flight allocations associated to each make-up, and for mouse drag & drop creating new flight allocations.

For the details about departure allocation application please refers to [DDS - DA].

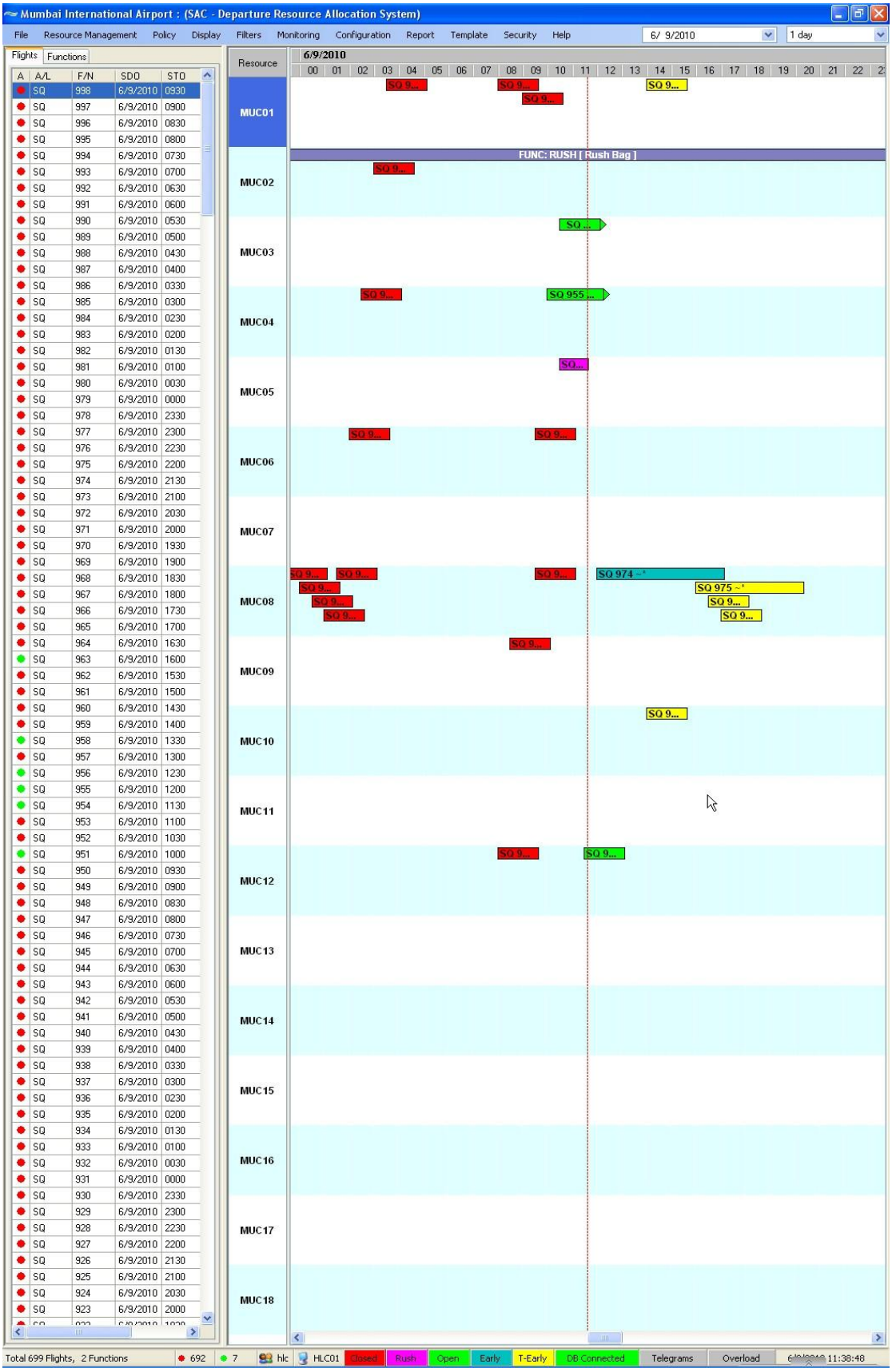


Figure 6-2: Departure Allocation Gantt chart

6.2 TYPE OF DEPARTURE ALLOCATION

In order for BHS Sortation Control system to sort the bag automatically, the Sort destination (Allocation Resources) must be assigned to the flight/airline/IATA fallback tag prior to the checking in of the bag. This destination assignment process is called “Departure Allocation”. It can be performed through “Departure Allocation” application software running on the SAC-OWS computer, which is located in the BHS control room.

PGL sortation control system support following allocation type for departure baggage sortation control:

- **Flight Allocation** – Assign sort destination (departure make-up carousel) to departure flights. The flight allocation could be created by airport AODB/RMS host system and sent to BHS for baggage sortation control. Flight allocation can also be created by BHS as well.
- **IATA Fallback Tag Allocation** – Assign sort destination (departure make-up carousel) to 10-digit IATA Fallback tag. The fallback tag used in airport shall comply with the rules stated in IATA Recommended Practice 1740b: License Plate Fallback Sortation Tag.
- **Airport Fallback Tag Allocation –** Assign sort destination (departure make-up carousel) to 4-digit Mumbai airport fallback tag.
- **Airline Allocation** – Assign sort destination (departure make-up carousel) to airline (carrier). The airline code can be identified from 10-digit number of bag IATA sortation tag (not IATA fallback tag).
- **Gate Allocation** – Assign sort destination (departure make-up carousel) to aircraft parking position (Gate).
- **Ground Handler Allocation** – Assign sort destination (departure make-up carousel) to its ground handler.

6.3 DEPARTURE FLIGHT ALLOCATION PROPERTIES

As shown in the Figure 6-3, the flight allocation is defined by several properties. And it has different states along with time. There is different sortation rules could be used by sortation control system according to the allocation states.

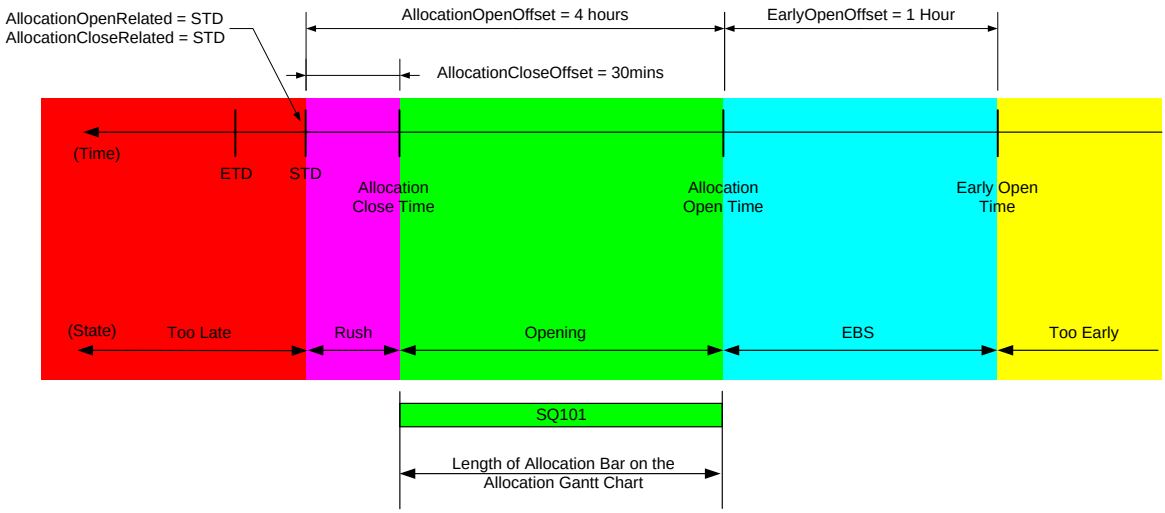


Figure 6-3: Departure Flight Allocation Property and State Determination

The properties of allocation are listed in the table below:

No.	Property	Description	Default Value
1	**Flight Number**	The departure flight number on which the allocation is created for.	SQ101
2	**Allocation Open Related Time**	The base time for departure flight allocation open time determination. It is the time to which the departure flight allocation open time is related. The open related setting could be following flight schedule times: • **STD** – Scheduled time of departure; • **ETD** – Estimated time of departure; The STD and ETD data is part of the flight information that is received from flight information system (e.g. AODB). If the ETD is not specified in the flight information, the STD value will be assigned to them as the default value.	STD
3	**Allocation Open Offset Time**	The offset from base time (Open Related Time) to determine departure flight allocation open time. Departure Flight Allocation Open Time = (Open Related Time – Open Offset Time). For Example: **Open Related Time** = STD (2008-01-20 11:30AM) **Open Offset Time** = 120 minutes (2 hours) Then this Departure Flight Allocation will be opened at the time "**2008-01-20 09:30AM**", 2 hours before the STD.	120 minutes (2 Hours)
4	**Allocation Close Related Time**	The base time for departure flight allocation close time determination. It is the time to which the departure flight allocation close time is related. The close related setting could be following flight schedule times: • **STD** – Scheduled time of departure; • **ETD** – Estimated time of departure; Or "MAN" for manual close allocation: • **MAN** – Manual close the allocation. MAN can be used to keep allocation opening in the case of flight is delayed with no further departure time is confirmed and sent to BHS. The STD and ETD data is part of the flight information that is received from flight information system (e.g. AODB). If the ETD is not specified in the flight information, the STD value will be assigned to them as	STD

		the default value. If MAN is selected, the Departure Flight Allocation will be kept as open, until the operator manually closes it from DA application GUI.	
5	**Allocation Close Offset Time**	The offset from base time (Close Related Time) to determine departure flight close time. Departure Flight Allocation Close Time = (Close Related Time – Close Offset Time). For Example: **Close Related Time** = STD (2008-01-20 11:30AM) **Close Offset Time** = 30 minutes Then this Departure Flight Allocation will be closed at the time "**2008-01-20 11:00AM**", 15 minutes before the STD.	30 minutes
6	**Early Open Offset Time**	The offset time from allocation open time to determine the early open time. Bags checked in before early open time is classified as the Too-Early baggage. For Example: **Open Related Time** = STD (2008-01-20 11:30AM) **Open Offset Time** = 120 minutes (2 hours) **Early Open Offset Time** = 60 minutes (1 Hour) Then those bags checked-in between 08:30AM to 09:30AM are the Early baggage. And bags checked in before 08:30AM are Too-Early baggage.	60 minutes
7	**Enable Too-Early Baggage Sortation**	Indicator of whether the Too-Early Baggage Sortation is enabled or disabled. If Too-Early Sortation is disabled, then early checked in baggage will not be differentiated as Early and Too-Early baggage. All bags checked in before the allocation is opened will be handled as Early baggage only.	FALSE
8	**Enable Early Baggage Sortation**	Indicator of whether the Early Baggage Sortation is enabled or disabled. If Early Sortation is disabled, all bags checked in before the allocation is closed will be handled as normal opening state baggage. This property could be set to FALSE for those airports that do not have early baggage storage.	TRUE
9	**Allocated Destination**	The sort destination (allocation resource) that is allocated to departure flight.	(to be vary)

		All OPEN state bags will be sorted to this allocated destination.	

The default value of the departure flight allocation properties can be changed by authorized BHS operator from Departure Allocation software graphic user interface.

6.4 DEPARTURE FLIGHT ALLOCATION STATES (BAG TIMING)

Flight allocation state is the time condition of allocation determined by allocation property settings and the time when bag is detected by sortation scanner (overhead ATR on the TTS, or hand-held scanner at MES) in the BHS. As shown in above Figure 6-3, the time-line can be divided into discrete 5 intervals, and each time interval represents one allocation state of departure flight.

No.	State	Description
1	**TOO EARLY**	If bag is checked in before the Early Open time, it will be classified as the Too Early baggage and will be handled in a special way, e.g. store it in some special place. Too-Early sortation function could be disabled if it does not need by airport. Enable or disable the Too Early state is controlled by "**Enable Too Early Function"** allocation property setting. If "Too Early" is enabled, sorting destination for "**Too Early**" baggage needs to be defined through Departure Functional Allocation (refer to next chapter). Otherwise, the Too Early bag will be handled as no allocation bag, which default sort destination is Manual Encoding Station (MES). If "Too Early" is disabled, all bags checked in before allocation is opened will be handled as the Early baggage.
2	**EARLY**	If the bag is checked-in before its flight allocation is opened (if Too-Early sortation is disabled), or within the time frame between Early Open Time and Allocation Open Time (if Too-Early sortation is enabled), it will be classified as the Early baggage and handled in a special way, typically sent to EBS. The sorting destination for **Early** state baggage needs to be allocated through Departure Functional Allocation (refer to next chapter). Otherwise, the Early bag will be handled as no allocation bag, which default sort destination is Manual Encoding Station (MES).
3	**OPENING**	If the bag is checked-in after its flight allocation is opened, and before rush state is opened, it will be classified as the normal bag and sorted to the final sort destination (make-up carousel) allocated to its flight. The majority of departure bags should be handled with this time frame in order to achieve the minimum manual intervention.
4	**RUSH**	The RUSH state is immediate started when the fight allocation is closed. And RUSH state is end at flight STD time. If bag is detected during this period, it will be classified as the Rush baggage and handled specially, for example sort to the dedicated carousel instead of allocated carousel to its flight, in order to expedite the sortation process and prevent miss its airplane.

		The sort destination for **Rush State** baggage needs to be allocated through Departure Functional Allocation (refer to next chapter). Otherwise, the Rush bag will be handled as no allocation bag, which default sort destination is Manual Encoding Station (MES).
5	**TOO LATE**	The TOO LATE state is started at flight STD time. If bag is checked in after STD, there is no enough time for it to catch up airplane. Hence, too late bag will miss its flight. Too late bag needs to be handled specially, for example sort to a dedicated make-up carousel for “Too Late” situation. The sort destination for **Too Late** baggage needs to be allocated through Departure Functional Allocation (refer to next chapter). Otherwise, the Too Late bag will be handled as no allocation bag, which default sort destination is Manual Encoding Station (MES).

When flight allocation is created, it will be presented as a bar graphic on the Gantt chart user interface of Departure Allocation (DA) application running on the SAC workstation. The length of bar represents the timeframe between allocation open and close time. As shown on refer to Figure 6-4, the red colour vertical dashed line cross over the Gantt chart represents the current time line. By comparison of allocation timeframe and current time, the state of each allocation can be determined and presented into 5 colours as below:

- Yellow - Allocation is in Too Early state;
- Light Blue - Allocation is in Early state;
- Green - Allocation is in Opening state;
- Pink - Allocation is in Rush state;
- Red - Allocation is in Too Late state;

Along the elapsing of time, the flight allocation state will keep changing from Too Early until Too Late. DA application will automatically change the allocation bar color accordingly. Moreover, the different Sortation rules will be applied automatically by Sortation control according to the current allocation state.

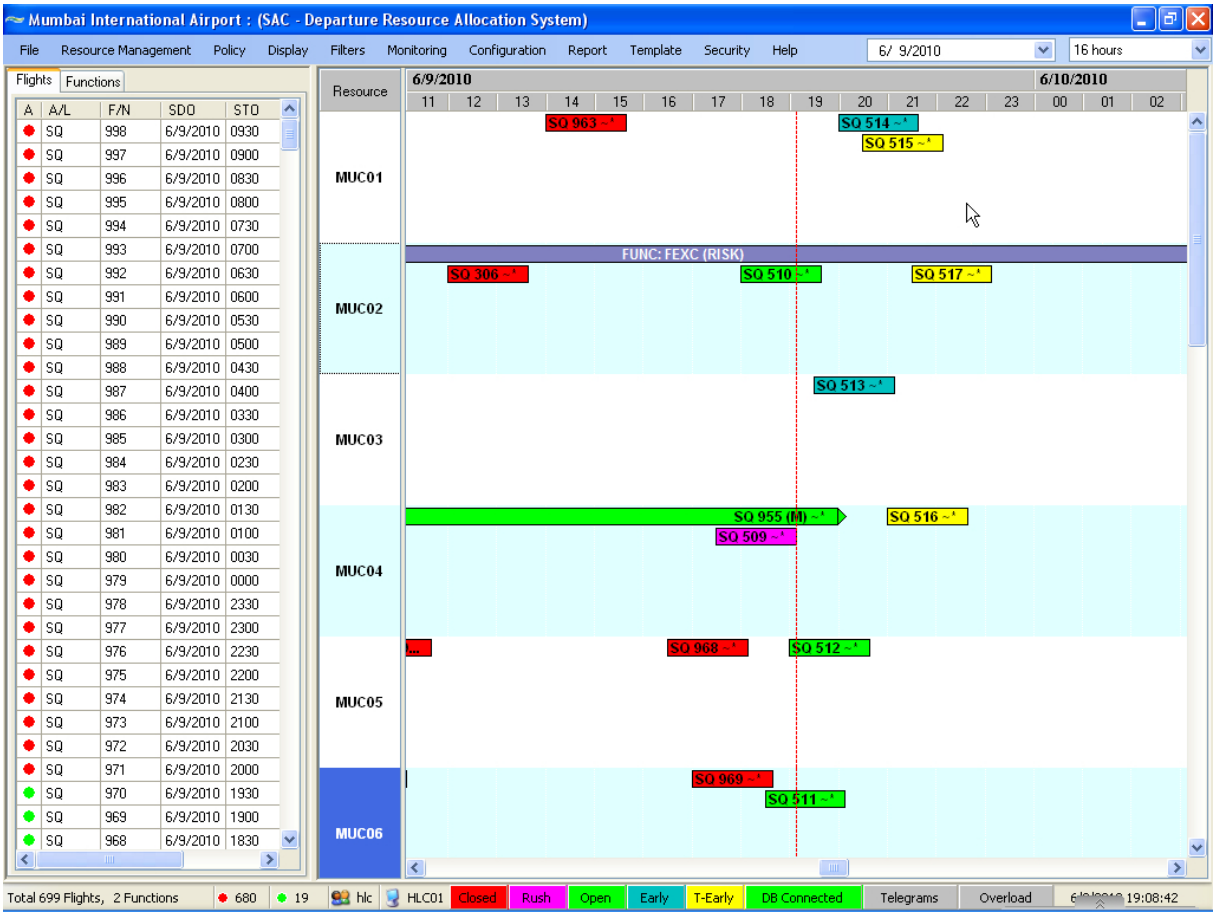
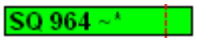


Figure 6-4: Flight Allocation Gantt chart

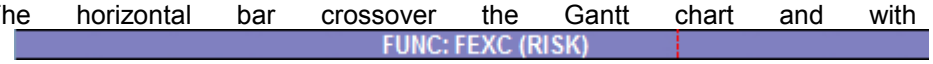
The flight allocation bar has below two shapes:

- **Rectangle Bar -** 

  It represents that the flight allocation will be closed automatically when current time passes the allocation closed time. The allocation bar label represents the flight number *(SQ964 in above sample)* and the travel class *(* in above sample that represents common class applicable to all bags)* that the allocation is created for.

- **Rectangle with Right Pointed Triangle Bar -** 

  It represents the open allocation that need to be closed by BHS operator manually. The "(M)" manual close application indicator is included into the allocation bar label, too. Manual close allocation could be needed when flight departure time is postponed after its allocation has been opened, and the new departure time is not confirmed yet.

The horizontal bar crossover the Gantt chart and with "FUNC:***" label (

 ), represents the function allocation for bags required special handling (e.g. bags of flight with exception data 'RISK' needs to be sent to dedicated make-up carousel). Refer to chapter 6.12 below for the details about function allocation.

6.5 AUTO FLIGHT SORT ALLOCATION

Flight allocation could be created in two ways, created by SAC system automatically or manual created by BHS operator via Departure Allocation application graphic user interface by mouse drag and drop manner.

Auto creation of departure flight allocation can be triggered by incoming flight information received from AODB in below two scenarios:

- **Scenario 1** - Auto create departure flight allocation by using allocation data included in the incoming flight information;

  As described in the chapter 5.1: BHS to Airport Flight Information System Interface, the assignment of make-up carousel to departure flight could be performed by airport AODB/RMS host system, and then sent to BHS. When BHS receives the flight information, and in which the 3 compulsory fields (**make-up carouse ID, open and close time of operation**) for define sort destination are included, then the allocation of this flight will be created by SAC automatically and stored in the BHS database.

  Once the departure flight allocation is created and stored in the BHS database, it will be automatically presented as allocation bars on the Gantt chart of Departure Allocation application that is running on the SAC workstation.

- **Scenario 2** - Auto create departure flight allocation by using pre-configured “Auto Allocation Profile” in the BHS.

  If the make-up carousel and its operation timeframe are not presented in the incoming flight information, BHS SAC system is still able to create the sort allocation automatically base on the “Auto Sort Allocation Policy” that is pre-set in the BHS.

6.5.1 Auto Sort Allocation Policy

In order for BHS to create flight sort allocation automatically upon receives the flight information, there must be one flight allocation profile, which contains one or more prioritized allocation templates, is activated as illustrated in Figure 6-5 below:

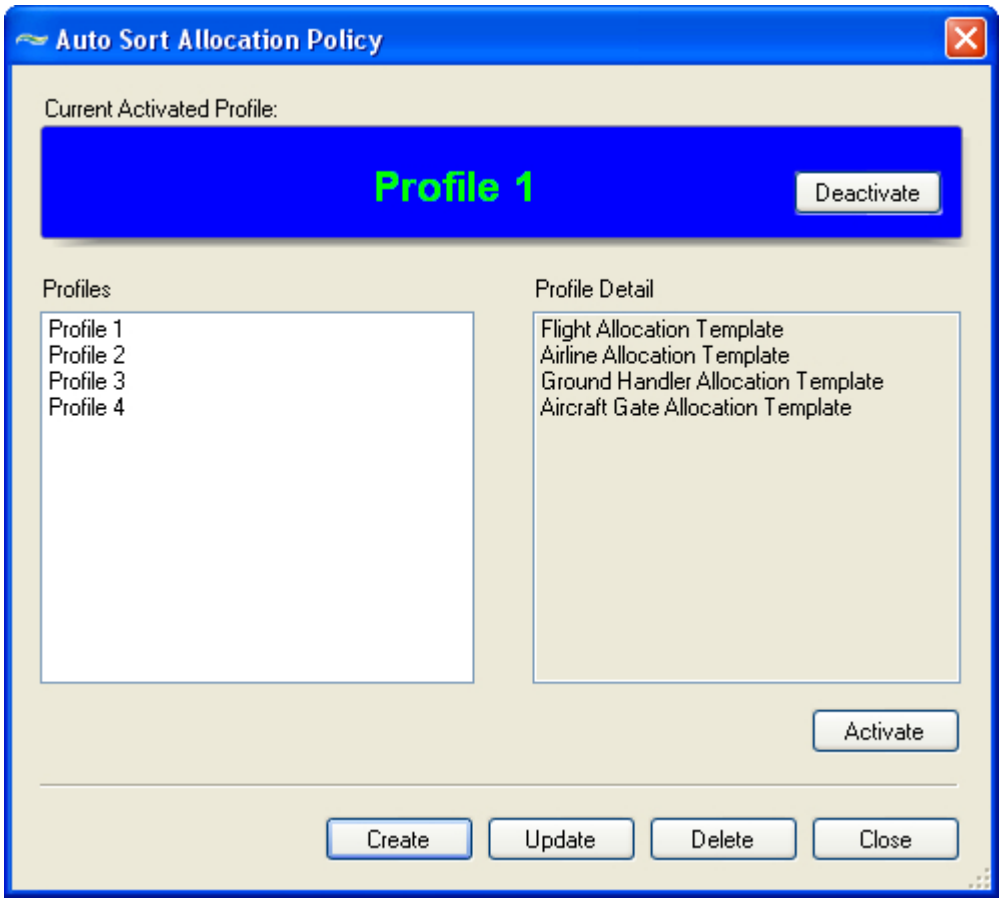


Figure 6-5: Auto Sort Allocation Policy

6.5.1.1 Allocation Templates

There are total 4 allocation templates are supported by BHS SAC system. They are required by creating auto sort allocation profiles. All of 4 templates are fully configurable by BHS operators via Departure Allocation application GUI. For the details of template management please refers to [DDS – DA].

These 4 allocation templates are:

- Flight Allocation Template
- Airline Allocation Template
- Ground Handler Template
- Aircraft Gate (Parking Position) Template

Flight Allocation Template

Flight Allocation Template contains the list of predefined relationships (template profiles) between the express of departure flight code, default time setting of allocation states, sort destination, etc. One template is defined for one weekday. And multiple templates can be organized into different groups. The individual template or template group can be assigned to the calendar days or weeks prior to the flight information be received for particular calendar day. As shown in Figure 6-6, “Monday”, “Tuesday” and “Wednesday” 3 templates are assigned to 3 calendar days 28/06/2010, 29/06/2010 and 30/06/2010 respectively.

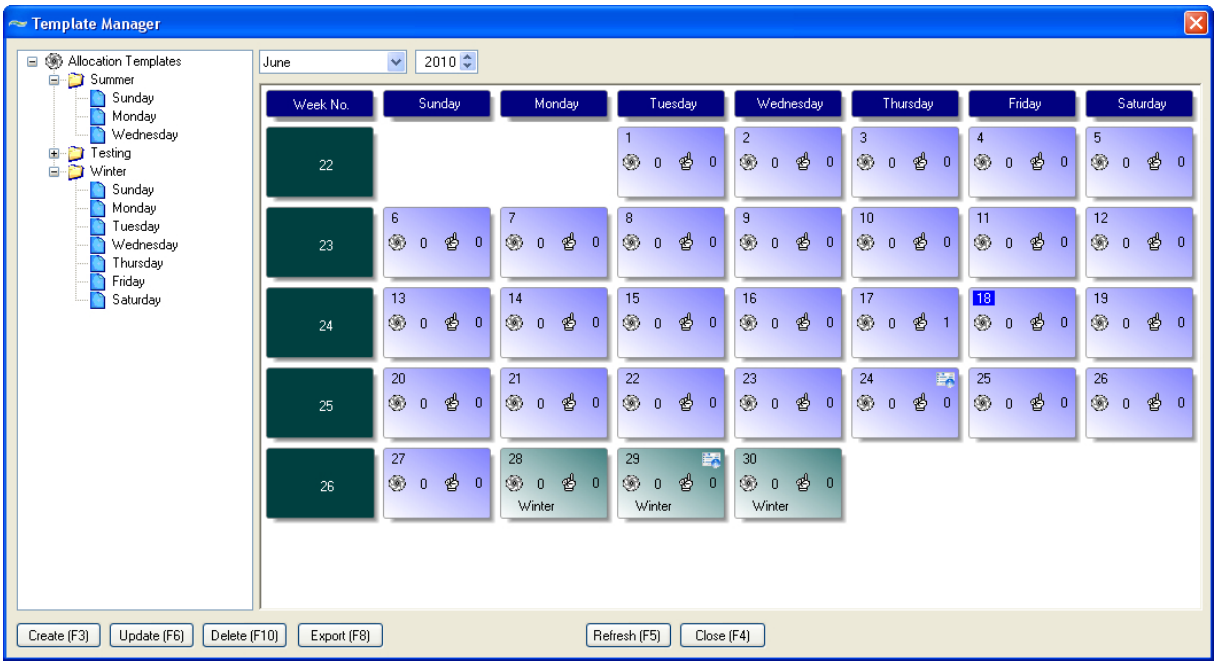


Figure 6-6: Flight Allocation Template Manager

When the flight information of any calendar day is received from AODB or imported from external XML or Excel file, and it match to the allocation profile defined in the calendar day assigned template, then the pre-configured sort destinations in the profile will be auto assigned to the flight for creating of allocations. BHS operator can afterwards change the new allocation settings inherited from template profile.

Within one flight template, the multiple template profiles can be created. The expression is used in the profile for matching to different airline code and flight numbers. It could be the actual flight number, or represented by wildcard. Below are two example records defined in “Winter\Monday” template for weekday Monday:

Example 1: Template profile for flight SQ123.

Template Group:	Winter
Template Weekday:	Monday
Flight Code Expression:	SQ123
Early Start Time:	180 minutes before STD
Open Time:	120 minutes before STD
Rush Start Time:	30 minutes before STD
Too Late Start Time:	0 minute before STD

Sort Destination and Sorting Criterions:	MUC05 <Bag Type: CREW, Flight Destination: *, Class: *, Onward Transfer: *> MUC06 <Bag Type: *, Flight Destination: *, Class: *, Onward Transfer: *>

Example 2: Template profile for all Air India flights.

Template Group:	Winter
Template Weekday:	Monday
Flight Code Expression:	AI*
Early Start Time:	180 minutes before STD
Open Time:	120 minutes before STD
Rush Start Time:	30 minutes before STD
Too Late Start Time:	0 minute before STD
Sort Destination and Sorting Criterions:	MUC10 <Bag Type: *, Flight Destination: *, Class: F, Onward Transfer: *> MUC11 <Bag Type: *, Flight Destination: *, Class: *, Onward Transfer: *>

In the Figure 6-6 example, the flight allocation template “Winter\Monday” is assigned to calendar day 28/06/2010. When BHS receives the information of date 28/06/2010 flight SQ123, the two allocations with sort destination MUC05 for CREW bags and MUC06 for other type bags will be auto created. Similarly, the two allocations with sort destination MUC10 for first class bags and MUC11 for other bags will be created automatically for all Air India flights when their flight information is received in BHS.

If the incoming flight information matches to multiple profiles in the assigned template of given calendar day, then the most matched with specified value in the expression will be chosen for auto allocation. For example, profile with **AI123** expression value will have higher priority than profile with **AI*** expression value.

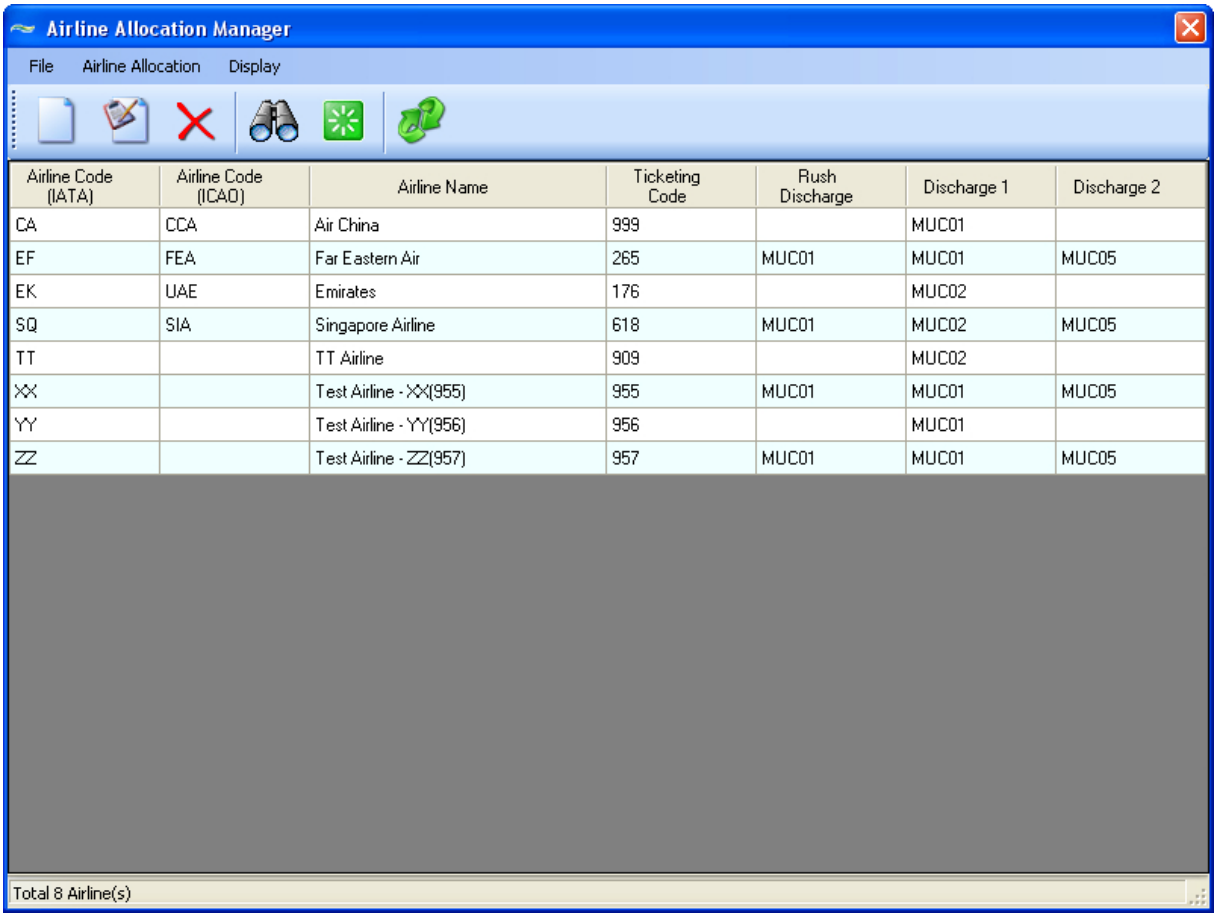
Using this template, the same flight but different sort destination could be defined in different sets of allocation templates and assigned to different seasons of the year in advance. For example: summary, winter, or Christmas holiday season, etc.

For any given day, there is only one flight allocation template can be assigned.

For the details about flight template management please refers to [DDS – DA].

Airline Allocation Template

Airline allocation template is the mapping table of airline name, its IATA code, and its associated make-up carousels. Using this template, it is possible to auto assign sort destination, which is associated to the airline defined in the airline allocation template, to the flight when its information is received from AODB or imported from external XML or Excel file.



Airline Code (IATA)	Airline Code (ICAO)	Airline Name	Ticketing Code	Rush Discharge	Discharge 1	Discharge 2
CA	CCA	Air China	999		MUC01	
EF	FEA	Far Eastern Air	265	MUC01	MUC01	MUC05
EK	UAE	Emirates	176		MUC02	
SQ	SIA	Singapore Airline	618	MUC01	MUC02	MUC05
TT		TT Airline	909		MUC02	
XX		Test Airline - XX(955)	955	MUC01	MUC01	MUC05
YY		Test Airline - YY(956)	956		MUC01	
ZZ		Test Airline - ZZ(957)	957	MUC01	MUC01	MUC05

Figure 6-7: Airline Allocation Template

The airline name/code can be identified by SAC automatically from received flight information. Each airline could have up to two (2) sort destinations.

It is possible to assign the sort destination of RUSH bag for airline respectively. If airline specific RUSH sort destination is given, it will supersede the global RUSH sort destination setting.

For the details about carrier/airline allocation management please refers to [DDS – DA].

Ground Handler Allocation Template

Ground handler allocation template is a mapping table of baggage ground handler name/code and its associate make-up carousel. Using this template, it is possible to auto assign sort destination, which is associate to flight's ground handler, to the flight when its information is received from AODB or imported from external XML or Excel file.

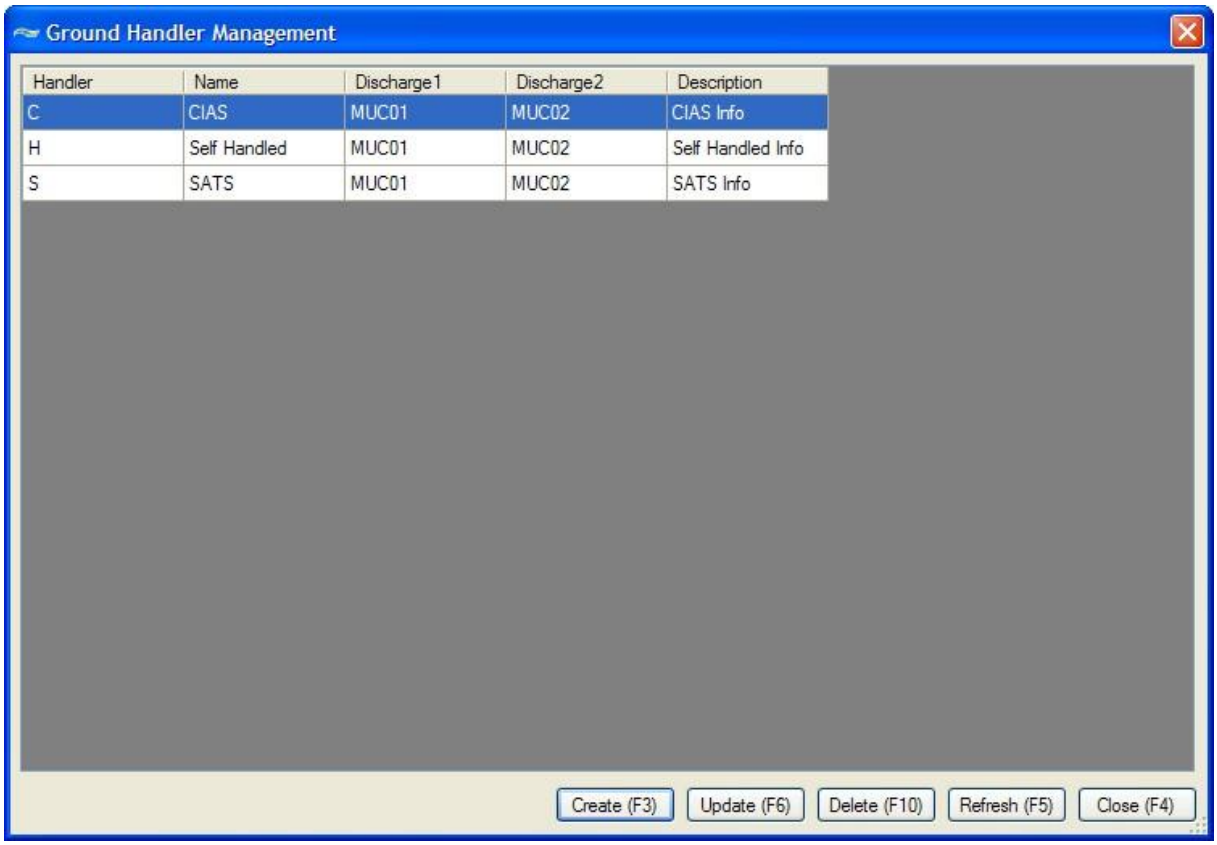


Figure 6-8: Ground Handler Allocation Template

The ground handler name/code can be identified by SAC automatically from received flight information. Each ground handler could have up to two (2) sort destinations.

For the details about ground handler allocation template please refers to [DDS – DA].

Aircraft Gate (Parking Position) Allocation Template

Aircraft gate allocation template is the mapping table of aircraft gate (parking position) and make-up carousel. Using this template, it is possible to auto assign the sort destination, which is associated to the aircraft gate, to the flight when its information is received from AODB or imported from external XML or Excel file.

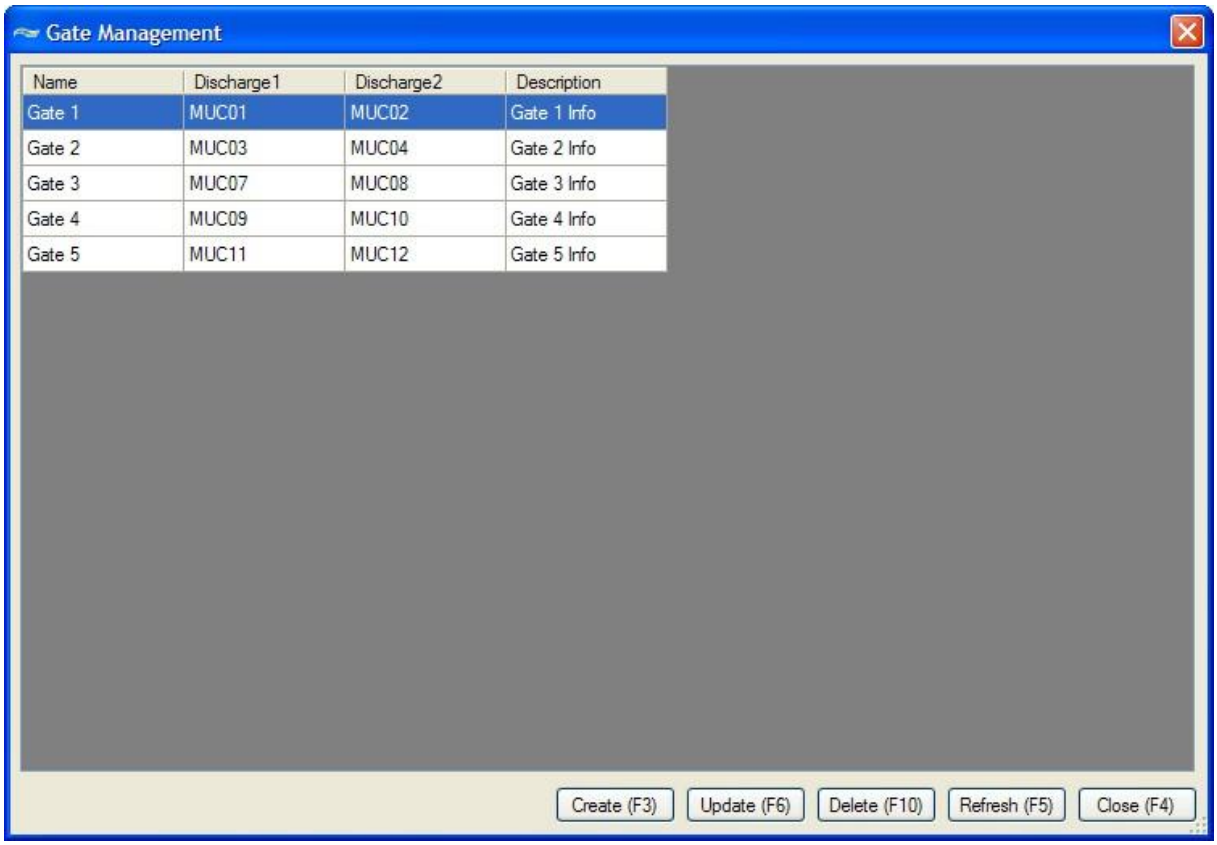


Figure 6-9: Aircraft Gate Allocation Template

The aircraft gate can be identified by SAC automatically from received flight information. Each aircraft gate could have up to two (2) sort destinations.

For the details about aircraft gate allocation template please refers to [DDS – DA].

6.5.1.2 Auto Sort Allocation Profile

In order to enable the auto creation of flight allocation feature, the “Auto Sort Allocation Profile” needs to be created and activated by BHS operator.

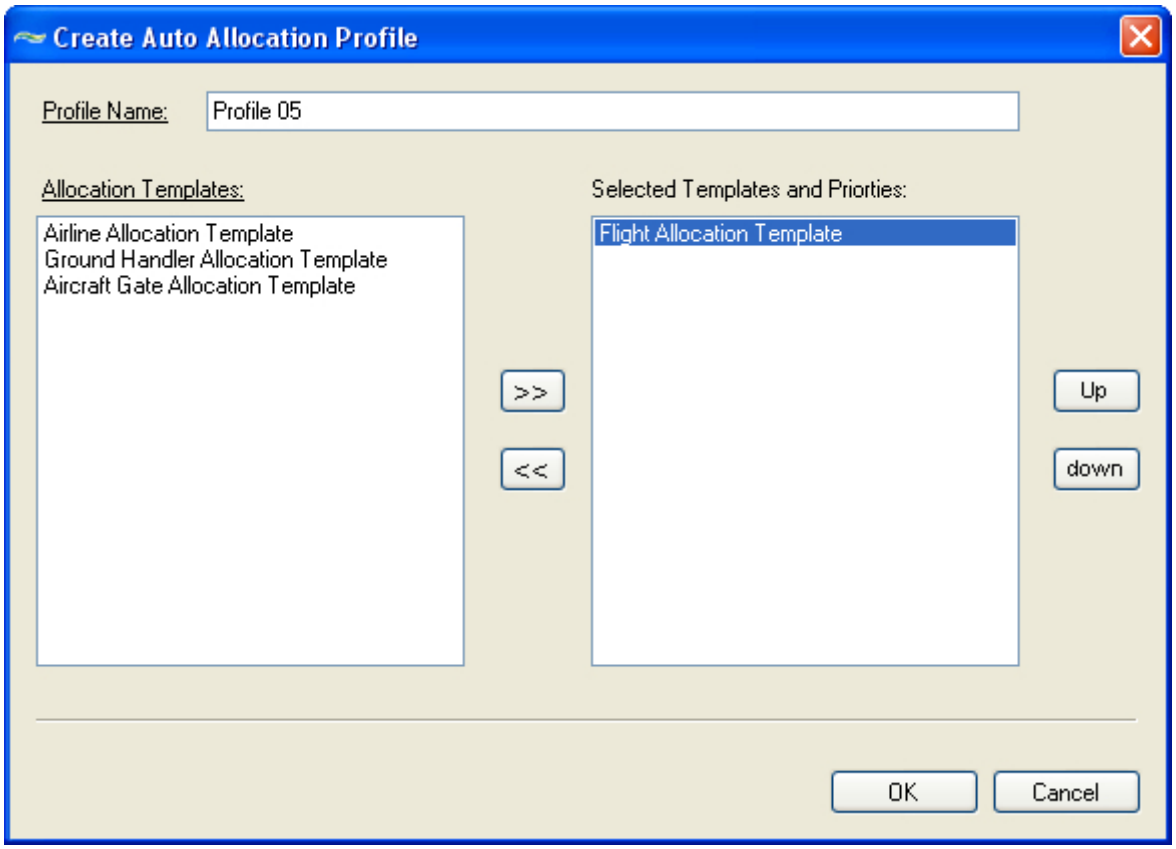


Figure 6-10: Create Auto Sort Allocation Profile

As shown in Figure 6-10, each “Auto Sort Allocation Profile” could include single or multiple above 4 templates. If multiple templates are selected for a profile, the priority will be applied to control the sequence of profiles to be followed by SAC during the auto creating of flight allocation.

If the flight allocation is successfully created by following the higher priority template, then the lower priority template will not be used. Otherwise, the auto allocation process will check the lower priority templates one by one, and will be completed when flight allocation is created by one priority level template or no allocation is created after look through all level templates.

BHS operator is allowed to create unlimited number of auto sort allocation profiles, but at any time only single profile can be activated and guide SAC system to create the flight allocation automatically.

If there is no any one of profiles is activated, then no any allocation will be created for the flight when its information is received by BHS. But the allocation can still be created manually by operator at any time after the flight information received.

After auto sort allocation profiles are created, they are allowed to be updated or deleted by BHS operator at any time. Any updated of allocation templates will not affect any existing flight allocations that were created base on the template. But the updates will be taken effective for any new auto flight allocations if the updated template is activated.

6.6 MANUAL FLIGHT SORT ALLOCATION

In additional to the auto creation triggered by receiving of flight information, Flight allocation could be created, updated or deleted manually by BHS operator. Manual creating flight allocation is useful when flight allocation is not created automatically due to some reasons, e.g. no auto sort allocation profile is created or activated, no match templates in the activated profile, etc.

The manual creating allocation is performed on Departure Allocation application graphic user interface in mouse drag and drop manner. Below are the procedures of manual creating flight allocation:

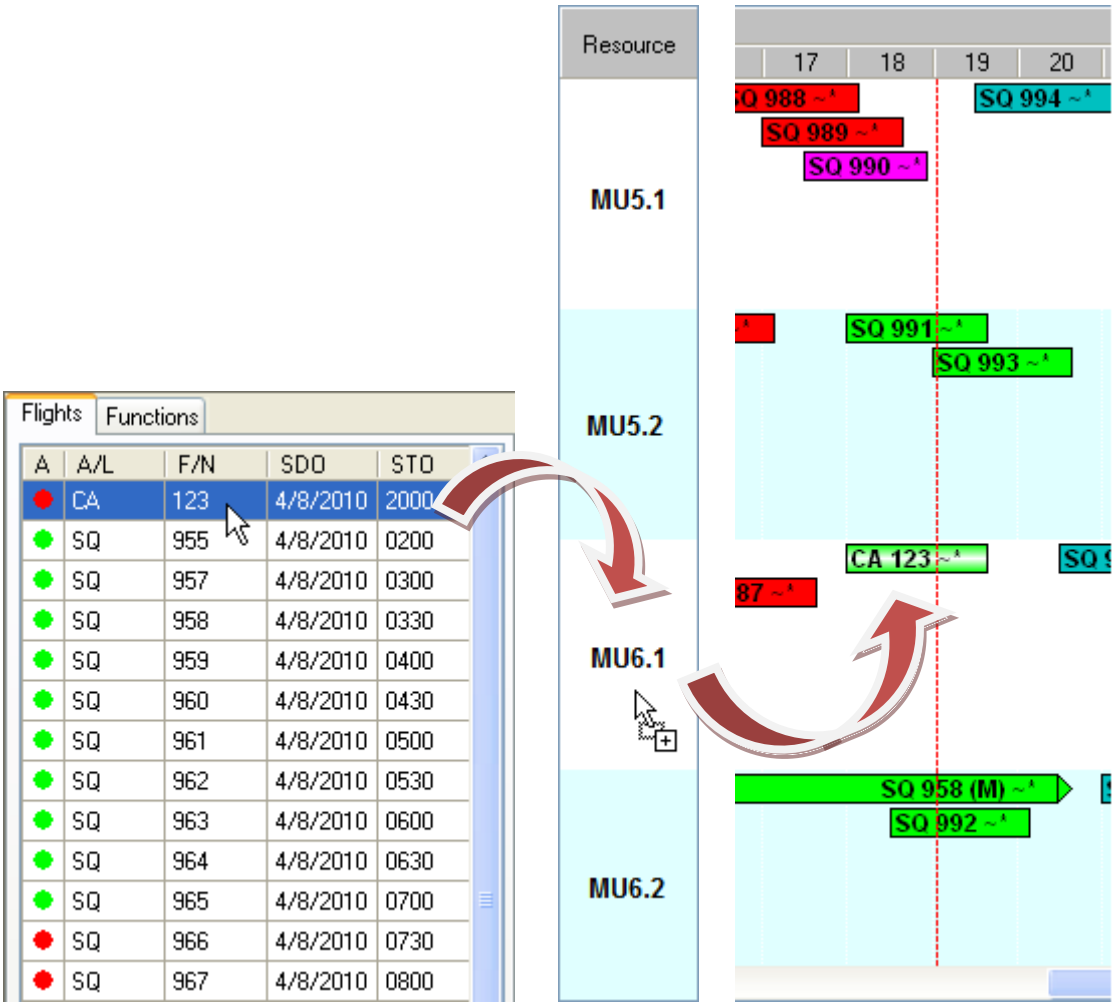
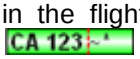


Figure 6-11: Create Departure Flight Allocation

As illustrated in Figure 6-11, the flight allocation can be created just in two steps:

1. Use mouse select the particular flight from the departure flight list;
2. Drag the selected flight and drop it on to the desired sort destination in “Allocation Resource” panel. Then the new flight allocation associated to the desired sort destination will be automatically created and uploaded into SAC database for baggage handling. Its action indicator  in the flight list will be turned from red to green color. And its associated allocation bar  with current state color will be shown on the allocation Gantt chart automatically, too.

The system global default setting of Allocation Open Related and Offset time, Allocation Close Related and Offset time will be automatically applied to each newly created flight allocations. However, the operator can still adjust these allocation properties individually via update flight allocation property function. For the details about BHS system global settings please refers to [DDS – DA].

6.7 MULTIPLE ALLOCATIONS PER FLIGHT

As shown in the Figure 6-12, one flight can have multiple allocations with different sort destination assigned. Each allocation is created for different sorting criteria of same flight.

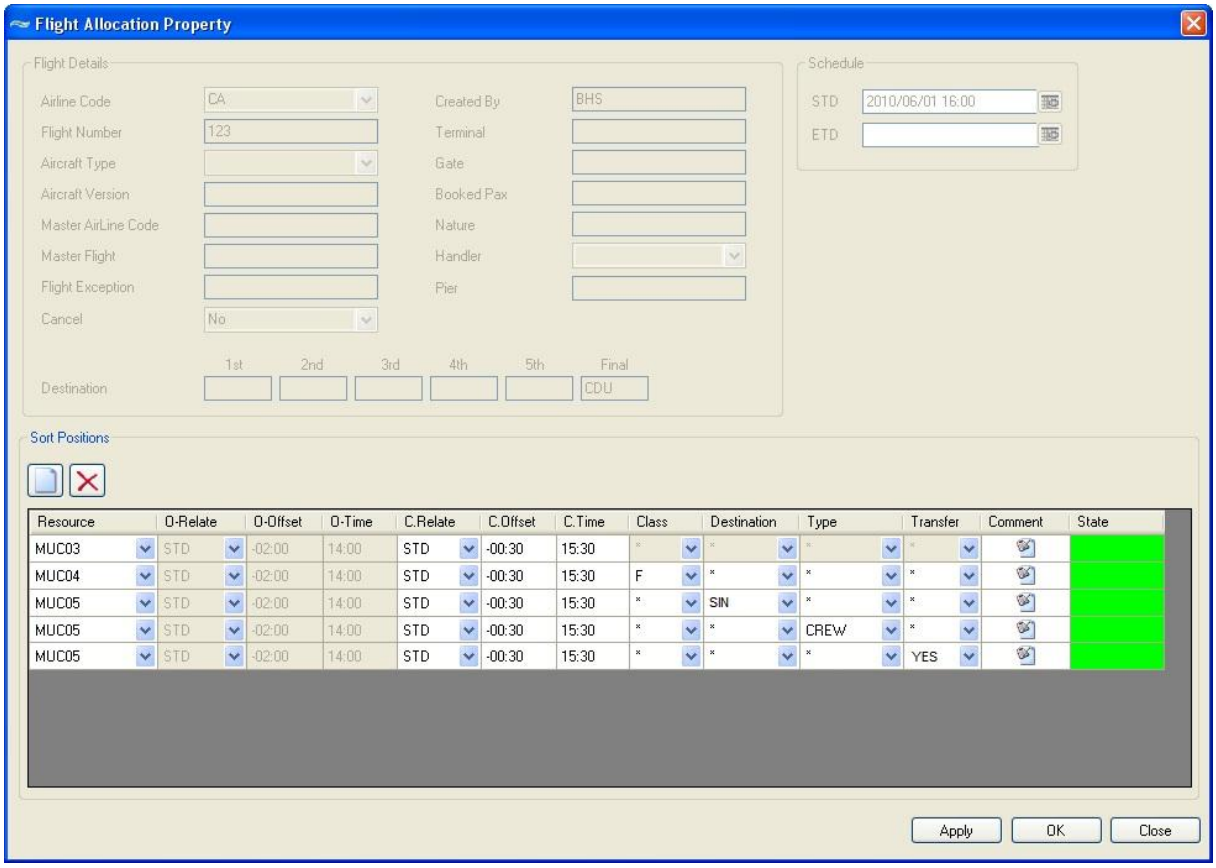


Figure 6-12: Multiple Allocations per Flight

There are 4 type of criterions are supported by BHS flight allocation and sortation control. They are:

- Passenger Class
- Flight Destination
- Baggage Type
- Onward Transfer Status

6.7.1 Allocation by Passenger Class

To differentiate bags of same flight by passenger class is possible by using one-letter class designator included in bag's BSM ".F" element (Refer to IATA RP1745). It is also possible to create allocation for different class and sort bag accordingly, so that the priority baggage handling service could be provided to higher class (e.g. first class) passengers.

6.7.2 Dedicated Allocation for Flight Destination

The flight destinations, including stop-over and final destinations, are included in the flight information and sent to BHS from AODB. It is possible to create dedicated allocations associated to stop-over destination of flight.

In the BHS, to differentiate bags of same flight by its travel destination is possible by using three letters outbound destination (Airport) code included in bag's BSM ".F" elements (refer to IATA RP1745). After the travel destination is identified, its associate allocation will be used for bag sorting.

Sort bag by flight destination could help on the unloading relevant baggage from airplane at the stop-over destination.

6.7.3 Dedicated Allocation for Bag Type

To satisfy the need for additional identification of baggage, or for special handling requirements of specific pieces of baggage, IATA RP 1745 has defined a series of bag type codes for use in baggage message. These bag type codes will be included in BSM ".E" element and sent to BHS for bag sorting. Below are some examples of bag type code:

- CREW - Crew member's baggage
- PRIO - Priority Baggage
- UNAC - Unaccompanied baggage in case of involuntary re-routing
- VIP - Very Important Person

In the BHS, the dedicated allocation could be created and associated to the individual bag types. Based on these allocations, bags can be sorted separately by bag type.

6.7.4 Dedicated Allocation for Onward Transfer Status

As per IATA RP1745, BSM ".O" element defines the onward transfer flight information of baggage. If BSM does not contain any onward flight, the bag is classified as terminated bag at destination airport. Otherwise, it is classified as the onward transfer bag.

It is possible to create a dedicated allocation to sort onward transfer bag separately from other bags that are terminating at the destination airport. When SAC identifies bag's onward transfer status from BSM, it could use the dedicated allocation for bag sorting.

Sort bag by onward transfer status (Yes or No) could help to separate terminating and transfer baggage at destination airport.

6.7.5 Common Allocation

If the flight allocation does not have any above 4 criterions are defined (wildcard is specified), it will be classified as the common allocation. Common allocation is used for bag sorting if there is no any other criterions dedicated allocation of the same flight match to the bag.

When the new flight allocation is manually created, the default wildcard value (*) will be assigned to all sorting criterion fields. Operator can change the default value to create criterion dedicated allocation. In order to handle all type of bags, at least one common allocation must be created for any departure flight.

6.7.6 Restriction of Creating Multiple Allocation per Flight

Below restrictions need to be followed for creating multiple allocation of single flight:

- One flight could have multiple allocations;
- One flight could have up to three (3) allocations with the identical setting of sorting criterions (passenger class, flight destination, bag type, and onward transfer status), and the allocated sort destination (make-up carousel) of each allocation must be different;
- Multiple flights could be allocated to the same sort destination (make-up carousel)

6.7.7 Allocation Priorities

If one departure flight has multiple allocations, the priority of these allocations will be determined by the setting of 4 sorting criteria fields with following rules:

1) Check is there special value (other than wildcard) defined for each field. The allocation whose sorting criteria filed assigned with special value will have higher priority than others.
2) If only some of the sorting criteria fields have assigned with special value and other fields don't have (assigned with wildcard), then the priority will be determined based on those fields have special value assigned by following sequence from top to bottom: Bag Type –> Flight Destination –> Passenger Class –> Onward Transfer Status.
3) If the same sorting criteria fields have assigned with special values, then these allocations will have the same priority. And only the particular one who matches to the bag information will be used for sorting.
4) If all of 4 sorting criteria fields don't have special value (assigned with wildcard), then these allocations will have the same priority. Which one will be used for bag sorting will be determined base on sortation scheme setting of flight allocation.

Below are some examples of allocation with different sorting criteria field values and their determined priority follow above rules:

No.	Bag Type	Flight Destination	Passenger Class	Onward Transfer Status	Sort Destination	Determined Priority
1	CREW	HKG	*	*	MUC04	1
2	CREW	*	*	*	MUC04	2
3	UNAC	*	*	*	MUC05	2
4	*	HKG	B	*	MUC06	3
5	*	SIN	B	*	MUC06	4
6	*	*	F	*	MUC06	5
7	*	*	*	YES	MUC07	6
8	*	*	*	*	MUC08	7
9	*	*	*	*	MUC09	7

In the example above, allocation 2 and 3 have same assignment status on 4 criteria fields (Bag Type has special value assigned, and other 3 fields don't have), as per above rule 3, these 2 allocations have the same priority. Which one will be used for bag sorting depend on bag type value in the BSM.

Both allocation 8 and 9 are common allocation, as per above rule 4, these 2 allocations have the same priority. And the sortation scheme setting of flight allocation will be used to determine which one will be used for bag sorting.

6.8 CODE SHARE FLIGHT ALLOCATION

Code Share is an agreement between airlines to sell space on each other's flights. The flights will have both the operating carrier's flight number (the airline that is using its aircraft for the flight), and the code sharing flight number (the partner airline in the agreement sells space on the flight as if it were its own, and has its own flight number). For example, Air Canada operates flight AC812 from Chicago O'Hare to Toronto Pearson. United code shares on this flight, selling space as UA3094.

In order for BHS to identify one flight is code share flight, FIS (Flight Information System) must inform BHS by sending flight information. If BHS receives, for example UA3094, flight information in which the "Master Flight" field has assigned value of "AC812", BHS will be intelligent enough to identify the flight UA3094 is code share (slave) flight and its master flight is AC812. The master flight allocation will always be used for bag sorting of both master and slave flight.

If both master and slave flight information are received by BHS, both will be displayed in the flight list on Departure Allocation application GUI (refer to Figure 6-4). If master flight has existing allocation been created, then the allocation indicator of its slave flight will be turned to green color automatically to represent that it has been “allocated”. The text label shown on master flight allocation bar will be updated automatically to display the number of both master and slave flight.

If the master flight does not have any allocation is created, and user tries to create allocation by manually drag slave flight from the flight list and drop it to the resource cell on allocation Gantt chart, the allocation will be created use STD of its master flight. Similarly, if user drag master flight and drop it to the resource cell, the STD of master flight will be used to create the allocation. Once the new allocation is created, the indicator of both master and slave flight will be turned to green color to represent that they have been “allocated”.

If slave flight information is received by BHS prior to its master flight information, creating allocation of slave flight will not be allowed. BHS operator can manually create its master flight information at the BHS, or wait for AODB to send the master flight information before create allocation for slave flight.

6.9 CHANGING OF FLIGHT SCHEDULE

Flight schedule information is sent from airport flight information host system to BHS. If flight schedule is changed, the airport host system shall send a new flight schedule data to BHS for updating.

As described in above chapters, the STD, and ETD are the essential data for BHS to determining the Departure Flight Allocation states. Hence, whenever the STD or ETD is changed, following rules must be applied in the different scenarios in BHS to update those Departure Flights Allocations whose opening time or closing time related to the updated STD or ETD.

No.	Scenario	Rule
1	Allocation not yet open	Open and close times of Departure Flight Allocation are updated. If the new calculated open time is before “**now**” and the close time is in the future, the open time is set to “**now**”.
2	Allocation has been opened	Only close time is updated. The close time will never be changed to a point in the past. If the allocation closes due to the update, it will enter the rush state immediately for the specified time period.
3	Allocation has been closed	A new allocation is created if updated STD or ETD dictates a close time later than current time. The new allocation will have

		an open time of ”**now**” and a close time dictated by STD & ETD.

In general, open or close times in the past will never be changed.

6.10 CHANGING SORT DESTINATION OF FLIGHT ALLOCATION

The BHS user is able to update the sort destination of existing departure flight allocation. Whenever the sort destination of existing allocation is changed, below rules will be applied:

No.	Scenario	Rule
1	Allocation not yet open	The entire allocation (from open time to close time) is moved to the new destination.
2	Allocation has been opened but not yet closed	The allocation closes at the time of the update, and a new allocation is created at the new destination with open time is set to “**now**” and close time is set to same close time as the original allocation.
3	Allocation has been closed	The allocation cannot be moved.

In the case of all flight allocation and functional allocations of one make-up need to be moved to another one, for example, original allocated make-up carousel malfunction, the remapping function of Departure Allocation allows BHS operator to remap them quickly in one operation. And above rules will be followed by the remapping operation.

6.11 FINAL SORT DESTINATION CAPACITY VERIFICATION

When the final sort destination (Departure Make-up Carousel) is decided during auto or manual flight allocation creation, before allocation is created and saved into SAC database, the capacity of final sort destination will be verified. If the capacity is exceeded, the warning will be shown on the Departure Allocation GUI on SAC workstation.

The final sort destination capacity could be exceeded when:

- Too many flights are allocated to the same make-up carousel;
- Too large flights are allocated to it;
- Change of allocation close time cause the overlap with over allocations.

When capacity exceed warning is turned on, BHS operator can allocate the flight to different make-up carousel, or decided to accept such overload situation and override the warning.

The aircraft type and number of seat information is required to be sent to BHS by AODB for capacity verification.

6.12 DEPARTURE FUNCTIONAL ALLOCATION

The Flight Allocation gives the way for BHS sorting control system to determine the allocation states, and defines the destination of OPENING state bags. However, it doesn't define the destinations for other states and other special scenario bags, e.g. Too Early, Early, Rush, Too Late, scanner no read bags, no BSM, unknown flight bags, etc. In order to sort those scenario bags, the special allocation type, called **Departure Functional Allocation**, is required.

The Function Allocation is the global settings for all flights. Their sorting rules are listed in the table below.

No.	Function Allocation (Bag Scenario)		Description	Default Sort Destination
	Name	Code		
1	Too Early Bag	TERL	Bags detected by TTS ATR or MES hand-held scanner during allocation TOO EARLY state period. One dedicated Allocation Resource could be allocated for Too Early baggage. This Too Early baggage destination could be same or different as the one allocated to Early Bag function type. If Too-Early sorting is not required by particular airport, the Too Early and Early bags will not be differentiated for sorting control. All of them will be sorted to the destination of Functional Allocation for Early Bag. If the Too Early sorting is enabled but Functional Allocation of Too Early bag is not defined, all Too Early bags will be sorted to the destination allocated to No Allocation function type, which default is MES.	**EBS**
2	Early Bag	ERLY	Bags detected by TTS ATR or MES hand-held scanner during allocation EARLY state period. The sort destination of Early bag usually is Early Bag Storage (EBS) rack. But it could be redirected to any one of departure make-up carousel if EBS line is not available. If Early bag sorting is not required by particular airport, it could be disabled via system configuration parameter. And then all early bags will be handled as the normal Opening bag and sorted to the destination of its opening flight allocation.	**EBS**
3	Rush Bag	RUSH	Bags detected by TTS ATR or MES hand-held scanner during allocation RUSH state period. Departure make up carousel MUC02 is the	**MUC02** (or user assigned make-up

			dedicated sort destination of Rush bags. But BHS operator could change it to any one of other make-up carousels in the case of MUC02 is unavailable.	carousel for Rush bags)
4	Too Late Bag	LATE	Bags detected by TTS ATR or MES hand-held scanner during allocation Too Late state period. One dedicated make-up carousel can be set as the default sort destination for all Too Late bags. BHS operator could change it to any one of other make-up carousels in the case of the dedicated one is unavailable.	**MUC01** (or user assigned make-up carousel for Problem bags)
5	No Read Bag	NORD	Bags whose tag was not be detected properly by ATR are classified as the No Read bag. No Read bags by default shall be sorted to Manual Encoding Station (MES) for manual handling. Operator could direct no read bag to make-up carousel by assign it as the sort destination of No Read function allocation. This is useful when all MES are not available (e.g. equipment failure).	**MES**
6	Multiple License Plate Bag	MTLP	If one bag has more than one IATA tags, or more than one Fallback tags are detected by ATR, it will be classified as the Multiple License Plate bag. Multiple License Plate bags by default shall be sorted to Manual Encoding Station (MES) for manual handling. Operator could direct multiple license plate bag to make-up carousel by assign it as the sort destination of Multiple License Plate function allocation. This is useful when all MES are not available (e.g. equipment failure).	**MES**
7	Unknown Flight Bag	UNFL	If bag has BSM received, but its flight information has not received from airport flight information system (e.g. AODB), it will be classified as the Unknown Flight bag. Unknown flight bags by default shall be sorted to Manual Encoding Station (MES) for manual handling. Operator could direct unknown flight bag to make-up carousel by assign it as the sort destination of Unknown Flight function allocation. This is useful when all MES are not available (e.g. equipment failure).	**MES**
8	No BSM Bag (Unknown	NBSM	If bag tag number detected by ATR cannot be found in the BSM list that were received from airport baggage information system, it will be classified as	**MES**

	License Plate Bag)		the No BSM bag. No BSM bag could be sorted by airline allocation, if the airline allocation sorting is enabled. Otherwise, it will be sorted to the destination allocated to No BSM function type. If Functional Allocation of No BSM Bag is not defined, all No BSM bags will be sorted to the destination of No-Allocation function type, which default is MES.	
9	No Allocation Bag	NOAL	If both bag BSM and its flight information are received, but there is no any sort destination (make-up carousel) can be found from SAC database, it will be classified as the No Allocation bag. No allocation bags by default shall be sorted to Manual Encoding Station (MES) for manual handling. Operator could direct no allocation bag to make-up carousel by assign it as the sort destination of No Allocation function allocation. This is useful when all MES are not available (e.g. equipment failure).	**MES**
10	Problem Bag	PROB	Most of bags that are sorted to MES can be manual encoded by license plate number, flight number or destination number depends on the available information getting from attached tag on the bag. But there are some bags are unable to be identified because lacking of information (e.g. missing of bag tag, etc.), such bags are classified as the Problem Bag. Problem bag can be removed at the MES and then manually handled by operator. Alternatively, it can also be sent to the dedicated sort destination assigned to for Problem Bag function allocation. So the problem bag of all flights can be centralized handled in one location. In Mumbai airport, the departure make up carousel MUC01 is the dedicated sort destination of problem bags.	**MUC01** (or user assigned make-up carousel for Problem bags)
11	Dump Discharge	DUMP	When bag is detected by TTS ATR, SAC will look up its sort destination as per the Flight Allocation or Function Allocation rules. However, if the desired sort destination is unavailable (e.g. equipment failure) at the time when SAC is making the sorting destination decision, SAC will redirect the bag to Dump discharge immediately without recirculation. Dump discharge is only needed when bag sorting is	**MUC01** (or user assigned make-up carousel for Problem bags)

			performed on the conveyor (or sorter) loop. Instead of re-circulating bags on the loop when above scenario is occurred, they can be redirected to dump discharge immediately to prevent bag miss its flight. If both original sort destination and dump discharge are unavailable, the bag will be re-circulated on the loop and re-direct to destination of Overflow function allocation after the maximum re-circulation limit is exceeded. It can still be sorted to the original sort destination or dump discharge whoever becomes available first before the maximum re-circulation limit is exceeded. Dump discharge and Overflow Discharge are used to prevent bag miss airplane due to re-circulating on the sorting loop. Therefore, it is not recommended to assign same make-up to both Dump and Overflow Discharges. For airports that do not have sorting loop layout configuration, the Dump and Overflow Discharge function allocation types will not be applied.	
12	Overflow Discharge	OVER	Overflow discharge will be used when the maximum re-circulation limit is exceeded. Refer to the description of Dump Discharge function allocation.	**MUC02** (or user assigned make-up carousel for Problem bags)
13	Flight Exception	FEXC	Some airports may have special sorting rule requirement for certain flights, e.g. All bags that is marked as High Risk flight must pass through Level 3 X-ray screening. The Functional Allocation of Flight Exceptions is designed to meet such requirements. If flight exception is required, the airport flight information host system (e.g. AODB) needs indicate the Exception data in the flight information, and sent to BHS. If flight exception data is unable to be identified in BHS, then bag will be handled as normal non flight exception bag. If flight exception data is included in the flight information, but the sort destination of specific flight exception is not assigned, then bag will be handled as non flight exception bag.	User assigned make-up carousel for specific flight exception.

6.13 FALLBACK TAG ALLOCATION

There are two types of fallback tag are used in Mumbai airport for baggage handling. They are:

- IATA Fallback Sortation Tag
- 4-digit Airport Fallback Tag

The sort destination needs to be assigned to both types of fallback tag before check-in process is started. This is called Fallback Tag Allocation.

6.13.1 IATA Fallback Sortation Tag Allocation

As per the requirement of individual airports, the IATA Fallback tag may be attached to the checked in baggage when:

- Demand tags with a license plate sortation bar code are temporarily unable to be produced;
- Communications interruptions temporarily prevent delivery of Baggage Source Message (BSMs) to the sortation system;
- Manual baggage tags are issued without supporting BSMs.

The fallback Sortation tag used by airport must comply with the rules stated in IATA RECOMMENDED PRACTICE 1740b: LICENCE PLATE FALLBACK SORTATION TAG.

As per the IATA RP1740b, the fallback tag number has ten digits and its format is illustrated as follows:

Digit Number	Description
Digit 1	Always 1 for fallback tag
Digit 2-4	3-digit numeric airline code (000 for non-airline handling agents)
Digit 5-8	4-digit numeric airport code It is used to differentiate the fallback tag from current airport and the fallback tag that comes from other airport, in case the passenger did not take out the old fallback tag. If the airport code in the fallback Sortation tag is not same as the current airport code, this fallback Sortation tag will be classified as the invalid fallback tag and will be ignored by BHS Sortation control system.
Digit 9-10	2-digit numeric departure makeup unit indicator. BHS will use it to look up the baggage sortation destination.

IATA fallback allocation is to assign sort destination to last 2-digit number of 10-digit fallback tag. Below Figure 6-13 is the example of IATA fallback tag mapping.

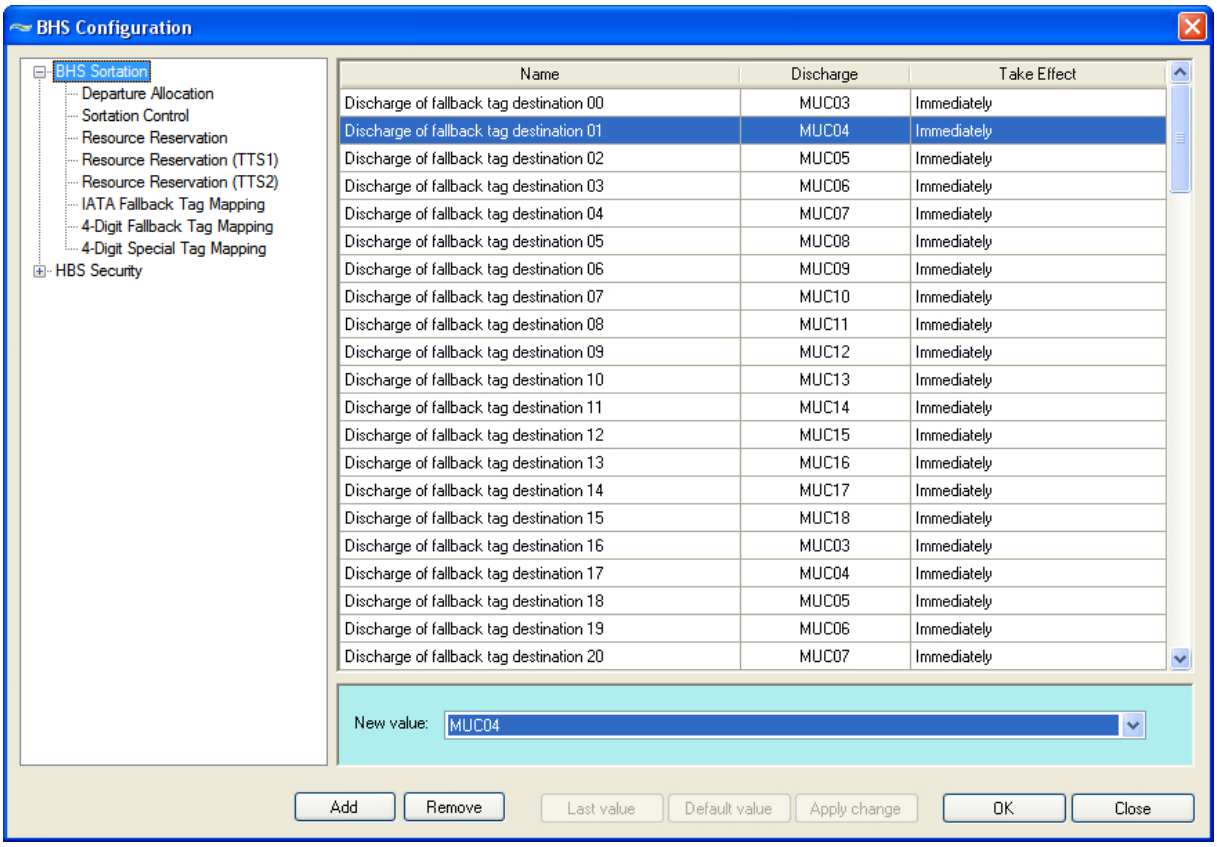


Figure 6-13: IATA Fallback Tag Mapping

6.13.2 4-Digit Airport Fallback Tag Allocation

4-digit airport fallback tags could be used at same scenarios as IATA fallback tag:

- Demand tags with a license plate sortation bar code are temporarily unable to be produced;
- Communications interruptions temporarily prevent delivery of Baggage Source Message (BSMs) to the sortation system;
- Manual baggage tags are issued without supporting BSMs.

The 4-digit airport fallback format is illustrated as follows:

Digit Number	Description
Digit 1	Always 0 for airport fallback tag First digit is used to differentiate 4-digit airport fallback tag and 4-digit airport special security tag (Refer to 6.14).
Digit 2-4	3-digit running numeric of sort destinations (001 for make-up carousel 1, 002 for make-up carousel 2, etc.)

Below is the sample of 4-digit airport fallback tag mapping.

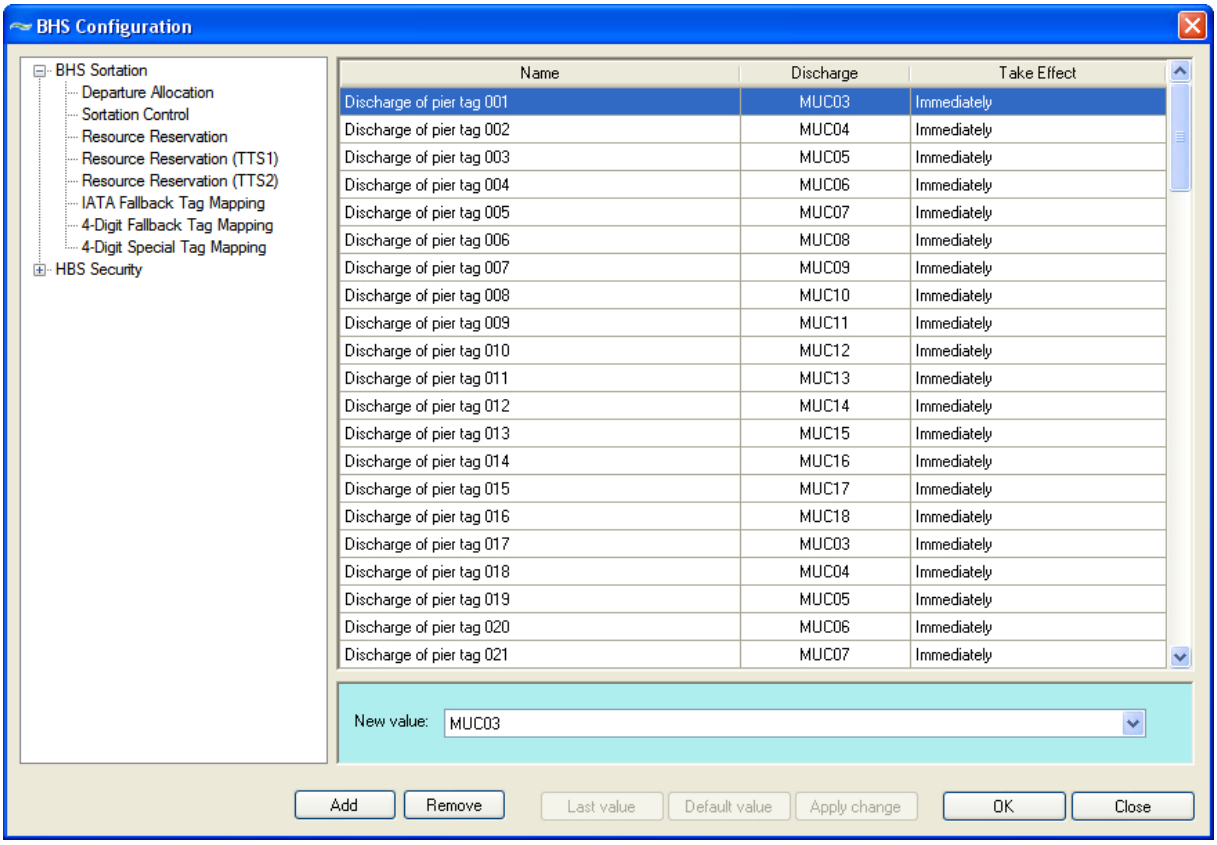


Figure 6-14: 4-digit Airport Fallback Tag Mapping

6.14 4-DIGIT AIRPORT SPECIAL SECURITY TAG ALLOCATION

There is a 4-digit special security tag could be used when BHS is running in “LLC Only” mode, e.g. the HLC system is unavailable. Bag with special security tag attached is required to clear the screening of minimum HBS security level defined in the security tag.

During the LLC mode, PLC is able to identify bag required security screening level and its sort destination from special security tag and without HLC involvement. If bag has not cleared the required security level, PLC will direct it to higher level screening. Otherwise, PLC will direct it to the sort destination given by the last 2-digit in the special security tag.

The special security tag contains two type of information as below.

Digit Number	Description
Digit 1	Always 9 for airport special security tag First digit is used to differentiate 4-digit airport fallback tag (refer to6.13.2) and 4-digit airport special security tag.
Digit 2	Identifier of minimum HBS security screening level (e.g. 1 for Level 1, 2 for Level 2, 3 for Level 3, etc.);
Digit 3-4	2-digit running numeric of sort destinations (e.g. 01 for make-up carousel 1, 02 for make-up carousel 2, etc.)

7. BHS SORTATION CONTROL

7.1 INTRODUCTION

7.1.1 Bag Group Security Policy - Minimum Screening Level Requirement

There are five (5) levels HBS screening in BHS:

- Level 1: In-line automatically screening by AT machine;
- Level 2: HBS operator manual decision based on the image from Level 1 AT machine;
- Level 3: Advance EDS machine automatically screening for Level 2 suspected bags;
- Level 4: HBS operator manual decision based on the image from Level 3 EDS machine;
- Level 5: HBS operator manual inspection using ETD device and/or passenger reconciliation for Level 4 rejected bags..

BHS HLC system provides configuration functions to configure the minimum HBS screening level for following bag security groups:

- Origin or Destination country of departure flight;
- Origin or Destination airport code;
- Airline of departure flight;
- Departure flight number;
- Passenger name;
- Security Screening Instruction Code given by the ".X" BSM element;
- "Special" security tag.

The minimum screening level set for each bag security groups could be any one of 5 HBS levels (e.g. 1, 2, 3, 4, or 5). The default minimum required HBS screening level for all bags is Level 1.

Once the bag group security policy is defined and activated, bag is allowed to be sorted to a make-up device until its security clearance for the minimum required HBS level screening is received. For example, if the minimum screening level of flight that is going to US is HBS Level 3, then all bags of this flight will be routed to Level 3 EDS machine for screening regardless of bag's Level 1 and Level 2 decision.

In HLC operation mode, bag's minimum screening level will be verified by HLC SAC when 1) bag tag is received from conveyor PLC, 2) HBS screening result is received from conveyor PLC, 3) or bag tag is received from TTS controller. SAC will return the minimum screening level setting to conveyor PLC for bag routing control on conveyor, or return the sort destination to conveyor PLC for forwarding it to TTS controller during the item transfer from conveyor to TTS induction, or return the sort destination to TTS controller for bag tilting.

In "LLC Only" operation mode, the verification of minimum screening level based on above bag group security policy setting is not possible. In this case, the airport "Special" security tag will be attached to the bag in conjunction with the IATA fallback tag when bag is checked in at check-in counter. The "Special" security tag is used to inform LLC control system (both conveyor PLC and TTS controller) about bag's minimum screening level requirement. When "Special" security tag is detected, both conveyor PLC and TTS controller need to verify the screening result tracked by PLC against the minimum screening level detected from "Special" security tag, and route on conveyor or tilt on TTS accordingly.

During the normal HLC operation mode, the “Special” tag and screening level mapping table are configured and updated by HLC and downloaded to conveyor PLC and TTS controller whenever network connection between them are established, and whenever the setting is changed. This mapping table will be used by conveyor PLC and TTS controller during the “LLC Only” operation mode.

For the details about Bag Group Security Policy configuration please refers to [DDS – DA].

7.1.2 HBS Security and Customs Screening

In addition to HBS security screening, the customs screening is required in Mumbai airport BHS and its process and result are integrated into bag sorting control.

The customs screening process is started at HBS Level 1 X-ray machine. All Level 1 X-ray images (regardless of machine auto decision) generated by the Level 1 x-ray machines will be sent to an HBS operator security workstation, and/or customs screening system (CSS) workstation (both are supplied by others). The customs screening will be performed by CSS operator, and the result will be sent from X-ray machine to BHS PLC, and then forwarded to SAC.

SAC will review bag’s sort destination base on both security screening result and customs screening result, and returned it to PLC. All baggage, as long as it has cleared the required minimum level security screening, will be sent to TTS regardless it customs screening result is received or not, cleared or rejected. Bag’s customs screening result will be verified upon it is scanned by TTS overhead ATR and redirected to customs reject area if it is not or not yet cleared customs screening.

HBS security screening result has higher priority than customs screening result for bag sorting control. If customs screening un-cleared bag has not passed minimum HBS security level screening, it is not allowed to be sorted to customs reject area. It has to be sorted to Level 3 HBS line for higher level security screening.

The bag will only be sorted to its final sort destination (make-up carousel) when its clearances of both HBS security and customs screening are received.

7.1.3 Sorting Distribution Scheme

PGL sorting control system accepts allocation of multiple make-up carousels per flight. Hence, one bag could have multiple sort destinations. In order to decide which one of multiple allocated sort destinations bag needs to be sorted to, there are three (3) sort distribution schemes are available in BHS:

- Round Robin
- Waterfall by Nearest
- Waterfall by Priority

The Round Robin scheme distributes bags evenly across the all available sort destinations. Each time a bag has more than one destination, the sorting control system will always send the bag to the next destination in the list. If the previous bag was sent to the last destination in the list, the next bag is sent to the first destination in the list.

The Waterfall by nearest scheme distributes bags to nearest sort destination to TTS overhead ATR until TTS discharge chute to this destination become unavailable (e.g. discharge line is full, or bag jam in the chute, etc.). Then bags will be directed to the next available sort destination. In this scheme, the next sort destination will only be used when the discharge chute to it become unavailable.

The Waterfall by priority scheme is similar with the Waterfall by nearest scheme. The only different is the determination of sort destination for the first bag. Waterfall by nearest schedule will direct first bag to the nearest sort destination to the TTS overhead scanner. And Waterfall by priority schedule will direct first bag to the preset sort destination instead.

The sort distribution scheme is a global setting applied to all flights. There are few scenarios need have the sort distribution scheme settings. They are:

No.	Scenarios	Description
1	Sorting Scheme for Flight Allocation	Will be used when flight has multiple same sorting criterions allocations (Refer to 6.7 for sorting criteria settings). Default Setting: Round Robin
2	Sorting Scheme for Function Allocation	Will be used when one function allocation has multiple sort destinations be assigned. E.g. Sending No-Read bags to multiple MES on the single TTS. Default Setting: Round Robin
3	Sorting Scheme for Airline Allocation	Will be used when one airline has multiple sort destinations be assigned (Refer to 6.5.1.1 for airline allocation). Default Setting: Round Robin
4	Sorting Scheme for Ground Handler Allocation	Will be used when one Ground Handler has multiple sort destinations be assigned (Refer to 6.5.1.1 for airline allocation). Default Setting: Round Robin
5	Sorting Scheme for Aircraft Gate Allocation	Will be used when one Aircraft Gate has multiple sort destinations be assigned (Refer to 6.5.1.1 for airline allocation). Default Setting: Round Robin

7.1.4 Code Share Flight Bag Sorting

Refer to chapter 6.8 for code share allocation details. If SAC detects one flight is code share slave flight, then its master flight schedule and allocation will be used by SAC automatically to sort slave flight bags.

7.1.5 IATA Interline Tag, In-house Tag & Pseudo BSM

The IATA interline tag is used to give a unique identification (number) to each bag. Its format is defined in IATA Resolution 740: FORM OF INTERLINE BAGGAGE TAG. The IATA interline tag is used for sorting control in BHS.

As per IATA 740, the 10-digit IATA interline tag number is composed as below:

Digit Number	Description
Digit 1	0 – for IATA interline tag 1 – for IATA fallback tag
Digit 2-4	3-digit numeric airline code (000 for non-airline handling agents) This part will be used to look up the airline and its allocated sort destination if airline sortation control in BHS is enabled.
Digit 5-10	6-digit numeric baggage tag number.

The electronic IATA interline tag information and passenger information (e.g. passenger class, onward transfer, etc.) will be produced by airport CUTE/DCS system and sent to BHS in BSM as defined in IATA Recommended Practice 1745 - Baggage Services Messages.

If bag arrives MES but the BSM of its IATA interline tag has not received by BHS, MES operator can create a “Pseudo BSM” for the tag. And then use the pseudo BSM for code conversion. The pseudo BSM of IATA Interline tag will always be overwritten by the actual BSM received from CUTE/DCS.

The airport in-house labeling tag could be produced at MES for bags that have no IATA Interline tag, fallback tag or special security tag attached. In-house labeling tag is 10-digit number tag that has the same format as IATA Interline tag, except the value of first digit is not 0 and 1. When in-house tag is printed out from MES tag printer, its “Pseudo BSM” is created by MES and saved into the SAC database. The pseudo BSM of in-house tag will be used for code conversion.

The pseudo BSM created from MES will be uploaded into SAC database as well.

7.1.6 IATA Fallback Tag, Airport Fallback Tag and Special Security Tag Sorting

As described in 6.13.1, 6.13.2 and 6.14, there are 5 different types of bag tag (IATA Normal sortation tag/IATA interline tag, IATA fallback sortation tag, airport fallback tag or airport special security tag) could be attached to bag for security and sortation control. If multiple types of valid tag are detected on single bag, following tag priority (from higher to lower) shall be followed by SAC for sortation control:

1) 4-digit airport special security tag;
2) 4-digit airport fallback tag;
3) IATA fallback sortation tag;
4) IATA normal sortation tag / IATA interline tag;
5) Airport 10-digit in-house labeling tag printed by MES workstation;

The Fallback Sortation tag and special security tags will always take precedence over the IATA normal Sortation tags.

If IATA fallback tag is determined to be used for bag sorting, the airport location code included in the tag will be verified by SAC. If the location code extracted from tag differ from the airport actual location code, this tag will be classified as invalid tag and will be ignored by sorting control.

If the destination identifier extracted from fallback tag or special security tag is not included in the fallback or special security tag allocation mapping table, then the tag is classified as invalid tag and will be ignored by sorting control.

Note: Since the passenger information is not included in the IATA & airport fallback, special security, or in-house labeling tag, it is not possible to sort bag in special way (sort by passenger class, bag type, destination, onward transfer status, etc.) when these tags are used.

7.1.7 Airline Sorting

In the event the BSM is not available, as the alternative to the airport Fallback Sortation tag, the bag could be sorted by the airline code, which is extracted from the 10-digit IATA normal sortation tag.

If airline sortation function is enabled and airline allocation template is configured, those No BSM (Unknown License Plate) bags will be handled as per following in sequence:

1) Extract airline code form 10-digit IATA normal sortation tag;
2) Look up the sort destinations that were assigned to the airline from airline allocation mapping table;
    a. If airline does not have allocated destination, bag will be sorted as per the Functional Allocation of No BSM (Unknown License Plate) bag, which default is MES.
    b. If sort destination of airline is found, sort bag to it.

If Sortation by airline function is disabled, those no BSM bags will be sorted as per the Functional Allocation of No BSM bag only.

7.1.8 Triggering of Code Conversion

As described in chapters before, the code conversion is to determine the minimum security screening level and sort destination of a bag. It could be triggered by different events as listed below:

- When bag is scanned by ATR;
- When bag's HBS security screening result is received;
- When bag's customs screening result is received;
- When bag is transferred from conveyor to TTS induction;
- When bag recirculation limit on TTS is exceeded;
- When bag failed to discharge due to some reason (e.g. chute become unavailable);

7.2 BAGGAGE SCENARIOS AND SORTATION RULES

7.2.1 Multiple Tags per Bag

As described before, there are four (4) types of tag could be used in BHS. They are:

1) 4-digit airport special security tag;
2) 4-digit airport fallback tag;
3) IATA fallback sortation tag;
4) IATA normal sortation tag / IATA interline tag.

If one bag has multiple tags attached, they are able to be detected by scanner array of ATR. Once the multiple tags of single bag are forwarded to SAC, following rules will be used for bag sorting control.

No.	Scenario Description	Sortation Rule
1	Multiple types of tag	Sort by the highest priority type tag. Refer to chapter 7.1.5 for tag type priority details.
2	Multiple 4-digit airport special security tags and they are mapped to different sort destinations.	Identify the highest HBS security level defined in the special security tags, and direct bag to it for screening. After bag clears the screening, direct it to the sort destination of “Multiple Tag” function allocation – default is MES.
3	Multiple 4-digit airport special security tags and they are mapped to the same sort destination.	Identify the highest HBS security level defined in the special security tags, and direct bag to it for screening. After bag clears the screening, direct it to the sort destination defined by special security tag.
4	Multiple 4-digit airport fallback tags and they are mapped to different sort destinations.	Direct to the sort destination of “Multiple Tag” function allocation – default is MES.
5	Multiple 4-digit airport fallback tags and they are mapped to the same sort destination.	Direct to the sort destination defined by 4-digit fallback tag.
6	Multiple valid IATA fallback tags and they are mapped to different sort destinations	Direct to the sort destination of “Multiple Tag” function allocation – default is MES.
7	Multiple valid IATA fallback tags and they are mapped to same sort destinations	Direct to the sort destination given by IATA fallback tag.
8	Multiple IATA fallback tags but only 1 is valid.	Direct to the sort destination given by valid IATA fallback tag.
9	Multiple IATA fallback tags but none of them is valid.	Direct it based on lower priority IATA interline tag if it is attached with the same bag. Otherwise, direct it to the sort destination of “No Read” function allocation – default is MES.
10	Multiple valid IATA interline tags	Direct to the sort destination of “Multiple Tag” function allocation – default is MES.
11	Multiple IATA interline tags but only 1 is valid.	Direct it based on valid IATA interline tag.
12	Multiple IATA interline tags but none of	Direct to the sort destination of “No BSM” function

	them is valid	allocation – default is MES.

In above table, “Valid IATA fallback tag” represents that the airport location code extracted from IATA fallback tag matches to the actual location code of airport. “Invalid IATA Interline Tag” represents that SAC has received associated BSM of the tag.

7.2.2 Single Tag per Bag

If single tag is detected, or multiple tags are detected but only one of them is determined to be used for bag sorting, bag could be classified as one of following scenarios, and the respective rules will be used by SAC for bag sorting.

No.	Scenario Description	Sortation Rule
1	Single 4-digit airport special security tag	Direct to the HBS security level defined in the special security tags for screening. After bag clears the screening, direct it to the sort destination of defined in the same security tag. Refer to chapter 6.14 for special security tag format.
2	Single 4-digit airport fallback tag	Direct to the sort destination defined by 4-digit airport fallback tag.
3	Single IATA fallback tag	If it is valid IATA fallback tag, direct the bag to the sort destination defined by IATA fallback tag, otherwise, use IATA interline tag for sorting if it is attached to the bag. If there is no IATA interline tag attached, SAC will direct bag to the sort destination of “No Read” function allocation – default is MES.
4	• Single IATA interline tag • Tag associated BSM is not received	If airline allocation is disabled, SAC will direct bag to the sort destination of “No BSM” function allocation – default is MES. Otherwise, SAC will extract the 3-digit carrier code from 10-digit IATA interline tag and direct bag to the sort destination assigned to the carrier.
5	• Single IATA interline tag • Multiple BSMs of tag have been received	Direct to the sort destination of “Multiple BSM” function allocation – default is MES.
6	• Single IATA interline tag • Tag associated BSM has been received • BSM associated flight information is not received	Direct to the sort destination of “Unknown Flight” function allocation – default is MES.
7	• Single IATA interline tag • Tag associated BSM has been received • BSM associated flight information has been received • No allocation found for the flight	Direct to the sort destination of “No Allocation” function allocation – default is MES.

8	• Single IATA interline tag • Tag associated BSM has been received • BSM associated flight information has been received • Allocation of flight is found • Allocation is in the TOO EARLY state	Direct to the sort destination of “Too Early” function allocation – default is EBS.
9	• Single IATA interline tag • Tag associated BSM has been received • BSM associated flight information has been received • Allocation of flight is found • Allocation is in the EARLY state	Direct to the sort destination of “Early” function allocation – default is EBS.
10	• Single IATA interline tag • Tag associated BSM has been received • BSM associated flight information has been received • Allocation of flight is found • Allocation is in the OPENING state.	Direct bag to the sort destination assigned to the flight allocation.
11	• Single IATA interline tag • Tag associated BSM has been received • BSM associated flight information has been received • Allocation of flight is found • Allocation is in the RUSH state.	Direct to the sort destination of “Rush” function allocation.
12	• Single IATA interline tag • Tag associated BSM has been received • BSM associated flight information has been received • Allocation of flight is found • Allocation is in the TOO LATE state.	Direct to the sort destination of “Too Late” function allocation.
13	• Single IATA interline tag • Tag associated BSM has been received • BSM associated flight information has been received • Allocation of flight is found • The flight exception data is defined in the received flight information, e.g. “**RISK**”.	Direct to the sort destination of “Flight Exception” function allocation.
14	• Single IATA interline tag • Tag associated BSM has been received • BSM associated flight information has been received • Allocation of flight is found • Flight is code share slave flight.	Sort bag based on its code share master flight.

7.2.3 Exception Sortation Scenarios

Some exceptions could happen during the bag movement on the sortation conveyor line. The following Sortation rules shall be applied respectively:

Scenarios	Exceptions Description	Sortation Rule
1	No any tag attached to the bag – no any identification information can be found by system.	Bag will not be read by ATR. SAC will direct bag to the sort destination of "No Read" function allocation – default is EBS. At MES, operator could remove the bag from conveyor, or send it to sort destination of "Problem Discharge" function allocation for centralized handling.
2	Bag lost tracking after TTS ATR and MES but before TTS discharge chute.	TTS controller will redirect bag to TTS overhead ATR for rescanning.
3	Allocated destination (make-up unit) becomes unavailable before bag reach the discharge point.	When bag reach the desired destination, it is not able to be discharged by PLC due to the unavailability of the destination. SAC will then redirect bag to its next available allocated destination if it has multiple allocations. If it has only one allocated destination, or has multiple allocations but all allocated destinations are unavailable, then bag will be redirected to sort destination of "Dump Discharge" function allocation.

8. SYSTEM EXCEPTION SCENARIOS

8.1 NO FLIGHT SCHEDULE INFORMATION RECEIVED

BHS is unable to receive the flight schedule information in the following cases:

- Airport Flight Information Host System failure;
- Network connection between BHS and Airport Host System failure.

If the above case is occurred, BHS operator can still manually create the Flight allocation information by using the “Flight Management” function provided by BHS Departure Allocation application. Once the flight and its allocation are manually created, the baggage sortation can be preceded as usual.

If flight allocation is not created in the BHS, when bags of this flight are detected by ATR, they will be classified as the “Unknown Flight” bag, and be sorted to the destination of “Unknown Flight” Functional Allocation, which default is MES.

8.2 NO BSM INFORMATION RECEIVED

BHS is unable to receive the BSM in following cases:

- No BSM is produced by particular airline and transferred to BHS;
- Airport Baggage Information Host System failure;
- Network connection between BHS airport Host System failure.

If the above case is occurred, following rules could be applied. They are:

- If check-in operator knows that there is no BSM being produced by the airline for the bag that is being checked in, and he knows which sort destination this bag needs to be sent to, he can attach the airport Fallback tag that is associated to that sort destination to inform BHS sort the bag according to Fallback Sortation rule;
- If airline sortation is enabled in BHS, and there is no any fallback Sortation tag and special security tag are attached to the bag, BHS will sort the bag as per airline allocation rules. Otherwise bag will be sort to the destination of “No BSM” function allocation, which default is MES;
- If no fallback sortation tag is detected and airline sortation is disabled in BHS, bag will be classified as “No BSM” bag and be sorted to the destination of Functional Allocation “No BSM Bag”, which default is MES.

8.3 BHS OPERATION WITHOUT HLC

BHS is able to operate without HLC available. When this scenario is happened, the PLC control will auto switch to “LLC Only” mode to carry on the baggage handling.

In the “LLC only” mode, since the SAC and database are not available, the IATA interline tag will not be used for bag sorting. Instead, the IATA fallback tag, 4-digit airport fallback tag or 4-digit special security tag shall be used by PLC for code conversion. PLC maintains a local copies of IATA fallback tag, 4-digit airport fallback tag or 4-digit special security tag application mapping table. They are used for PLC layer code conversion in “LLC Only” operation mode.

In the “LLC Only” mode, if bag is not read or only IATA Interline tag is read by ATR, PLC will direct it to MES for manual encoding.

MES workstation has a local copy of flight allocation, BSM, fallback and special security tag allocation mapping tables to be used for MES to perform code conversion in the “LLC Only” operation mode. The local data copies are downloaded from SAC database during the normal operation mode whenever the data in the SAC database is updated.

If the “LLC Only” operation mode takes long time, the MES local data copies will become outdated. In this case, manual encoding by IATA Interline tag or by flight will not be possible. But the bag can still be manual encoded by sort destination directly, or encode by fallback or special security tag.

MES workstation has the direct communication interface with their related PLCs to provide manual encoded sort destination to PLC without the needs for HLC (SAC, database, & external interfaces) communication.

During the normal BHS operation mode (when HLC is available), the SAC database, instead of MES local data copy will be used by MES workstation for code conversion.

When SAC and database server is recovered, the normal sortation control will resume automatically.

9. DOCUMENT REFERENCES

Abbreviation	Reference
[IATA]	IATA Passenger Services Conference Resolutions Manual, 27th Edition, June 2007. Includes: IATA Resolution 740 - Form of interline baggage tag IATA Resolution 761 – Flight Numbers IATA Resolution 762 - Airline designators IATA Resolution 766 – Interline Passenger Reservations Procedure IATA Resolution 769 – Bag Tag Issuer Codes (BTIC) IATA Recommended Practice 1740b - License Plate Fallback Sortation Tag IATA Recommended Practice 1745 - Baggage Services Messages
DDS - HLCCS	Detail Design Specification HLC Configuration Specification (HLCCS) Doc#: MIAL-LT-O-N55B-BG-DOC-DDD-001
DDS - DA	Detail Design Specification Departure Allocation (DA) Doc#: MIAL-LT-O-N55B-BG-DOC-DDD-002
DDS - MDS	Detail Design Specification Monitoring & Diagnostic System (MDS) Doc#: MIAL-LT-O-N55B-BG-DOC-DDD-003
DDS - MES	Detail Design Specification Manual Encoding System(MES) Doc#: MIAL-LT-O-N55B-BG-DOC-DDD-004
DDS - EBS	Detail Design Specification Early Baggage Storage (EBS) Doc#: MIAL-LT-O-N55B-BG-DOC-DDD-005
DDS - BIS	Detail Design Specification Baggage Identification System (BIS) Doc#: MIAL-LT-O-N55B-BG-DOC-DDD-006
DDS - BHIDS	Detail Design Specification Baggage Handling Information Display System (BHIDS) Doc#: MIAL-LT-O-N55B-BG-DOC-DDD-007
DDS - MIS	Detail Design Specification Management Information System (MIS) Doc#: MIAL-LT-O-N55B-BG-DOC-DDD-008
DDS – HLC Security	Detail Design Specification HLC Security Doc#: MIAL-LT-O-N55B-BG-DOC-DDD-009