Aarhus University
Systems Engineering
Company H

DDD-01-00-MJ_TM-v01-20210421

Detailed Design Document

BEUMER Group

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May 3, 2021

1 Version History

Ver.	Date	Initials	Description
1.0	01-04-2020	TM	First draft of document.
1.1	02-04-2020	TM	System-wide Design
1.2	02-04-2020	MJ	System Architecturel Design
1.3	02-04-2020	TM	Additional comments to SAD

Contents

2 Scope

2.1 Identification

The system of interest is the Baggage Handling system, which is an extension to an already implemented CRISBAG provided by BEUMER. Please refer to the case description for more information [1].

2.2 System Overview

The purpose is SOI is to extend the CRISBAG system with additional screening, specifically SecureScreen RX 5001 level 3 screening machines.

2.3 Document Overview

The document describes the structure of the systems in relation to the specified requirements. The architecture and composition of systems and subsystems are based on the *Preliminary Design*. The document structure and setup is inspired by the SE Casebook [2].

3 Referenced Documents

System Requirements Specification, id: SRS-01-00-JJ_RC_MB_MJE-v01_07-20212403.
Preliminary Design, id: 01-00-ALL-v01-24032021.
TraceabilityMatrix, id: 01-00-RC_MJ_TM-v01_7-20210407.pdf

4 System-wide Design Decisions

This section describes the system's behavioural design and other decisions affecting the selection and design of system components.

4.1 Input & Output

The two major interfaces for the system is the connection to the original CRISBAG system, i.e. totes entering (input) and exiting (output) as seen on figure 4.1 in the yellow marked area 'Prior Extension'.

The system must also support additional scanning and will receive input (scans) from the RX 5001 scanners (green marked area, 'Additional Screening'). In relation to this the scans, location and states of totes must be monitored by an operator (Blue marked area, 'Ultimate Control'). This is also an output of the system. See figure 4.2 which illustrates the relationship between the actors and the system.

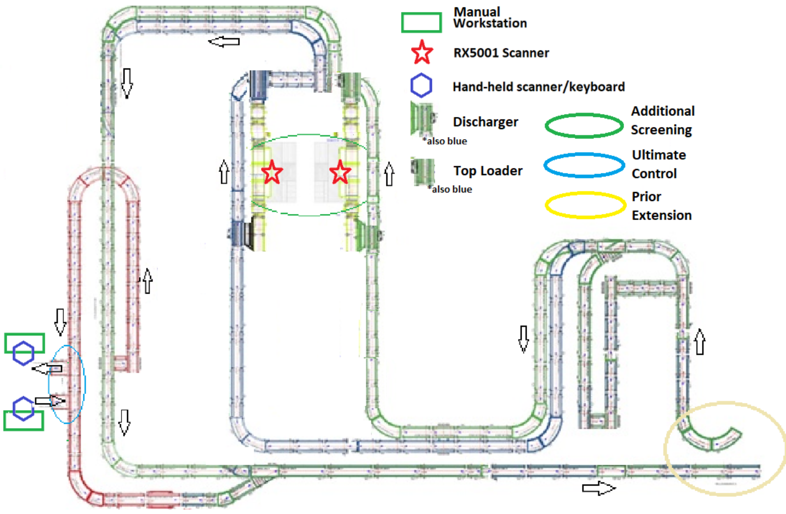

Figure 4.1: System sketch with components.

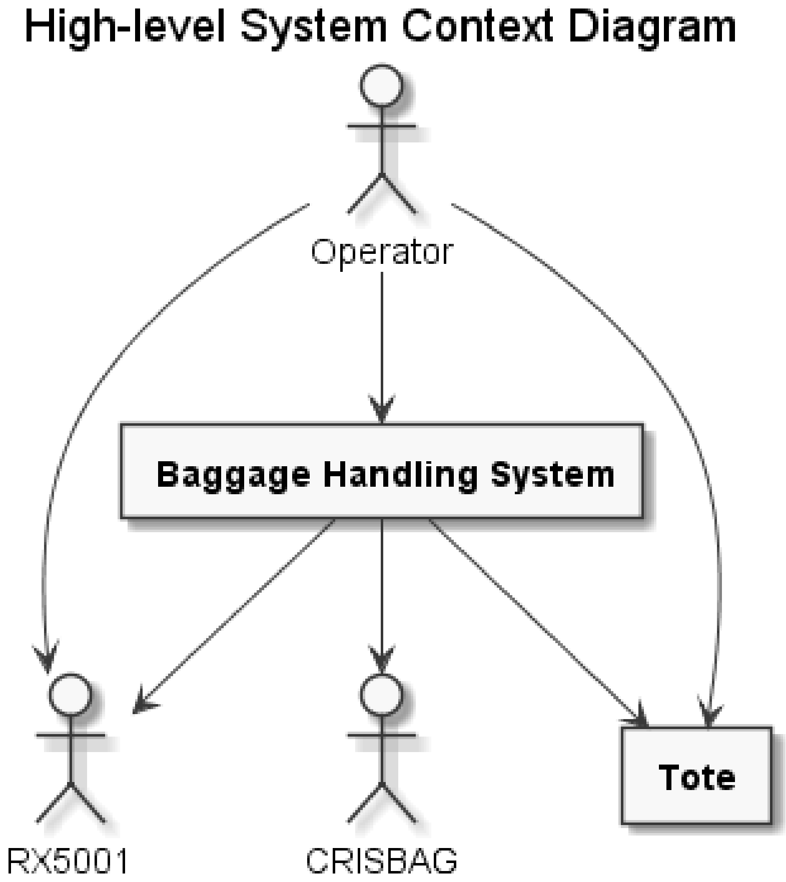

Figure 4.2: System Context Diagram showing actors and interfaces between them. The diagram gives a notion of the inputs and outputs of the system.

4.2 Input responses

Several requirements will be referred to in this paragraph, please refer to *System Requirements Specification* for the exact requirements.

Most of the input responses are encountered during the 'luggage life cycle'. Totes arriving from the CRISBAG system must have minimum travel time of 70 seconds (T2) before arriving to *additional screening*. Before entering the RX5001 scanner the luggage must be separated from the tote and connected afterwards (T33, T34). This happens just before the dischanger as seen on figure 4.1.

In case a luggage unit is deemed unsafe based on the RX5001 scan, it must be subject to manual inspection. The system must reroute the tote (with unsafe luggage) to the ultimate control area, where an operator must manual inspect the luggage (T1, T17). There must pass at least 30 seconds between additional screening and manual inspection (T3).

4.3 System Files

Scan, location and state of all totes are monitored in by the system and accessible by on-site operators (T36). The system can be accessed at dedicated workstations illustrated on figure 4.3

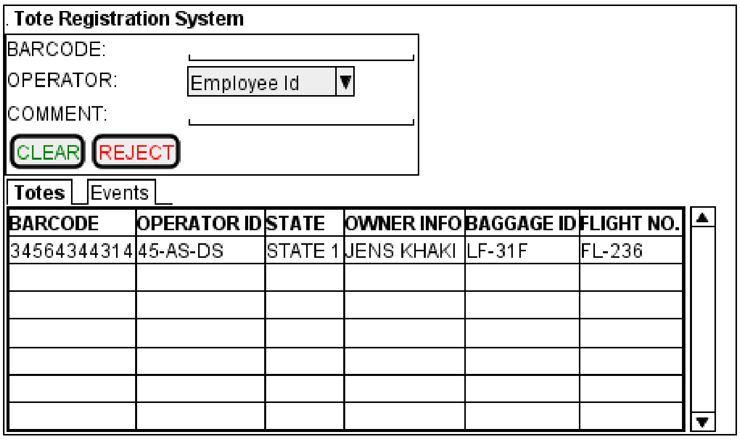

Figure 4.3: Mock-up of tote monitoring system.

4.4 Safety, Security and Privacy

The primary safety and security concerns are part of the luggage/tote life cycle. All luggage must be security approved (T1, T5, T15) either by scan or manual inspection. In case of faulty behaviour in the system all movable parts must be stopped to avoid property damage (T21). All luggage must be tracked when entering the system. The system must focus on reliability as 100% of all luggage must be accounted for - if this cannot be achieved the system must be unavailable until it can achieve this (T24).

All data will be stored according to GDPR regulations and backed up every 24 hours (T19, T20). The servers used must be scaleable and should adjure to the transparency rules defined by Wolfgang Emmerich [3] (T22, T23, T25).

4.5 Construction of hardware systems

All hardware systems are constructed by 3rd party companies or BEUMER Group.

5 System Architectural Design

5.1 System components

The figure in 5.1 shows the different subsystems in the system with the ID's of the components written in parenthesis. Please refer to the *Preliminary Design* document for a more information about the components, section **5.1 - 6.3**.

Down below the versioning of each component is shown. It is a requirement that all components are versioned (T5, T29).

```
<Component ID>
<Version Number>
<Latest Modified Date>
```

As an example, one version of the software for the Screening Management System could be: SMS-01-201213103.

5.2 Concept of execution

In figure 5.1 the relationship between components are shown through an interface. Each interface has been given an unique ID and will be explained in detail in section 5.3. The interface between two components is important to keep track of, since the version of the two components needs to fit together.

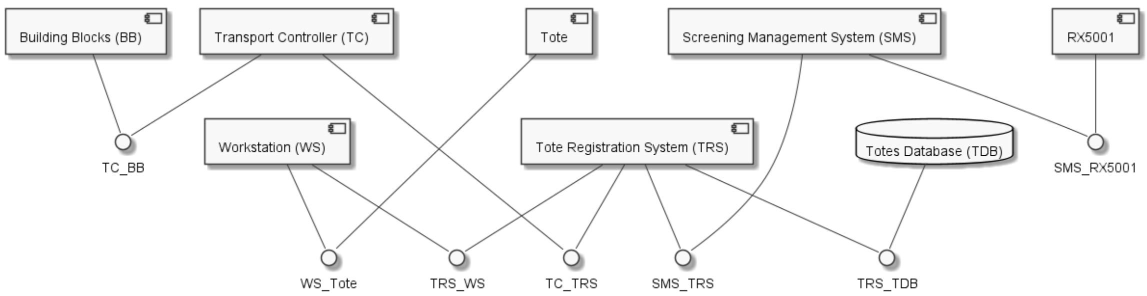

Figure 5.1: Interface diagram that shows the interfaces between components in the system with an unique ID.

5.3 Interface design

Each interface in shown in figure 5.1 has a unique ID. Characteristics for each interface is shown below.

5.3.1 SMS_RX5001

The interface between the RX5001 and the Screen management is the interface that separates the RX5001 from the CRISBAG extension system. The Screen Management System is the software boundary and will be able to talk to other components internally in the system. The RX5001 is not expected to change during the lifetime of the system, so the interface to the RX5001 is not expected to change a lot if at all. I2C protocol will be the main communication protocol between SMS and RX5001. The RX5001 will send messages that contain the scan of the luggage and other associated information.

5.3.2 SMS_TRS

The Screen Management System is also connected to the Tote Registration System. The Screen Management system uses the HTTP protocol to send messages to the Tote Registration System about Tote State. STATE as shown in 4.3 is the only thing The Screen Management System change for each Tote.

5.3.3 TRS_TDB

The Tote Registration System will show the information shown in the Mock-up in figure 4.3. The Tote Registration System will communicate with the Tote Database via the HTTP protocol, where it will store all the information shown in figure 4.3 for every Tote and the luggage transported by the Tote. The figure also shows a tab with the events a given token is shown and will also be stored together with each Tote in the system.

The TBD is a shared database server which is also used by original CRISBAG system. This means luggage registered prior extension will be known by the TRS as well.

5.3.4 TC_TRS

The Transport Controller and Tote Registration System communicate via the HTTP protocol. The Transport Controller will monitor the Totes through the system and send events to the Tote Registration System about Totes and luggage with information about location and activity of each Tote in the system. The Transport Controller will also get events send from the Tote Registration System about the state of Totes to know if the luggage is to be cleared from the system or to be transported to the Ultimate Control Area for further inspection.

5.3.5 TRS_WS

The Tote Registration System serves a frontend application (as seen on figure 4.3) to the workstations. The workstations connect to the frontend application by downloading the software (or by browser). The frontend application will be using the HTTP protocol between frontend and server application. See figure 5.2

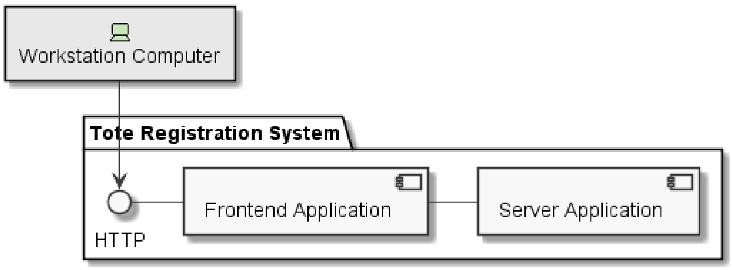

Figure 5.2

5.3.6 WS_Tote

The workstation has a dedicated scanner, which can scan the Totes barcode to identify them in the system. The scanner (workstation) is provided by BEUMER. Please see [1] for size requirements regarding the ultimate control area where the workstation is placed.

5.3.7 TC_BB

The Transport Controller needs to communicate with the different building blocks (see case description [1]) of the system to be able to change the speed of the conveying belt and to either clear baggage of the system after additional screening or direct it to the ultimate control area for further screening. The communication between the Transport Controller and the different Building blocks is done using the I2C protocol.

6 Requirements Traceability

See TraceabilityMatrix-00-RC_MJ_TM-v01_7-20210407.pdf

References

[1] Beumer, “BAGGAGE HANDLING UPGRADE,” vol. 2017, pp. 1–11, 2018.

[2] R. H. Jacobsen and S. Hallerstede, “Systems Engineering Cases and Instructions,” [Online]. Available: https://blackboard.au.dk/bbcswebdav/pid-2945704-dt-content-rid-10601901_1/courses/BB-Cou-UUVA-94215/SECaseBook8.pdf.

[3] W. Emmerich, “Engineering Distrubted Objects,” 2000. [Online]. Available: https://www.scenarioplus.org.uk/reviews/emmerich.htm.