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**1 Introduction**

* 1. **Purpose**

The purpose of this document is to define a set of requirements which will define all the functions and features required by train controller.

The intended audience of this document is the faculty of the University of Pittsburgh and the Port Authority of Allegheny County (PAAC) procurement committee.

* 1. **Scope**

The software product to be produced is the Centralized Train Control Suite (CTCS). It will operate a real-time simulations of trains running on the train-track network. It will display the simulation, and gives the users the options to modify the simulated environment, also regulate the train traffic.

The CTCS will be consist the following five subsystems

* Train model: Models the state, behaviors and failures of a train.
* Track model: Models the state, behaviors, and failures of a track.
* Train Controller: Process signals and send to Train Model
* Track Controller: Send signal to Train Model
* CTC Office: Let users to send and receive signals and commends

The goal of the CTCS is to operate and process train routing to one single office. Previously, train routing were carried out by local signal operators. The benefits of this suite is that it will save manpower by replacing manual operation with automation. And the benefits of the suite increases as the train traffic under the suites grows.

This documents is the highest level of the STS for this suite, there is no higher level for this software suite.

* 1. **Definitions and abbreviations**

Authority - how far (how many blocks) in distance the train is permitted to travel

Block – a section of a railway line

Setpoint – the target distance that an automatic control system sim to reach

CTC – Centralized Traffic Control

CUI – Graphical User Interface

Vital – safety critical

Non-vital – Not safety critical

CTCS – Centralized Train Control Suite

PAAC – Port Authority of Allegheny County

* 1. **Reference**

IEEE Std 830-1998, IEEE Recommended Practice for Software Requirements Specifications.

IBM standard, <http://pic.dhe.ibm.com/infocenter/rsawshlp/v7r5m0/index.jsp?topic=%2Fcom.businessobjects.integration.eclipse.designer.doc%2Fhtml%2Ftopic631.html>

* 1. **Overview**

Section 2 of this document will describe a general factor with the CTCS and the requirements

Section 3 of this document will contain all the software requirements in details which enables designers to design a system to satisfy the requirements

1. **Overall Description**
   1. **Product Perspective**

The CTCS is an independent product.

* 1. Product Functions

The system shall properly monitor trains and track blocks for vital and non-vital component failures and send signals between these components

* 1. User Characteristics
     1. Engineers
        1. The engineers have the ability to pull emergency brake
     2. The Dispatchers
        1. The dispatchers have the ability to set authority
        2. The dispatchers has the ability to set the suggest speed
        3. The dispatchers has the ability to set the speed limit
        4. The dispatchers has the ability to schedule trains
        5. The dispatchers has the ability to add and remove track blocks
  2. **Constraints**
     1. The CTCS shall operate reliably in the environment in which it is operating
     2. The CTCS shall properly handle fails.
  3. **Assumptions and dependencies**
     1. The CTCS shall depend on the Java™ SE Runtime Environment 7 platform.
     2. It is assumed that the system that runs CTCS is Windows 7
     3. It is assumed that the computer CTCS is installed on has a screen and input devise ie. Keyboard and Mouse.

**3 Specific Requirements**

**3.1 External Interface**

3.1.1 Software Interface

3.1.1.1 Inputs from User

3.1.1.1.1 Train authority

3.1.1.1.2 Track Speed limits

3.1.1.1.3 Train schedule

3.1.1.2 Outputs to User

3.1.1.2.1 Train Speed

3.1.1.2.2 Train Direction

3.1.1.3 Input into trains

3.1.1.3.1 Authority

3.1.1.3.2 Acceleration

3.1.1.3.3 Emergency brake signal

3.1.1.3.4 Speed Limit

3.1.1.3.5 Light signal

3.1.1.3.6 Door Signal

3.1.1.3.7 Failure handle signal

3.1.1.4 Output from Train

3.1.1.4.1 Current speed

3.1.1.4.2 Current Light status

3.1.1.4.3 Door Status

3.1.1.4.4 Authority Update

3.1.1.4.5 Failure type signal

3.1.1.5 Input into tracks

3.1.1.5.1 Train authority

3.1.1.5.2 Track Speed limits  
3.1.1.5.3 Train schedule

3.1.1.6 Output from tracks

3.1.1.6.1 Train authority

3.1.1.6.2 Track Speed limits

3.1.1.6.3 Emergency brake signals

3.1.2 System Requirements

3.1.2 General Requirements

3.1.2.1 The system shall have an automatic mode with preset scenarios to demo itself.

3.1.2.2 The system shall have a manual mode which user can input suggested inputs.

3.1.2.3 The system should be capable of running faster than wall clock time.

3.1.2.4 The system shall be able to be operated by the CTC office.

3.1.2.5 The system shall be able to deny user input when they are not valid. Ex: Non-numerical inputs and values exceeds train speed limit or track speed limit.

3.1.2.6 The system’s measurements shall be taken in the United States customary units.

**3.2 Product Function**

3.2.1 Train Model

3.2.2 Track Model

3.2.2.1 The track model shall be configurable and stored in a database.

3.2.2.2 The track model shall be designed with grade and elevation considerations.

3.2.2.3 The track model shall consider travel direction.

3.2.2.4 The track model shall specify branching and speed limits.

3.2.2.5 The track model shall show block size and allow it to be configured.

3.2.2.6 The track model shall have track circuits for presence detection.

3.2.2.7 The track model shall have a track layout input method.

3.2.2.8 The track model shall consider railway crossings and show signals and switch machines.

3.2.2.9 The track model shall include stations for loading and unloading passengers.

3.2.2.10 The track model shall consider power limitations and include temperature regulation.

3.2.2.11 The track model shall display the following failure modes: broken rail, track circuit failure, power failure.

3.2.3 Train Controller Functions

3.2.3.1 The train controller shall be able to regulate speed of the train to the setpoint while not exceeding the speed limit or authority allowed by the system.

3.2.3.2 The train controller shall be able to use track signal as input and decodes the information to determine speed limit and authority.

3.2.3.3 The train controller shall be able to take as input command setpoint from a transit operator.

3.2.3.4 The train controller shall be able to open and close doors at the appropriate times. ie. When the train stops at the train stations, the door should automatically open for passengers to leave or go in.

3.2.3.5 The train controller shall be able to turn on and off lights at the appropriate times. ie. When the train goes into a tunnel, the lights should automatically turned on.

3.2.3.6 The train controller shall be able to announce stations and stops when the train is 1 mile from the stations and stops

3.2.3.7 The train controller shall be able to monitor train for faults and act upon faults in a safe manner, including stop the train and decelerates the train..

3.2.3.7 The train controller shall be able to make the train stop at the center of stations.

3.2.4 Track Controller Functions

3.2.4.1 The track controller shall be able to relay information about the train authority and track speed limits.

3.2.4.2 The track controller shall be able to relay information regarding state of the tracks, railway crossings, and trains.

3.2.4.3 The track controller shall be able to send light and crossbar signals.

3.2.4.4 The track controller shall be able to send track changing signals.

3.2.4.5 The track controller shall be able to relay information regarding the detection of broken rails and the presence of trains, on a given track.

**3.3 Performance requirements**

The train control shall receive activities within 0.1 second

**3.4 Design constraints**

The format of dates and times reported by the CTCS shall follow the IBM standard

**3.5 Software System Attributes**

3.5.1 Reliability

The system shall operate a simulation in a fail-safe manner. The train controller is a safety critical while train has a failure. Thus the train controller should be 100% reliable and should account for all possible failures.

3.5.2 Availability

CTCS shall be available at all times while it’s running.

3.5.3 Portability

3.5.3.1 CTCS shall be able to be used on the systems with Java™ SE Runtime Environment 7 installed

3.5.3.2 CTCS shall be able to be used on PC with Windows 7 operating system installed.

3.5.3.3 CTCS shall be able to be used on PC with Java complier installed.

3.5.4 Maintainability

The CTCSS shall have no maint ainability requirements, because its first release shall be its last release.