ITCC Release 1.0 Test Report -

Integration Test

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Document Number: 00002655- A

Revision History

Revision	Date	Summary of Changes
1.0	01/09/2013	First draft of FRA grant document.

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1. Introduction

The MCC PTC communication system contains three primary subsystems: 220 MHz radios, Messaging software, and Systems Management software. Integration testing of the communication system refers to a process under which two or more of these subsystems are combined together and tested.

1.1 Purpose

This document presents the results associated with integration testing of ITCC Release 1.0. It does not completely detail the test activities and results of each phase of testing, but rather provides a summary of the overall results and provides references to other documents where the details can be found. (See Section 1.4 for reference document file names.) This document also serves as a baseline to which future test results can be compared.

1.2 Acronyms

The table below provides acronyms used in this document.

Acronym	Description
AAR	Association of American Railroads
BO	Back Office
CM	Connection Manager
CSMA	Carrier Sense Multiple Access
CTT1	Closed Track Test 1
CTT2	Closed Track Test 2
DHCP	Dynamic Host Control Protocol
DQPSK	Differential Quadrature Phase Shift Keying
DVT	Design Verification Test
ELM	External Link Manager
FDMA	Frequency Division Multiple Access
FM	Frequency Modulation

Acronym	Description
FW	Firmware
HRX	Host-Radio Exchange
IP	Internet Protocol
ITC	Interoperable Train Control
ITCM	ITCC Messaging System
ITCR	ITCC Radio System
ITCSM	ITCC System Management System
ITCNet	PTC 220 MHz Radio Air Interface Protocol
KPI	Key Performance Indicator
Local	Generic term for base radio
MCC	Meteorcomm LLC
OTA	Over-the-Air
PTB	Protocol Test Bed
PTC	Positive Train Control
RF	Radio Frequency
SBC	Single Board Computer
SM	System Management System
SNMP	Simple Network Management Protocol
SSTB	Software Stress Test Bed
SW	Software

1.2.1 Redaction Notes

Sections of this report have been “blacked out” as proprietary and confidential information internal to Meteorcomm LLC and are not to be released externally. These sections relate to statistical tables supporting conclusions drawn in the report and do not alter the test conclusions.

1.3 Definitions

The table below provides definitions of terms used in this document.

Term	Definition
Closed Track Testing	PTC communication system testing that takes place on non-revenue track at the TTCI test facility.
Corner Case Testing	Testing of a product or system under multiple simultaneous extreme conditions. For example, testing radio performance while operating the radio at the limits of specified operating conditions such as ambient temperature and supply voltage.
Customer	Refers to a railroad.
Direct Validation	Direct validation of a PTC communication system requirement is achieved when the expected result of test case execution ties to a specific ITCC requirement.
Endpoint	Endpoints include WIUs, TMC, and back office applications
End to End Testing	Tests that encompass the delivery of messages between specified endpoints
Indirect Validation	Indirect validation of a PTC communication system requirement is achieved when the nature of a test is such that multiple elements of the system must be functioning properly to achieve a positive outcome.
Functional Testing	Testing to determine whether or not a specific product feature is operational or not. Functional tests are typically pass/fail.
Integration Test Strategy	A top level description of MCC's overall approach to integration testing.
Kit	Specific set of configuration data and/or software files that can be downloaded to assets within the PTC communication system.

Term	Definition
Performance Testing	Testing to determine how well some aspect of a product or system behaves under a particular workload as compared to a defined set of metrics. Performance metrics are quantitative in nature. Some examples of performance metrics that apply during integration testing are message latency and throughput.
PTC Communication System	Includes PTC 220 MHz radios, Wi-Fi and cellular alternate messaging paths, messaging software, and system management software.
Railroad	Refers to a Class I Railroad entity.
Remote	Generic term for locomotive and wayside radios .
Scenario	A defined setup of product or system usage that approximates actual operation of the product in the field. Scenarios can be used to develop test cases. Typically multiple test cases are derived from each scenario.
Segment	A subsystem of the PTC system. The subsystems pertinent to integration testing are: • Locomotive • Office • Wayside • Communications
Subsystem	With reference to MCC's development of the PTC communication system, in the context of integration testing, there are three subsystems: • Messaging software • System management software • 220 MHz radios
Test Bed	Refers to the specific hardware and software needed to test a product or system.
Test Case	Describes a specific test to be performed within a specified test environment and using a specific test configuration. The expected results of an executed test case support the validation of one or more requirements. The mapping of test cases to requirements can be one-to-one or one-to-many.

Term	Definition
Test Configuration	Specific arrangement of test bed resources to facilitate execution of a specific test suite.
Test Cycle	A set of test suites grouped together for execution.
Test Environment	Generic term that refers to the nature of a test facility. Typically, a test environment includes one or more test beds. Environmental variables can include physical as well as operational parameters.
Test Procedure	Detailed description of how to execute a specific test case.
Test Scripts	A set of commands or SW elements that facilitate the execution of test cases.
Test Suite	A group of test cases executed to accomplish specific technical or business goals.
Use Case	A formalized scenario that identifies actors, stimulus, and responses within a system. A use case is made up of a set of possible sequences of interactions between systems and users in a particular environment and related to a particular goal.
Validation	A test process whereby specific product features, functionality, or performance levels are verified.
Witness Testing	Witness Testing (WT) is a designated portion of Closed Track Testing 2 (CTT2) when ITCC members are invited to observe testing operations at TTCI. The Demonstration Days portion of WT includes 1-1.5 days. Test cases conducted during WT are selected by MCC to reflect ITCC member input, but without disrupting the progress of CTT2. WT is not an acceptance test.
Work Stream	A development program within MCC's PTC communication system development project. There are four separate work streams: • 220 MHz radio development • Messaging SW development • Systems management SW development • PTC communication system integration

1.4 References

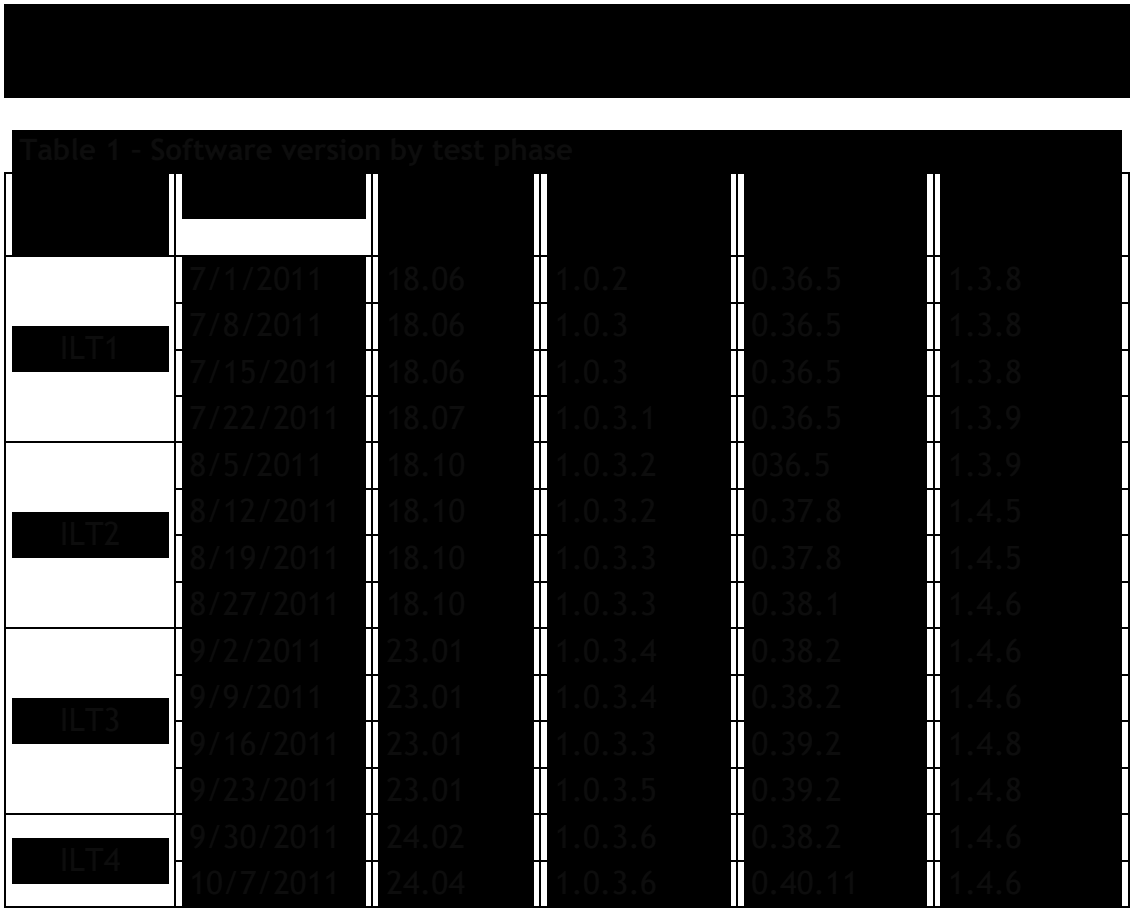
[1] Closed Track 1 Test Report_Initial Release_V1.1 2467-A

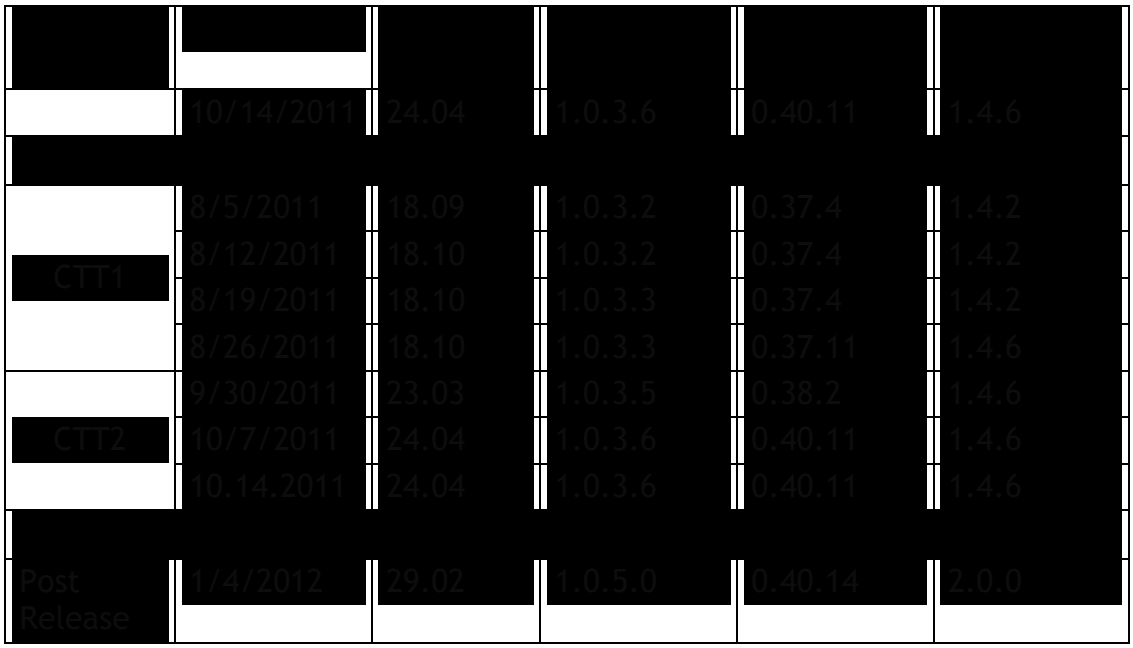
[2] Radio HW Open Track Qualification Test Results_V1.0 2639-A

1.5 Software revisions

There are three software pieces that come together to support the PTC system: Radio software, Messaging software, and System Management System software. In addition, an MCC-developed test control and data analysis tool called Test Executive (TE) was used to facilitate testing, data accumulation, and analysis.

[The following table has been deleted due to proprietary and confidential protections afforded under Exemption 4 of The Freedom of Information Act. The omitted information is a protected trade secret related to proprietary load testing of various radio and messaging software versions used in tests performed during development testing of pre-production radios during the period July – October, 2011. Accordingly, this information is exempt from FOIA search and disclosure.]





1.6 Test case priorities

Integration test cases are prioritized as a guide during test execution.

Table 2 - Test case priority guidelines

Priority Level	Attributes
P1	• Tests an essential product feature • Tests a basic element of functionality • Tests functionality or performance that cannot or has not been tested in prior integration phases
P2	• Supports testing of important usage scenarios • Tests features or functionality not well tested elsewhere
P3	• Extensive like testing at the subsystem level • Do not directly address core functionality

Test cases are executed using the priority level as a guideline as to what test cases to perform last if there are time constraints. In many cases, Priority 3 test cases were run along with Priority 1 or 2 test cases due to the similar nature or set-up of the test.

1.7 Test case categories

Table 3 - Test case categorization

Test Area	Description/Conditions
Key Performance Indicator (KPI)	• Basic RF link validation • RF link performance as a function of locomotive speed (BER) • Base station RF coverage along the test track • Wayside signal level as a function of locomotive position • Latency • Radio transport bandwidth
Systems Management	• Remote upgrade of remote message server SW • Remote upgrade of PTC radio SW
Fragmentation	• Long message delivery tests
Quality of Service (QoS)	• Message priority test • Message expiration tests
Inter-Operability Testing (IOT)	• Message delivery involving foreign locomotive and foreign back office
Cost Metrics	• Routing messages based on user defined transport cost
Mobility	• Base selection process • Message delivery during locomotive radio handoffs
Basic Functionality	• Basic validation tests of system operation
Stability	• Message success rate • Confidence tests • Radio network operation • SW soak tests • Message rate and data throughput
Re-Routing	• Message delivery during transport failure
Positive Train Control (PTC)	• WIU status request and response • Beacon On and Get WIU Status

2. Testing results

2.1 Pass/Fail summary

For ITCC Release 1.0 testing, a total of 374 test cases were developed.

Overall results are:

- 346 of 374 test cases passed (93%).
- 21 of 374 test cases failed.
- Six test cases were blocked.
- One test case was not executed.
- 11 of the failures were Priority 1 (P1) or priority 2 (P2) test cases.
- Ten of the failures were Priority 3 (P3) test cases.
- The failures were the results of 5 defects.

In the sections that follow, the pass/fail results are sorted first by test case priority and then by test case category. Also included is a discussion of the failures.

Section 4 contains a complete list of test cases and the execution status of each.

2.2 Test case by priority results

Integration test cases are prioritized to the three levels indicated in Table 2. Table 4 provides the execution status of the test cases sorted by priority level.

Table 4 – Test case execution by priority

Priority	Blocked	Failed	Not Completed	Passed	Total	% Tested	% Passed	Pass as % tested
P1	2	10	0	137	149	99%	92%	93%
P2	2	1	0	147	150	99%	98%	99%
P3	2	10	1	62	75	96%	83%	86%
Total	6	21	1	346	374	98%	93%	94%

2.3 Test case by category results

The execution status of the test cases sorted by category is shown below.

Table 5 - Test case by category

Category	Blocked	Failed	Not Completed	Passed	Total	% Tested	% Passed	Pass as % tested
KPI	2	0	0	78	80	100%	97.5%	97.5%
Systems Management	0	0	0	16	16	100%	100%	100%
Fragmentation	0	10	1	17	28	96.4%	60.7%	63%
QoS	0	1	0	14	15	100%	98.3%	93.3%
IOT	0	0	0	11	11	100%	100%	100%
Cost Metrics	0	0	0	6	6	100%	100%	100%
Mobility	0	0	0	37	37	100%	100%	100%
Basic Functionality	0	0	0	34	34	100%	100%	100%
Stability	2	0	0	40	42	100%	95.2%	95.2%
Re-Routing	0	0	0	41	41	100%	100%	100%
PTC	2	10	0	52	64	100%	82.3%	81.3%
Total	6	21	1	346	374	99.7%	92.5%	92.8%

2.4 Failures

There were 21 test cases that failed out of the 374 total test cases. These failures have been entered as defects into the MCC tracking system in order to provide visibility and track the defect through closure.

Table 6 below outlines the test cases that failed and the associated defects that were logged against them.

Table 6 - Test case failures

Number of Test Cases	Defect #	Description	Status	Notes
6	1841	Messages stick in Fragment Receivers.	Closed	Messaging software setting issue
4	1867	Remote Connection Manager send out incorrect notification of a TNU.	Closed	Unable to reproduce this issue in latest software.

Number of Test Cases	Defect #	Description	Status	Notes
1	1891	qpid does not always deliver messages based on priority.	Closed	Fixed
7	1894	Long broadcast messages dropped	Open	Developers think the drop rate due to collisions is expected and normal for CSMA messages. Assigned back to triage by Integration.
3	2442	Long broadcast messages 40% dropped with lots of activity	Open	Has been declared expected and normal by developers and recommended for closing.

2.5 Test cases not run

There was one test case out of the 374 total test cases that was not executed.

3. System performance

The following sections address the performance results for ITCC Release 1.0 testing, including latency and bit error rate (BER).

3.1 Latency results

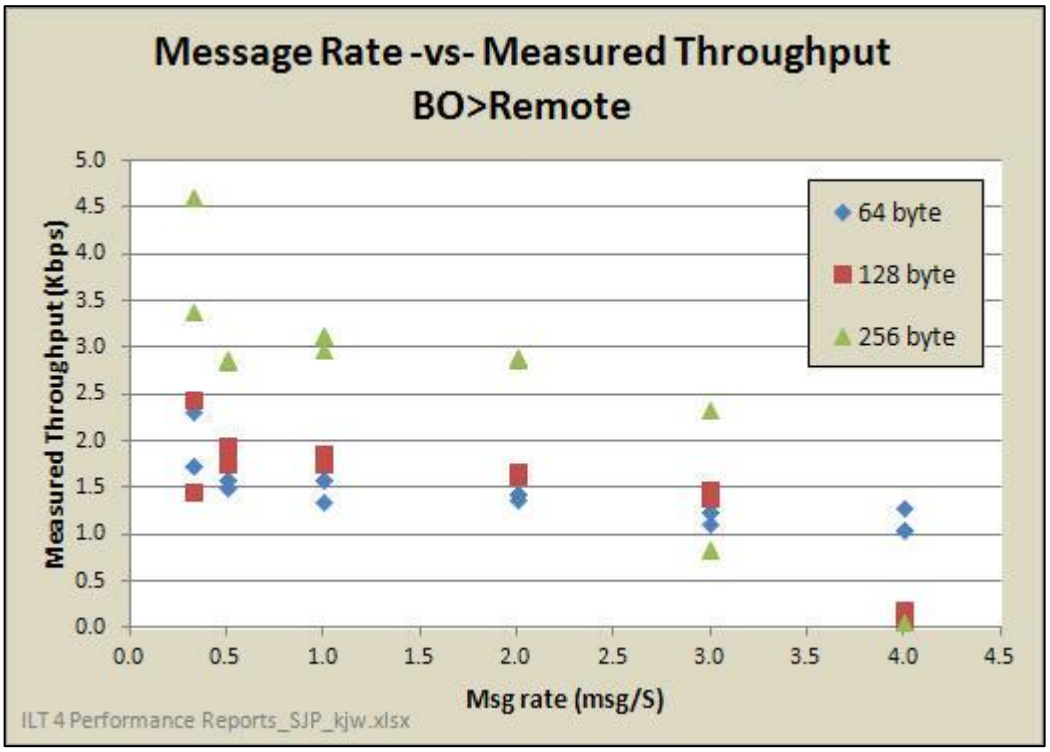
For latency testing in ITCC Release 1.0, messages were generated at the source by a Meteorcomm proprietary software called End Point Simulator (EPS). At the destination, the messages were consumed by another copy of EPS. Latency was measured as the difference in time from when the message was generated by the EPS at the source, until the time when it was consumed by the EPS at the destination.

The measured throughput is the amount of data that was transferred from source to destination within the latency figure given. The measured throughput is derived from the known message size in bits divided by the measured latency in seconds. As the message rate increases, the throughput decreases because the radio starts to get backed up and the latency goes up, reducing throughput. This is more pronounced at larger message sizes.

Table 7 and Table 8 show the average latency for various message paths, rates and sizes using the radio as a transport and also include the measured throughput. The measured throughput is the amount of data that was transferred from source to destination within the latency figure given.

Figure 1 shows the measured throughput in kilobits per second (Kbps) as a function of the message rate at various message sizes using radio as the transport.

Figure 1 – Radio data throughput as a function of message rate



The average latency and throughput figures from the ITCC 1.0 Release testing are presented in the following sections for locomotive and wayside radio links to the back office – from endpoint to endpoint.

3.1.1 Latency between Back Office and Locomotive using Radio

During the latency testing, messages were queued up at various sizes and rates between the locomotive endpoint and the back office endpoint. Each message had a unique message number that was tracked in order to measure the length of time it took to get from the source to the destination. The message rate was varied from one message every few

seconds up to 4 messages every second. Numerous messages were sent and the average figures are shown in the table below.

Table 7 - Latency between BO and Locomotive over Radio

Avg. Latency (S)	Msg Path, Size, Rate	Avg. Measure Throughput (Kbps)
0.9	BO->L, 256 Byte, 1 to 3 Msg/s	2.7
1.1	L->BO, 256 Byte, 1 to 2 Msg/s	2.3
1.1	L->BO, 128 Byte, 1 to 2 Msg/s	1.4
1.4	L->BO, 64 Byte, 1 to 4 Msg/s	0.8

3.1.2 Latency between Back Office and Wayside using radio

Latency was also tested between the back office and wayside endpoints similar to above. The average figures, using radio as a transport, are shown in the table below.

Table 8 – Latency between Back Office and Wayside radio

Avg. Latency (S)	Msg Path, Size, Rate	Avg. Measure Throughput (Kbps)
1.6	BO->W, 256 Byte, 1 to 3 Msg/s	2.3
3.7	W->BO, 256 Byte, 1 to 2 Msg/s	0.9
2.0	W->BO, 128 Byte, 1 to 2 Msg/s	0.8
1.9	W->BO, 64 Byte, 1 to 4 Msg/s	0.6

3.1.3 Latency using cell

Table 9 below shows a comparison of the average latency over radio and cell for large messages. The highlighted figures are radio and the remaining figures are cell.

Table 9 – Comparison between radio and cell latency (Seconds)

Message Size	BO->L	L->BO	BO->W	W->BO
1024	303	200	0.29	0.42
4096	0.48	1.3		

3.1.4 Latency using Wi-Fi

Table 10 below shows the average latency between the remote Messaging software and the Back Office server communication over a Wi-Fi path in the lab test bed known as CTTB. For each message path, there were 1,000 PING messages sent and the latency was averaged.

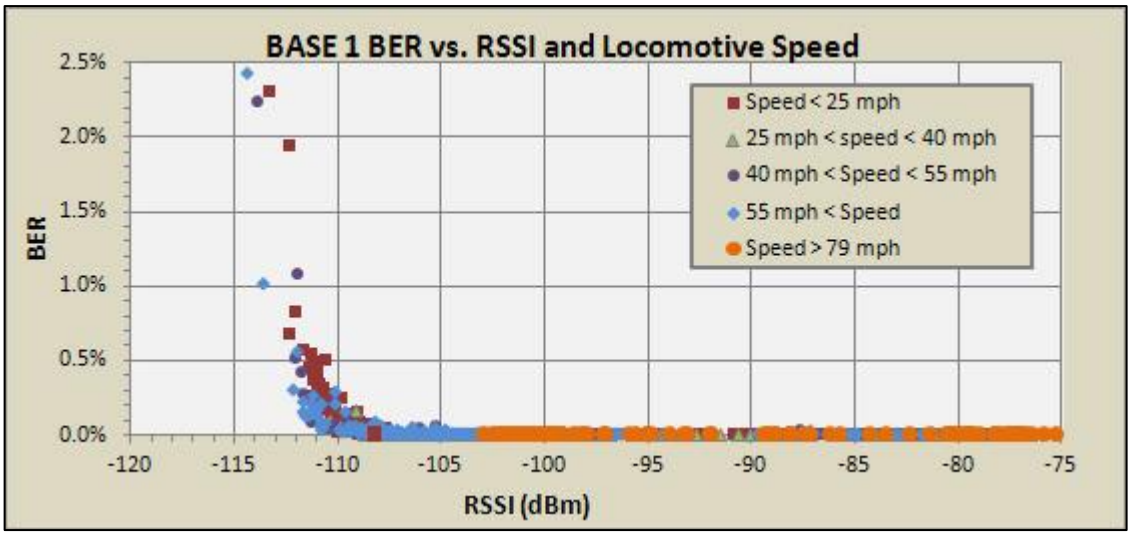
Table 10 – Wi-Fi latency

Message Path	Average Latency (mS)
L->BO	5.3
WS->BO	5.6
BO->L	4.1
BO->W	4.2

3.2 BER

The data represents locomotive speeds between 0 and 84 mph, reference Figure 2. The measurements indicate no discernible difference in BER performance as a function of locomotive speed. This was an unexpected result as the radios were operating without the benefit of forward error correction (FEC). The likely reason for this result is two-fold: first, the RF environment at TTCI for 220 MHz is benign and second, though all the radios were padded down to reduce transmit power, there was still a significant signal level around the test track. As such, there was minimal need for fade margin.

Figure 2 – BER vs. radio RSSI and locomotive speed



4. Test case execution status

Table 11 lists all of the test cases for ITCC Release 1.0 and provides the following information:

- Test case identifier (name)
- ID number
- Test subject or category
- Execution status (whether it passed, failed or was blocked)
- Defect ID associated to the test case if it failed
- Priority that was assigned to the test case

Table 11 – Test case execution status

Test Case Identifier	Test ID	Subject	Status	Defect ID	Priority
CTT_Mob_Radio104_TC05_Cond5	10366	Mobility	Passed		3
CTT_ConfCN_SR-009_TC001_Cond0	13004	Confidence	Passed		1
CTT_ConfCN_SR-009_TC006_Cond0	13005	Confidence	Passed		1
CTT_ConfCN_SR-009_TC008_Cond0	13006	Confidence	Passed		1
CTT_ConfCN_SR-009_TC009_Cond0	13007	Confidence	Passed		1
CTT_ConfCN_SR-144_TC001_Cond0	13008	Confidence	Passed		1
CTT_ConfCN_SR-145_TC001_Cond0	13009	Confidence	Passed		1
CTT_ConfCN_SR-145_TC002_Cond0	13010	Confidence	Passed		1
CTT_ConfRL_SR-049_TC001_Cond0	13011	Confidence	Passed		1
CTT_ConfRL_SR-049_TC002_Cond0	13012	Confidence	Passed		1

Test Case Identifier	Test ID	Subject	Status	Defect ID	Priority
CTT_ConfRL_SR-049_TC003_Cond0	13013	Confidence	Passed		1
CTT_ConfFR_SR-014_TC001_Cond0	13014	Confidence	Passed		3
CTT_ConfFR_SR-014_TC002_Cond0	13015	Confidence	Passed		3
CTT_ConfFR_SR-014_TC003_Cond0	13016	Confidence	Passed		3
CTT_ConfRL_SR-041_TC001_Cond0	13017	Confidence	Passed		2
CTT_ConfRL_SR-040_TC002_Cond0	13018	Confidence	Passed		2
CTT_ConfRL_SR-040_TC003_Cond0	13019	Confidence	Passed		2
CTT_ConfRL_SR-041_TC002_Cond0	13020	Confidence	Passed		2
CTT_ConfRL_TC001_Cond0	13021	Confidence	Passed		2
CTT_ConfRL_TC003_Cond0	13022	Confidence	Passed		2
CTT_ConfRL_SR-127_TC001_Cond0	13023	Confidence	Passed		1
CTT_ConfPRI_TC001_Cond0	13024	Confidence	Passed		3
CTT_ConfRL_TC002_Cond0	13029	Confidence	Passed		2
CTT_ConfRL_TC004_Cond0	13030	Confidence	Passed		2
CTT_Conf_Msg_Restart_DR	13039	Confidence	Passed		1
CTT_Mob_Radio104_TC02_Cond5	13040	Mobility	Passed		3
CTT_Mob_Radio104_TC03_Cond5	13042	Mobility	Passed		3
CTT_Mob_Radio104_TC04_Cond5	13043	Mobility	Passed		1
CTT_Mob_Radio104_TC01_Cond5	13052	Mobility	Passed		1
CTT_ConfRL_SR-041_TC003_Cond0	13054	Confidence	Passed		2
CTT_ConfRL_SR-040_TC001_Cond0	13055	Confidence	Passed		2

Test Case Identifier	Test ID	Subject	Status	Defect ID	Priority
CCT_ConfLST_TC001_Cond4	13056	Confidence	Passed		1
CTT_SL-010_TC01	13636	KPI	Passed		2
CTT_SL-010_TC02	13638	KPI	Passed		2
CTT_SL-010_TC03	13639	KPI	Passed		2
CTT_SL-010_TC04	13640	KPI	Passed		2
CTT_DL-032_TC01	13725	KPI	Passed		2
CTT_DL-032_TC02	13726	KPI	Passed		2
CTT_SR-020_TC01	13729	KPI	Passed		2
CTT_ML-060_TC01	13730	KPI	Passed		2
CTT_ML-060_TC02	13731	KPI	Passed		2
CTT_SL-012_TC01	13750	KPI	Passed		2
CTT_SL-012_TC02	13751	KPI	Passed		2
CTT_SL-012_TC03	13752	KPI	Passed		2
CTT_SL-012_TC04	13753	KPI	Passed		2
CTT_SL-012_TC05	13754	KPI	Passed		2
CTT_SHO_SL-010_TC01	13755	Mobility	Passed		1
CTT_MHO_SL-025_TC01	13756	Mobility	Passed		3
CTT_MHO_SL-025_TC02	13757	Mobility	Passed		1
CTT_MHO_SL-025_TC03	13758	Mobility	Passed		3
CTT_MHO_SL-025_TC04	13760	Mobility	Passed		1
CTT_DL-032_TC03	13783	KPI	Passed		2

Test Case Identifier	Test ID	Subject	Status	Defect ID	Priority
CTT_DL-032_TC04	13784	KPI	Passed		2
CTT_DL-032_TC05	13785	KPI	Passed		2
CTT_DL-032_TC06	13786	KPI	Passed		2
CTT_DL-032_TC07	13787	KPI	Passed		2
CTT_DL-032_TC08	13788	KPI	Passed		2
CTT_ML-060_TC03	13789	KPI	Passed		2
CTT_ML-060_TC04	13790	KPI	Passed		2
CTT_DL-032_TC09	13791	KPI	Passed		2
CTT_DL-032_TC10	13792	KPI	Passed		2
CTT_DL-032_TC11	13793	KPI	Passed		2
CTT_DL-032_TC12	13794	KPI	Passed		2
CTT_BRL_TC01	13795	KPI	Passed		1
CTT_BRL_TC02	13796	KPI	Passed		1
CTT_BRL_TC03	13797	KPI	Passed		1
CTT_BRL_TC04	13798	KPI	Passed		1
CTT_BRL_TC05	13799	KPI	Passed		1
CTT_BRL_TC06	13800	KPI	Passed		1
CTT_BRL_TC07	13801	KPI	Passed		1
CTT_MHO_SL-025_TC05	13802	Mobility	Passed		2
CTT1_Lat-070_TC01	13812	KPI	Passed		2
CTT1_Lat-070_TC02	13813	KPI	Passed		2

Test Case Identifier	Test ID	Subject	Status	Defect ID	Priority
CTT1_Rout_SR-022_TC001	13814	Rerouting	Passed		2
CTT1_Lat-075_TC01	13815	KPI	Passed		2
CTT1_Lat-075_TC02	13816	KPI	Passed		2
CTT1_SH-Lat-070_TC01	13818	KPI	Passed		1
CTT1_SH-Lat-070_TC02	13819	KPI	Passed		1
CTT1_SH-Lat-070_TC03	13820	KPI	Passed		1
CTT1_Rout_SR-022_TC002	13822	Rerouting	Passed		2
CTT1_KPI-130	13824	KPI	Blocked	1789	2
CTT_SHC-1_TC02	13843	Beacon On	Passed		1
CTT_QosPRI_SR-047_TC002_Cond4	13846	QoS	Failed	1891	2
CTT_QosPRI_SR-048_TC002_Cond0	13847	QoS	Passed		2
CTT_QosPRI_SR-052_TC001_Cond0	13848	QoS	Passed		2
CTT_QosTTL_SR-056_TC001_Cond0	13849	QoS	Passed		3
CTT_QosTTL_SR-056_TC002_Cond4	13850	QoS	Passed		3
CTT_QosTTL_SR-056_TC003_Cond4	13851	QoS	Passed		3
CTT_QosTTL_SR-057_TC001_Cond0	13852	QoS	Passed		3
CTT_PTC-Cap_065_TC01_Cond3	13862	Periodic Beacon	Passed		1
CTT_PTC-SH_71_TC01_Cond0	13863	Periodic Beacon	Passed		1
CTT_PTC-SH_R-71_TC001_Cond0	13865	Status Request	Failed	1894	1
CTT_PTC-SH_SR049_TC01_Cond0	13866	Periodic Beacon	Passed		1
CTT_PTC-SH_SR049_TC04_Cond0	13867	Status Response	Passed		1

Test Case Identifier	Test ID	Subject	Status	Defect ID	Priority
CTT_PTC-SpclHdlng_068_TC01_Cond3	13868	Periodic Beacon	Passed		1
CTT_PTC-SH_R-xxx_TC001_Cond-0	13875	Beacon On	Passed		1
CTT_PTC-SH_R-xxx_TC002_Cond-0	13876	Beacon On	Passed		1
CTT_PTC-SH_R-71_TC002_Cond0	13891	Status Request	Passed		1
CTT_PTC-SH_SR049_TC02_Cond0	13892	Periodic Beacon	Passed		1
CTT_PTC-SH_SR049_TC05_Cond0	13893	Status Response	Passed		1
CTT_PTC-SH_SR049_TC06_Cond0	13894	Status Response	Failed	1894	1
CTT_PTC-SH_SR049_TC07_Cond0	13895	Status Response	Passed		1
CTT_PTC-SH_R-71_TC003_Cond0	13896	Status Request	Passed		1
CTT_PTC-SH_R-71_TC004_Cond0	13897	Status Request	Passed		1
CTT_PTC-SH_R-xxx_TC003_Cond-0	13898	Beacon On	Passed		1
CTT_Mob_Radio_104_TC001_Cond0	13903	Mobility	Passed		3
CTT_RemoteSWUpgrade_TC01	13965	Confidence	Passed		1
CTT_SL-010_TC05	14259	KPI	Passed		2
CTT_SL-010_TC06	14260	KPI	Passed		2
CTT_SL-010_TC07	14261	KPI	Passed		2
CTT_SL-010_TC08	14262	KPI	Passed		2
CTT_PTC-SH_R-71_TC005_Cond0	14271	Status Request	Failed	1894	1
CTT_PTC-SH_R-71_TC006_Cond0	14272	Status Request	Passed		1
CTT_PTC-SH_SR049_TC03_Cond0	14273	Periodic Beacon	Passed		1
CTT_MHO_SL-025_TC06	14274	Mobility	Passed		3

Test Case Identifier	Test ID	Subject	Status	Defect ID	Priority
CTT_MHO_SL-025_TC07	14275	Mobility	Passed		3
CTT_MHO_SL-025_TC08	14277	Mobility	Passed		3
CTT_MHO_SL-025_TC09	14278	Mobility	Passed		3
CTT_Mob_Radio104_TC06_Cond5	14279	Mobility	Passed		1
CTT_PTC-SH_SR-064_TC001_Cond0	14280	Status Relay	Passed		1
CTT_PTC-SH_SR-064_TC002_Cond0	14281	Status Relay	Passed		1
CTT_MHO_SL-025_TC10	15475	Mobility	Passed		3
CTT_MHO_SL-025_TC11	15476	Mobility	Passed		2
CTT_MHO_SL-025_TC12	15477	Mobility	Passed		3
CTT_MHO_SL-025_TC13	15478	Mobility	Passed		2
CTT1_Rout_SR-022_TC003	15479	Rerouting	Passed		2
CTT1_Rout_SR-022_TC004	15480	Rerouting	Passed		2
CTT_IOT_SR-076_TC001_Cond0	16405	IOT	Passed		2
CTT_IOT_SR-076_TC002_Cond0	16406	IOT	Passed		2
CTT_IOT_SR-076_TC003_Cond0	16407	IOT	Passed		2
CTT_IOT_SR-076_TC004_Cond0	16408	IOT	Passed		2
CTT_IOT_SR-076_TC005_Cond0	16409	IOT	Passed		2
CTT_IOT_SR-076_TC006_Cond5	16613	IOT	Passed		2
CTT_DL-032_TC01_1	16664	KPI	Passed		2
CTT_DL-032_TC02_1	16665	KPI	Passed		2
CTT_DL-032_TC03_1	16666	KPI	Passed		2

Test Case Identifier	Test ID	Subject	Status	Defect ID	Priority
CTT_DL-032_TC04_1	16667	KPI	Passed		2
CTT_DL-032_TC05_1	16668	KPI	Passed		2
CTT_DL-032_TC06_1	16669	KPI	Passed		2
CTT_DL-032_TC07_1	16670	KPI	Passed		2
CTT_DL-032_TC08_1	16671	KPI	Passed		2
CTT_DL-032_TC09_1	16672	KPI	Passed		2
CTT_DL-032_TC10_1	16673	KPI	Passed		2
CTT_DL-032_TC11_1	16674	KPI	Passed		2
ILT_IOT_SR-076_TC01_Cond0	8644	IOT	Passed		2
ILT_IOT_SR-072_TC001_Cond0	10011	IOT	Passed		2
ILT_IOT_SR-072_TC002_Cond0	10012	IOT	Passed		2
ILT_IOT_SR-072_TC003_Cond0	10013	IOT	Passed		2
ILT_IOT_SR-072_TC004_Cond0	10014	IOT	Passed		2
ILT_ConfBF_TxRX_TC01	13424	Basic Functionality	Passed		1
ILT_ConfBF_TxRx_TC02	13425	Basic Functionality	Passed		1
ILT_ConfBF_TxRx_TC03	13426	Basic Functionality	Passed		1
ILT_ConfBF_TxRX_TC04	13427	Basic Functionality	Passed		1
ILT_ConfBF_TxRx_TC05	13428	Basic Functionality	Passed		1

Test Case Identifier	Test ID	Subject	Status	Defect ID	Priority
ILT_ConfBF_TxRx_TC06	13429	Basic Functionality	Passed		1
ILT_ConfCN_SR-029_TC001_Cond0	13430	Basic Functionality	Passed		2
ILT_ConfFR_SR-014_TC001_Cond0	13431	Basic Functionality	Passed		3
ILT_ConfFR_SR-014_TC002_Cond0	13432	Basic Functionality	Passed		3
ILT_ConfFR_SR-014_TC003_Cond0	13433	Basic Functionality	Passed		3
ILT_ConfPRI_TC001_Cond0	13434	Basic Functionality	Passed		3
ILT_ConfRL_SR-040_TC001_Cond0	13435	Basic Functionality	Passed		2
ILT_ConfRL_SR-040_TC002_Cond0	13436	Basic Functionality	Passed		2
ILT_ConfRL_SR-040_TC003_Cond0	13437	Basic Functionality	Passed		2
ILT_ConfRL_TC001_Cond0	13438	Basic Functionality	Passed		2
ILT_ConfRL_TC002_Cond0	13439	Basic Functionality	Passed		2
ILT_ConfRL_TC003_Cond0	13440	Basic Functionality	Passed		2
ILT_ConfRL_TC004_Cond0	13441	Basic Functionality	Passed		2

Test Case Identifier	Test ID	Subject	Status	Defect ID	Priority
ILT_ConfCN_SR-009_TC001_Cond0	13442	Stability	Passed		1
ILT_ConfCN_SR-009_TC002_Cond0	13443	Stability	Passed		1
ILT_ConfCN_SR-009_TC003_Cond0	13444	Stability	Passed		3
ILT_ConfCN_SR-009_TC006_Cond0	13445	Stability	Passed		1
ILT_ConfCN_SR-009_TC008_Cond0	13446	Stability	Passed		1
ILT_ConfCN_SR-009_TC009_Cond0	13447	Stability	Passed		1
ILT_ConfCN_SR-144_TC001_Cond0	13448	Stability	Passed		1
ILT_ConfLST_TC001_Cond4	13449	Stability	Passed		1
ILT_ConfLST_TC002_Cond4	13450	Stability	Passed		1
ILT_ConfLST_TC003_Cond4	13451	Stability	Passed		1
ILT_ConfTH_SR-087_TC001_Cond0	13453	Stability	Passed		2
ILT_ConfTH_SR-088_TC001_Cond0	13454	Stability	Passed		2
ILT_ConfCN_SR-145_TC001_Cond0	13455	Basic Functionality	Passed		1
ILT_ConfMF_SR-005_TC001_Cond0	13456	Basic Functionality	Passed		1
ILT_ConfMF_SR-018_TC001_Cond0	13457	Basic Functionality	Passed		1
ILT_ConfMF_SR-098_TC001_Cond0	13458	Basic Functionality	Passed		1
ILT_ConfRL_SR-040_TC004_Cond0	13459	Basic Functionality	Passed		2

Test Case Identifier	Test ID	Subject	Status	Defect ID	Priority
ILT_ConfRL_SR-041_TC001_Cond0	13460	Basic Functionality	Passed		2
ILT_ConfRL_SR-049_TC001_Cond0	13461	Basic Functionality	Passed		1
ILT_ConfRL_SR-127_TC001_Cond0	13462	Basic Functionality	Passed		1
ILT_Conf_SR-108_TC001_Cond0	13464	Basic Functionality	Passed		1
ILT_ConfCN_SR-145_TC002_Cond0	13465	Basic Functionality	Passed		1
ILT_ConfRL_SR-041_TC002_Cond0	13466	Basic Functionality	Passed		2
ILT_ConfRL_SR-041_TC003_Cond0	13467	Basic Functionality	Passed		2
ILT_ConfRL_SR-049_TC002_Cond0	13468	Basic Functionality	Passed		2
ILT_ConfRL_SR-049_TC003_Cond0	13469	Basic Functionality	Passed		2
ILT_Frag_SR-001_TC001_Cond0	13470	Fragmentation	Passed		3
ILT_Frag_SR-001_TC002_Cond0	13471	Fragmentation	Passed		3
ILT_Frag_SR-001_TC003_Cond0	13472	Fragmentation	Failed	1867	3
ILT_Frag_SR-001_TC004_Cond0	13473	Fragmentation	Failed	1867	3
ILT_Frag_SR-001_TC005_Cond0	13474	Fragmentation	Failed	1867	3
ILT_Frag_SR-001_TC006_Cond0	13475	Fragmentation	Passed		3
ILT_Frag_SR-014_TC001_Cond0	13476	Fragmentation	Passed		3

Test Case Identifier	Test ID	Subject	Status	Defect ID	Priority
ILT_Frag_SR-014_TC002_Cond0	13477	Fragmentation	Passed		3
ILT_Frag_SR-014_TC003_Cond	13478	Fragmentation	Passed		3
ILT_Frag_SR-049_TC001_Cond0	13479	Fragmentation	Failed	1841	3
ILT_Frag_SR-049_TC002_Cond0	13480	Fragmentation	Failed	1841	3
ILT_Frag_SR-049_TC003_Cond0	13481	Fragmentation	Failed	1841	3
ILT_FragPRI_SR-200_TC006_Cond4	13482	Fragmentation	Failed	1841	3
ILT_FragPRI_SR-200_TC007_Cond4	13483	Fragmentation	Failed	1841	3
ILT_FragPRI_SR-200_TC008_Cond4	13484	Fragmentation	Failed	1841	3
ILT_FragPRI_SR-200_TC009_Cond4	13485	Fragmentation	Passed		3
ILT_FragPRI_SR-200_TC010_Cond4	13486	Fragmentation	Failed	1867	3
ILT_FragPRI_SR-200_TC011_Cond0	13487	Fragmentation	No Run		3
ILT_FragRL_SR-014_TC004_Cond4	13488	Fragmentation	Passed		3
ILT_FragRL_SR-014_TC005_Cond4	13489	Fragmentation	Passed		3
ILT_FragRL_SR-014_TC006_Cond4	13490	Fragmentation	Passed		3
ILT_FragRL_SR-014_TC007_Cond4	13491	Fragmentation	Passed		3
ILT_FragRL_SR-014_TC008_Cond4	13492	Fragmentation	Passed		3
ILT_FragRL_SR-014_TC009_Cond4	13493	Fragmentation	Passed		3
ILT_FragRL_SR-014_TC010_Cond4	13494	Fragmentation	Passed		3
ILT_FragRL_SR-014_TC011_Cond0	13495	Fragmentation	Passed		3
ILT_QosPRI_SR-200_TC004_Cond4	13496	Fragmentation	Passed		3
ILT_QosPRI_SR-200_TC005_Cond4	13497	Fragmentation	Passed		3

Test Case Identifier	Test ID	Subject	Status	Defect ID	Priority
ILT_QoS_SR-134_TC001_Cond0	13498	QoS	Passed		1
ILT_QosPRI_SR-047_TC002_Cond4	13499	QoS	Passed		2
ILT_QosPRI_SR-048_TC002_Cond0	13500	QoS	Passed		2
ILT_QosPRI_SR-052_TC001_Cond0	13501	QoS	Passed		2
ILT_QosTTL_SR-056_TC001_Cond0	13502	QoS	Passed		3
ILT_QosTTL_SR-056_TC002_Cond4	13503	QoS	Passed		3
ILT_QosTTL_SR-056_TC003_Cond4	13504	QoS	Passed		3
ILT_QosTTL_SR-057_TC001_Cond0	13505	QoS	Passed		3
ILT_Rout_SR-022_TC001_Cond0	13506	Re-Routing	Passed		2
ILT_Rout_SR-022_TC002_Cond0	13507	Re-Routing	Passed		2
ILT_Rout_SR-022_TC003_Cond0	13508	Re-Routing	Passed		2
ILT_Rout_SR-022_TC004_Cond0	13509	Re-Routing	Passed		2
ILT_Rout_SR-028_TC001_Cond0	13514	Re-Routing	Passed		2
ILT_Rout_SR-028_TC002_Cond0	13515	Re-Routing	Passed		2
ILT_Rout_SR-028_TC003_Cond0	13516	Re-Routing	Passed		2
ILT_Rout_SR-028_TC004_Cond0	13517	Re-Routing	Passed		2
ILT_Rout_SR-028_TC005_Cond0	13518	Re-Routing	Passed		2
ILT_Rout_SR-028_TC006_Cond0	13519	Re-Routing	Passed		2
ILT_Rout_SR-023_TC001_Cond0	13520	Re-Routing	Passed		2
ILT_Rout_SR-023_TC002_Cond0	13521	Re-Routing	Passed		2
ILT_Rout_SR-034_TC001_Cond0	13522	Re-Routing	Passed		2

Test Case Identifier	Test ID	Subject	Status	Defect ID	Priority
ILT_Rout_SR-166_TC001_Cond0	13523	Re-Routing	Passed		2
ILT_Cap_086_TC01_Cond0	13525	KPI	Passed		2
ILT_Mob_SR-076_TC01_Cond0	13526	Mobility	Passed		1
ILT_Mob_SR-076_TC02_Cond0	13527	Mobility	Passed		1
ILT_Mob_SR-076_TC03_Cond0	13528	Mobility	Passed		1
ILT_Mob_SR-076_TC04_Cond0	13529	Mobility	Passed		1
ILT_Mob_SR-076_TC05_Cond0	13530	Mobility	Passed		1
ILT_PTC-Cap_065_TC01_Cond3	13532	PTC	Passed		1
ILT_PTC-SH_71_TC01_Cond0	13533	PTC	Passed		1
ILT_PTC-SH_R-71_TC001_Cond0	13536	PTC	Passed		1
ILT_PTC-SH_SR049_TC01_Cond0	13537	PTC	Passed		1
ILT_PTC-SH_SR049_TC04_Cond0	13539	PTC	Passed		1
ILT_PTC-SpclHdlng_068_TC01_Cond3	13541	PTC	Passed		1
ILT_QoS_SR-198_TC001_Cond0	13548	Re-Routing	Passed		3
ILT_QoS_SR-198_TC002_Cond0	13549	Re-Routing	Passed		3
ILT_QoS_SR-198_TC003_Cond0	13550	Re-Routing	Passed		3
ILT_Rout_SR-029_TC001_Cond0	13551	Re-Routing	Passed		2
ILT_Rout_SR-029_TC002_Cond0	13552	Re-Routing	Passed		2
ILT_Rout_SR-029_TC003_Cond0	13553	Re-Routing	Passed		2
ILT_Rout_SR-030_TC001_Cond0	13554	Re-Routing	Passed		2
ILT_Rout_SR-030_TC002_Cond0	13555	Re-Routing	Passed		2

Test Case Identifier	Test ID	Subject	Status	Defect ID	Priority
ILT_Rout_SR-030_TC003_Cond0	13556	Re-Routing	Passed		2
ILT_Rout_DR-001_TC001_Cond0	13557	Re-Routing	Passed		3
ILT_Rout_DR-001_TC002_Cond0	13558	Re-Routing	Passed		3
ILT_Rout_SR-023_TC07_Cond0	13559	Re-Routing	Passed		2
ILT_Rout_SR-023_TC003_Cond0	13560	Re-Routing	Passed		2
ILT_Rout_SR-023_TC004_Cond0	13561	Re-Routing	Passed		2
ILT_Rout_SR-023_TC005_Cond0	13562	Re-Routing	Passed		2
ILT_Rout_SR-023_TC006_Cond0	13563	Re-Routing	Passed		2
ILT_TPT_SR-087_TC001_Cond0	13570	KPI	Passed		2
ILT_TPT_SR-088_TC001_Cond0	13571	KPI	Passed		2
ILT_QoSCost_DR-001_TC001_Cond0	13573	Cost Metrics	Passed		1
ILT_QoSCost_DR-001_TC002_Cond0	13574	Cost Metrics	Passed		1
ILT_QoSCost_DR-001_TC003_Cond0	13575	Cost Metrics	Passed		1
ILT_QoSCost_DR-002_TC001_Cond0	13576	Cost Metrics	Passed		3
ILT_QoSCost_DR-002_TC002_Cond0	13577	Cost Metrics	Passed		3
ILT_QoSCost_DR-002_TC003_Cond0	13578	Cost Metrics	Passed		3
ILT_PTC-Load_DR_TC001_Cond0	13579	PTC	Blocked	1789	1
ILT_PTC-Load_R-75_TC001_Cond0	13580	PTC	Blocked	1789	1
ILT_PTC-SH_R-xxx_TC001_Cond-0	13584	PTC	Passed		1
ILT_Radio_052_TC001_Cond0	13601	PTC	Passed		3
ILT_Radio_069_TC001_Cond0	13603	PTC	Passed		1

Test Case Identifier	Test ID	Subject	Status	Defect ID	Priority
ILT_Radio_075_TC001_Cond0	13604	Mobility	Passed		1
ILT_SMS_Asset Bootstrap with CSR_TC001_Cond2	13614	Systems Management	Passed		1
ILT_SMS_AssetBootstrap_WOCSR_TC001_Cond2	13615	Systems Management	Passed		1
ILT_SMS_Event_Alert_TC001_Cond2	13616	Systems Management	Passed		1
ILT_SMS_OPK Security Kit Refresh_TC001_Cond2	13617	Systems Management	Passed		1
ILT_SMS_PingTest_TC001_Cond2	13618	Systems Management	Passed		1
ILT_SMS_Event_Alert_TC001_Cond1	13619	Systems Management	Passed		1
ILT_SMS_Asset Bootstrap with CSR_TC001_Cond1	13620	Systems Management	Passed		1
ILT_SMS_AssetBootstrap_WOCSR_TC001_Cond1	13621	Systems Management	Passed		1
ILT_SMS_OPK Security Kit Refresh_TC001_Cond1	13622	Systems Management	Passed		2
ILT_SMS_PingTest_TC001_Cond1	13623	Systems Management	Passed		1
ILT_PTC-SH_R-71_TC002_Cond0	13646	PTC	Passed		1
ILT_PTC-SH_SR049_TC02_Cond0	13653	PTC	Passed		1
ILT_PTC-SH_SR049_TC05_Cond0	13654	PTC	Passed		1
ILT_PTC-SH_SR049_TC06_Cond0	13655	PTC	Passed		1

Test Case Identifier	Test ID	Subject	Status	Defect ID	Priority
ILT_PTC-SH_SR049_TC07_Cond0	13656	PTC	Passed		1
ILT_PTC-SH_R-71_TC004_Cond0	13658	PTC	Passed		1
ILT_PTC-SH_R-xxx_TC003_Cond-0	13659	PTC	Passed		1
ILT_PTC-SH_R-xxx_TC004_Cond0	13719	PTC	Passed		1
ILT_TPT_Radio_BOtx	13734	KPI	Passed		2
ILT_TPT_Radio_BOrx	13735	KPI	Passed		2
ILT_TPT_Radio_L_B_Lat	13737	KPI	Passed		2
ILT_TPT_Radio_B_L_Lat	13738	KPI	Passed		2
ILT_TPT_Radio_W_B_Lat	13739	KPI	Passed		2
ILT_TPT_Radio_B_W_Lat	13740	KPI	Passed		2
ILT_TPT_Radio_BOrx_1	13741	KPI	Passed		2
ILT_TPT_Radio_BOtx_1	13742	KPI	Passed		2
ILT_TPT_Radio_B_L_Lat_1	13743	KPI	Passed		2
ILT_TPT_Radio_B_W_Lat_1	13744	KPI	Passed		2
ILT_TPT_Radio_L_B_Lat_1	13745	KPI	Passed		2
ILT_TPT_Radio_W_B_Lat_1	13746	KPI	Passed		2
ILT_TPT_BOtx_Max	13747		Blocked	1789	3
ILT_TPT_BOrx_Max	13748		Blocked	1789	3
ILT_RS_LO_TC01	13777	KPI	Passed		2
ILT_MOB_LO_TC01	13779	KPI	Passed		2
ILT_Rout_SR-022_TC005_Cond0	13828	Re-Routing	Passed		2

Test Case Identifier	Test ID	Subject	Status	Defect ID	Priority
ILT_RS_LO_TC02	13836	KPI	Passed		2
ILT_RS_LO_TC03	13837	KPI	Passed		2
ILT_Mob_SR-076_TC06_Cond0	13911	Mobility	Passed		1
ILT_Mob_SR-076_TC07_Cond0	13912	Mobility	Passed		1
ILT_Mob_SR-076_TC08_Cond0	13913	Mobility	Passed		1
ILT_Mob_SR-076_TC09_Cond0	13914	Mobility	Passed		1
ILT_Mob_SR-076_TC10_Cond0	13915	Mobility	Passed		1
ILT_Mob_SR-076_TC11_Cond0	13916	Mobility	Passed		1
ILT_Mob_SR-076_TC12_Cond0	13919	Mobility	Passed		1
ILT_MobFR_SR-076_TC02_Cond0	13921	Mobility	Passed		3
ILT_MobFR_SR-076_TC01_Cond0	13922	Mobility	Passed		3
ILT_TPT_ASYM_Data_TC01	13929	KPI	Blocked	1789	2
ILT_PTC-SH_R-71_TC005_Cond0	13930	PTC	Failed	1894	1
ILT_PTC-SH_R-xxx_TC005_Cond-0	13931	PTC	Passed		1
ILT_PTC-SH_SR049_TC08_Cond0	13932	PTC	Passed		1
ILT_RFD_SR-039_TC001_Cond0	13935	Re-Routing	Passed		3
ILT_RFD_SR-039_TC002_Cond0	13936	Re-Routing	Passed		3
ILT_RFD_SR-039_TC003_Cond0	13937	Re-Routing	Passed		3
ILT_Rout_SR-050_TC001_Cond0	13938	Re-Routing	Passed		3
ILT_SMS_Event_Alert_TC001_Cond3	13950	Systems Management	Passed		1

Test Case Identifier	Test ID	Subject	Status	Defect ID	Priority
ILT_SMS_AssetBootstrap_WOCSR_TC001_Cond3	13951	Systems Management	Passed		1
ILT_SMS_PingTest_TC001_Cond3	13952	Systems Management	Passed		1
ILT_SMS_OPK Security Kit Refresh_TC001_Cond3	13953	Systems Management	Passed		2
ILT_SMS_Asset Bootstrap with CSR_TC001_Cond3	13954	Systems Management	Passed		1
ILT_SMS_OPK Sec Kit Refr_wLrgFile_TC001_Cond3	13955	Systems Management	Passed		2
ILT_ConfMNT_SR-211_Cond0	13957	Basic Functionality	Passed		1
ILT_ConfRL_SR-059_Cond0	13958	Basic Functionality	Passed		1
ILT_Rout_SR-023_TC08_Cond0	13959	Re-Routing	Passed		2
ILT_PTC-SH_SR049_TC03_Cond0	13962	PTC	Passed		1
ILT_PTC-SH_SR-064_TC001_Cond0	13963	PTC	Passed		1
ILT_PTC-SH_SR-064_TC002_Cond0	13964	PTC	Passed		1
ILT_PTC-SH_SR049_TC09_Cond0	14266	PTC	Passed		1
ILT_Rout_DR-001_TC003_Cond0	14286	Re-Routing	Passed		3
ILT_PERF_Radio_B_L_Soak_Test	15739	KPI	Passed		2
ILT_PERF_Radio_B_L_Soak_Test_1	15740	KPI	Passed		2
ILT_PERF_Radio_B_W_Soak_Test	15741	KPI	Passed		2
ILT_PERF_Radio_B_W_Soak_Test_1	15742	KPI	Passed		2

Test Case Identifier	Test ID	Subject	Status	Defect ID	Priority
ILT_Mob_SR-076_TC13_Cond0	16167	Mobility	Passed		1
ILT_PTC-SH_R-71_TC006_Cond0	16209	PTC	Failed	1894	1
ILT_PTC-SH_R-xxx_TC006_Cond0	16211	PTC	Failed	1894	1
ILT_PTC-SH_SR049_TC10_Cond0	16213	PTC	Failed	1894	1
ILT_PTC-SH_SR049_TC11_Cond0	16214	PTC	Passed		1
ILT_PTC-SH_SR-064_TC003_Cond0	16215	PTC	Passed		1
ILT_PTC-SH_R-71_TC007_Cond0	16627	PTC	Passed		1
ILT_PTC-SH_R-xxx_TC007_Cond0	16628	PTC	Passed		1
ILT_PTC-SH_SR049_TC12_Cond0	16629	PTC	Passed		1
ILT_PTC-SH_SR049_TC13_Cond0	16630	PTC	Passed		1
ILT_PTC-SH_R-71_TC003_Cond0	16634	PTC	Passed		1
ILT_PTC-SH_R-xxx_TC002_Cond0	16635	PTC	Passed		1
ILT_PTC-DR-001_TC01_Cond0	16634	PTC	Failed	2442	1
ILT_PTC-DR-001_TC02_Cond0	16635	PTC	Failed	2442	1
ILT_PTC-DR-001_TC03_Cond0	16634	PTC	Failed	2442	1
ILT_PTC-DR-002_TC01_Cond0	16635	PTC	Passed		1
ILT_PTC-DR-002_TC02_Cond0	16635	PTC	Passed		1

5. Requirements matrix

Table 12 contains a requirements traceability matrix that maps the requirements to one or more ITCC Release 1.0 test cases. The table also provides the status of each requirement (yellow for partially satisfied

and red for not satisfied). The requirements are grouped by the categories Messaging, Radio, and Systems Management.

Table 12 – Messaging requirements mapping

Req ID	Category	Requirement Summary	Status	Test Case ID
SR-001	App	The messaging system shall support the delivery of messages at least as large as the maximum size allowed by EMP.	X	ILT_Frag_SR-001_TC001_Cond0 ILT_Frag_SR-001_TC002_Cond0 ILT_Frag_SR-001_TC003_Cond0
SR-004	App	The messaging system shall support more than one application, with no upper limit, in any given segment that can simultaneously access it for sending or receiving messages.	X	ILT_PTC-Cap_065_TC001_Cond3 Tested with up to 3 applications / Endpoint
SR-008	App	The messaging system shall ensure that its operation is independent of the contents of the message body.	X	All test send messages with random size / content payloads
SR-009	App	The ITCC Messaging System shall accept EMP messages from applications, and deliver EMP messages to applications.	X	ILT_ConfCN_SR-009_TC001_Cond0 ILT_ConfCN_SR-009_TC006_Cond0 ILT_ConfCN_SR-009_TC008_Cond0 ILT_ConfCN_SR-009_TC009_Cond0

Req ID	Category	Requirement Summary	Status	Test Case ID
SR-012	App	The messaging system shall accept or deliver messages from an application via the Class D protocol.	X	ILT_ConfCN_SR-009_TC001_Cond0 ILT_ConfCN_SR-009_TC006_Cond0 ILT_ConfCN_SR-009_TC008_Cond0 ILT_ConfCN_SR-009_TC009_Cond0
SR-013	App	The messaging system shall accept or deliver messages from an application via AMQP	X	ILT_ConfCN_SR-009_TC001_Cond0 ILT_ConfCN_SR-009_TC006_Cond0 ILT_ConfCN_SR-009_TC008_Cond0 ILT_ConfCN_SR-009_TC009_Cond0
SR-014	App	The messaging system shall only deliver complete messages to the destination application.	X	ILT_ConfFR_SR-014_TC001_Cond0 ILT_ConfFR_SR-014_TC003_Cond0 ILT_Frag_SR-001_TC001_Cond0 ILT_Frag_SR-001_TC001_Cond0 ILT_Frag_SR-014_TC001_Cond0 ILT_Frag_SR-014_TC003_Cond0 ILT_FragRL_SR-014_TC004_Cond0 ILT_FragRL_SR-014_TC010_Cond0
SR-017	QoS - SH	The messaging system shall deliver application messages to the receiver with the application headers unaltered from what was sent, except in cases where special handling with size optimization is requested.	X	ILT_ConfMF_SR-018_TC001_Cond0

Req ID	Category	Requirement Summary	Status	Test Case ID
SR-019	Addr/Rtng	The messaging system shall support the delivery of peer-to-peer messages (between nearby remotes without going through a back office) over the 220MHz network.	X	ILT_PTC-SH_R-71_TC003_Cond0 ILT_PTC-SH_R-xxx_TC003_Cond0
SR-020	Addr/Rtng	The messaging system shall support the delivery of peer-to-peer messages over the 220MHz network whether or not there is a connection from the remote to a base station.	X	ILT_PTC-SH_R-71_TC002_Cond0 ILT_PTC-SH_R-71_TC003_Cond0 ILT_PTC-SH_R-71_TC007_Cond0 ILT_PTC-SH_R-xxx_TC002_Cond0 ILT_PTC-SH_R-xxx_TC003_Cond0 ILT_PTC-SH_SR-049_TC02_Cond0 ILT_PTC-SH_SR-049_TC05_Cond0 ILT_PTC-SH_SR-049_TC07_Cond0 ILT_PTC-SH_SR-049_TC12_Cond0 ILT_PTC-SH_SR-049_TC12_Cond0
SR-021	Addr/Rtng	If the messaging system cannot send a message to its destination, it shall retain the message until conditions support sending the message and then the messaging system shall again attempt to send the message to its destination.	X	ILT_Rout_SR-022_TC001_Cond0 ILT_Rout_SR-022_TC005_Cond0 ILT_Frag_SR-014_TC001_Cond0 ILT_Frag_SR-014_TC003_Cond0

Req ID	Category	Requirement Summary	Status	Test Case ID
SR-022	Addr/Rtng	The messaging system shall update the routing information as the destinations lose and reestablish connections to the system.	X	ILT_Rout_SR-022_TC001_Cond0 ILT_Rout_SR-022_TC005_Cond0 ILT_Frag_SR-014_TC001_Cond0 ILT_Frag_SR-014_TC003_Cond0 ILT_Rout_SR-023_TC001_Cond0 ILT_Rout_SR-023_TC008_Cond0 ILT_Rout_SR-028_TC001_Cond0 ILT_Rout_SR-028_TC006_Cond0 ILT_FragRL_SR-014_TC004_Cond0 ILT_FragRL_SR-014_TC010_Cond0
SR-023	Addr/Rtng	The messaging system shall support the routing of messages over multiple communication paths (IP and non-IP, wired and wireless as underlying transports) simultaneously, in all segments.	X	ILT_Rout_SR-023_TC001_Cond0 ILT_Rout_SR-023_TC008_Cond0
SR-024	Addr/Rtng	The messaging system shall accept messages from an application when there is no current path to the message destination.	X	ILT_Rout_SR-022_TC001_Cond0 ILT_Rout_SR-022_TC005_Cond0 ILT_QoSPRI_SR-047_TC001_Cond0 ILT_QoSPRI_SR-048_TC002_Cond0
SR-025	Addr/Rtng	The messaging system will only share the presence information of a mobile via a network transport once it has ensured the network transport link is stable.	X	ILT_RFD_SR-039_TC001_Cond0 ILT_RFD_SR-039_TC003_Cond0
SR-026	Addr/Rtng	The messaging system will remove the presence information of a mobile for any network transport link that becomes unstable.	X	ILT_RFD_SR-039_TC001_Cond0 ILT_RFD_SR-039_TC003_Cond0

Req ID	Category	Requirement Summary	Status	Test Case ID
SR-028	Addr/Rtng	The messaging system shall route messages around lost connections to the destination where the routing policy allows the use of other transport paths.	X	ILT_Rout_SR-028_TC001_Cond0 ILT_Rout_SR-028_TC006_Cond0
SR-029	Addr/Rtng	The messaging system shall support configurable routing policies that define whether a message of a certain class of service can be sent over a particular transport path.	X	ILT_Rout_SR-029_TC001_Cond0 ILT_Rout_SR-029_TC003_Cond0
SR-030	Addr/Rtng	The messaging system shall support configurable attributes that will allow a transport routing policy to be enforced such that a unique network path is selected for each message and utilizes the following two business defined attributes: 1. Message class 2. Message Network Preference indicator	X	ILT_Rout_SR-030_TC001_Cond0 ILT_Rout_SR-030_TC003_Cond0
SR-032	Addr/Rtng	The messaging system shall reconsider the appropriate path for a message whenever a new path becomes available for that message.	X	ILT_Rout_SR-022_TC001_Cond0 ILT_Rout_SR-022_TC005_Cond0 ILT_Frag_SR-014_TC001_Cond0 ILT_Frag_SR-014_TC003_Cond0 ILT_Rout_SR-023_TC001_Cond0 ILT_Rout_SR-023_TC008_Cond0 ILT_Rout_SR-028_TC001_Cond0 ILT_Rout_SR-028_TC006_Cond0 ILT_FragRL_SR-014_TC004_Cond0 ILT_FragRL_SR-014_TC010_Cond0

Req ID	Category	Requirement Summary	Status	Test Case ID
SR-033	Addr/Rtng	The messaging system shall reconsider the appropriate path for a message whenever the selected path for that message becomes unavailable.	X	ILT_Rout_SR-022_TC001_Cond0 ILT_Rout_SR-022_TC005_Cond0 ILT_Frag_SR-014_TC001_Cond0 ILT_Frag_SR-014_TC003_Cond0 ILT_Rout_SR-023_TC001_Cond0 ILT_Rout_SR-023_TC008_Cond0 ILT_Rout_SR-028_TC001_Cond0 ILT_Rout_SR-028_TC006_Cond0 ILT_FragRL_SR-014_TC004_Cond0 ILT_FragRL_SR-014_TC010_Cond0
SR-034	Addr/Rtng	The messaging system shall deliver messages to the application as specified by the destination address information in the message unless special handling applies.	X	ILT_PTC-SH_SR-049_TC001_Cond0 ILT_PTC-SH_SR-049_TC003_Cond0 ILT_PTC-Cap_065_TC01_Cond3 ILT_PTC-Load_DR_TC001_Cond0
SR-037	Addr/Rtng	The messaging system shall respond to stable link up events (presence information) from each wireless transport network (Wi-Fi, Cell or 220) and cause the routing information to be updated appropriately.	X	RFD Testing With Radio and Native AMQP Transports

Req ID	Category	Requirement Summary	Status	Test Case ID
SR-038	Addr/Rtng	The messaging system shall respond to link down events (presence loss information) from each wireless transport network (Wi-Fi, Cell or 220) and cause the routing information to be updated appropriately.	X	ILT_Rout_SR-022_TC001_Cond0 ILT_Rout_SR-022_TC005_Cond0 ILT_Frag_SR-014_TC001_Cond0 ILT_Frag_SR-014_TC003_Cond0 ILT_Rout_SR-023_TC001_Cond0 ILT_Rout_SR-023_TC008_Cond0 ILT_Rout_SR-028_TC001_Cond0 ILT_Rout_SR-028_TC006_Cond0 ILT_FragRL_SR-014_TC004_Cond0 ILT_FragRL_SR-014_TC010_Cond0
SR-040	QoS-MC	The messaging system shall only allow a message to use a transport network if the message class of the message is among the transport network's allowable message classes, regardless of any other Routing Request parameters associated with the message.	X	ILT_ConfRL_SR-040_TC001_Cond0 ILT_ConfRL_SR-040_TC003_Cond0
SR-041	QoS-NP	When the messaging system is unable to satisfy a network preference route request for specific transport preference, it should handle the message as if the transport preference was unspecified.	X	ILT_ConfRL_SR-041_TC001_Cond0 ILT_ConfRL_SR-041_TC003_Cond0
SR-042	QoS-NP	The messaging system shall provide a mechanism for an application to request special handling for messages.	X	All Tests Involving special handling demonstrate this is satisfied
SR-047	QoS-P	Absolute Priority: The messaging system shall service higher priority messages prior to servicing lower priority messages.	X	ILT_QosPRI_SR-048_TC002_Cond0

Req ID	Category	Requirement Summary	Status	Test Case ID
SR-049	QoS-NP	The messaging system shall support a network preference route request attribute on a message that would instruct the system to transmit the message using every network transport which the configured message classes allow.	X	ILT_ConfRL_SR-049_TC001_Cond0 ILT_ConfRL_SR-049_TC003_Cond0
SR-050	QoS-MC	The messaging system shall ensure that the list of allowable message classes used for both directions of message traffic on a network transport link between a remote area and an office area is the intersection of the list of allowable message classes configured for that link in the remote area with the list of allowable message classes configured for that link in the office area.	X	ILT_Rout_SR-050_TC001_Cond0
SR-052	QoS-P	The messaging system shall use the message priority to determine the order in which messages are sent.	X	ILT_QosPRI_SR-052_TC001_Cond0
SR-056	QoS-TTL	Every message shall contain a time to live (TTL) which is defined as the amount of time the system shall actively attempt to deliver the message.	X	ILT_QoSTTL_SR-056_TC001_Cond0 ILT_QoSTTL_SR-056_TC003_Cond0
SR-057	QoS-TTL	The messaging system shall discard messages that have not been delivered and whose TTL is expired.	X	ILT_QoSTTL_SR-057_TC001_Cond0

Req ID	Category	Requirement Summary	Status	Test Case ID
SR-059	QoS-NP	When the application specifies the network preference routing request, the messaging system shall consider the network transport specified in the network preference as having the lowest transport routing cost for the processing of that message, regardless of any other Routing Request parameters associated with the message.	X	ILT_ConfRL_SR-059_TC001_Cond0
SR-064	Qos-SH	The messaging system shall communicate to the underlying transport the special handling that was requested by the application.	X	All Tests Involving special handling demonstrate this is satisfied
SR-066	QoS-SH	The messaging system shall support the ability to configure the action performed by each component of the messaging system for each special handling code.	Partial - SH Tests involved different conditions on CM/ELM behavior.	ILT_PTC-SH_R-71_TC002_Cond0 ILT_PTC-SH_R-71_TC003_Cond0 ILT_PTC-SH_R-71_TC007_Cond0 ILT_PTC-SH_R-xxx_TC002_Cond0 ILT_PTC-SH_R-xxx_TC003_Cond0 ILT_PTC-SH_SR-049_TC02_Cond0 ILT_PTC-SH_SR-049_TC05_Cond0 ILT_PTC-SH_SR-049_TC07_Cond0 ILT_PTC-SH_SR-049_TC12_Cond0 ILT_PTC-SH_SR-049_TC12_Cond0
SR-067	SR-067	The messaging system shall not lose messages due to preemption. The general context for this requirement is the goal for effective utilization of wireless bandwidth.	X	ILT_QoSPRI_SR-048_TC002_Cond0 ILT_QoSPRI_SR-052_TC001_Cond0

Req ID	Category	Requirement Summary	Status	Test Case ID
SR-072	Interop	The messaging system shall support the ability of the field asset (locomotive, wayside) of any agreement member to communicate using IP transport assets of it's own or of any other agreement member.	X	ILT_IOT_SR-072_TC001_Cond0 ILT_IOT_SR-072_TC004_Cond0
SR-073	Interop	The messaging system shall support the following locomotive scenarios defined by the RESC a. Homebody (talking to your own BO) b. Traveler (talking to your BO via someone else's BO) c. Tourist (talking to someone else's BO)	X	ILT_IOT_SR-072_TC001_Cond0 ILT_IOT_SR-072_TC004_Cond0
SR-075	Interop	The ITCC Messaging System shall accept messages from applications and attempt to deliver those messages regardless of source or destination organization or segment (back office, locomotive or wayside).	X	ILT_IOT_SR-072_TC001_Cond0 ILT_IOT_SR-072_TC004_Cond0
SR-076	Interop	The messaging system shall support the ability of the field asset (locomotive, wayside)of any agreement member to communicate using the 220MHz transport assets (e.g. base station) of it's own or of any other agreement member.	X	ILT_IOT_SR-076_TC001_Cond0

Req ID	Category	Requirement Summary	Status	Test Case ID
SR-087	Perf & Avail	The messaging system shall support a minimum of 33 messages per second (32 in, 1 out) passing through a mobile remote area over an indefinite period of time (at least 8 hours) without losing messages due to resource constraints.	X	ILT_TPT_SR-087_TC001_Cond0
SR-088	Perf & Avail	The messaging system shall support a minimum of 6 messages per second (5 in, 1 out) passing through a wayside remote area over an indefinite period of time (at least 8 hours) without losing messages due to resource constraints.	X	ILT_TPT_SR-088_TC001_Cond0
SR-108	Sys Mgt	The messaging system shall support the traceability and identification of all its managed components connecting to the system at an individual component level.	X	ILT_Conf_SR-108_TC001_Cond0
SR-127	Addr/Rtng	If two or more network transports meet criteria of class and network preference QOS values, the ITCM shall select the network transport with the lowest cost.	X	ILT_ConfRL_SR-127_TC001_Cond0
SR-128	Addr/Rtng	If two or more available network transports have equal costs, the ITCM shall distribute the load between the networks in an approximately even manner.	X	ILT_QosCost_DR-001_TC001_Cond0 ILT_QosCost_DR-001_TC003_Cond0 ILT_QosCost_DR-002_TC001_Cond0 ILT_QosCost_DR-002_TC003_Cond0

Req ID	Category	Requirement Summary	Status	Test Case ID
SR-133	Addr/Rtng	The messaging system shall react to changes in routing information by re-determining the best path for a message at the next available routing decision point.	X	ILT_Rout_SR-028_TC001_Cond0 ILT_Rout_SR-028_TC006_Cond0
SR-134	Addr/Rtng	The messaging system shall support the delivery of messages to 220mhz base stations for the purpose of broadcast out of that base station.	X	ILT_PTC-SH_SR-64_TC001_Cond0 ILT_PTC-SH_SR-64_TC003_Cond0
SR-144	Configuration	After a new remote asset is provisioned, configured and activated it shall immediately function within the messaging system without the need for manual intervention.	X	ILT_ConfCN_SR-144_TC001_Cond0
SR-145	Addr/Rtng	All remote assets which come into coverage of the interoperable transport network supported by the messaging system , even for the first time, shall immediately be able to register their presence and exchange messages with the back office system without the need for manual intervention.	X	ILT_ConfCN_SR-145_TC001_Cond0 ILT_ConfCN_SR-145_TC002_Cond0
SR-151	Protocol	The messaging system shall drop any message that does not conform with the transport message format specification.	Partial - Tested only certain instances of this.	ILT_ConfMF_SR-005_TC001_Cond0

Req ID	Category	Requirement Summary	Status	Test Case ID
SR-166	Addr/Rtng	The Messaging System shall support the ability to route a message from a remote area that is addressed to another remote area through one or more office areas.	X	ILT_IOT_SR-072_TC001_Cond0 ILT_IOT_SR-072_TC004_Cond0
SR-167	Qos-SH	The messaging system shall support making copies of a message and replacing the address and QoS on the copies with the configured values per the special handling information associated with the message.	X	ILT_PTC-SH_SR-064_TC001_Cond0 ILT_PTC-SH_SR-064_TC003_Cond0
SR-168	Qos-SH	The messaging system shall support stripping the application and/or the transport headers from messages prior to handling them off to an underlying transport per the special handling information associated with the message.	X	ILT_PTC-SH_SR-049_TC001_Cond0 ILT_PTC-SH_SR-049_TC003_Cond0
SR-169	Qos-SH	The messaging system shall support receiving a message from an underlying transport and adding configured application and/or the transport headers where they have been stripped per the special handling information associated with the message. If there is no reconstruction value in the configuration the messaging system shall discard the message.	X	ILT_PTC-SH_SR-049_TC001_Cond0 ILT_PTC-SH_SR-049_TC003_Cond0

Req ID	Category	Requirement Summary	Status	Test Case ID
SR-178	Addr/Rtng	The messaging system on remote areas shall support a configurable filter on incoming wireless messages so that it can filter out and drop messages whose destination area does not match that remote area.	X	ILT_PTC-SH_R-71_TC002_Cond0 ILT_PTC-SH_R-71_TC003_Cond0 ILT_PTC-SH_R-71_TC007_Cond0 ILT_PTC-SH_R-xxx_TC002_Cond0 ILT_PTC-SH_R-xxx_TC003_Cond0 ILT_PTC-SH_SR-049_TC02_Cond0 ILT_PTC-SH_SR-049_TC05_Cond0 ILT_PTC-SH_SR-049_TC07_Cond0 ILT_PTC-SH_SR-049_TC12_Cond0 ILT_PTC-SH_SR-049_TC12_Cond0
SR-198	Addr/Rtng	The messaging system shall support the configuration of the following attributes for each end of a network transport within a configurable collection of wireless network paths (i.e. specific Wi-Fi or 220 connections). 1) A list of allowable message classes which may be an empty list. 2) Transport Cost metric 3) Transport type The scope of a collection could be fixed at the entire wireless network transport (for cell and satellite) or configured to be per a grouping of one or more base stations (for the 220 network) or a collection of access points that are all served by the same back office transport subsystem (for the Wi-Fi network		ILT_QoSCost_DR-001_TC001_Cond0 ILT_QosCost_DR-001_TC003_Cond0 ILT_QosCost_DR-002_TC001_Cond0 ILT_QosCost_DR-002_TC003_Cond0

Req ID	Category	Requirement Summary	Status	Test Case ID
SR-200	Qos-P	The messaging system shall implement preemption so as to not delay the servicing of higher priority messages due to the servicing of lower priority messages.	X	ILT_FragPRI_SR-200_TC004_Cond0 - ILT_FragPRI_SR-200_TC011_Cond0
SR-211	Configuration	The Messaging system shall support the immediate application of configuration changes in the following scenarios: - Adding a radio to an External Link Manager (ELM) - Adding an application to an Application Gateway (AG) - Changing the logging level of a component Immediate means the added configuration is available without requiring a restart of the component. The specific parameters to support these scenarios are provided in Application Parameter Characteristics (MCC DCN REQ-PTC-00001226-A, published 3/9/2011). All other parameter changes shall require a restart of the affected component(s) to take effect.	X	ILT_ConfCN_SR-145_TC002_Cond0
SR-213	Platform/PoC	The messaging system in all areas shall support running on a RHEL 5.x platform.	X	All testing was carried out on RHEL 5.7 platform

Table 13 – Radio requirements mapping

Req ID	Category	Requirement Summary	Status	Test Case ID
52	GPS	The radio must support broadcasting or responding to a time request (accurate to +/- 1 seconds) to/from the WIU through an Ethernet interface.	X	ILT_Radio_052_TC001_Cond0
56	HA	The radio must be able to communicate with a Locomotive in the absence of a Base.	X	ILT_PTC-SH_R-71_TC002_Cond0 ILT_PTC-SH_R-71_TC003_Cond0 ILT_PTC-SH_R-71_TC007_Cond0 ILT_PTC-SH_R-xxx_TC002_Cond0 ILT_PTC-SH_R-xxx_TC003_Cond0 ILT_PTC-SH_R-xxx_TC007_Cond0 ILT_PTC-SH_SR-064_TC002_Cond0 ILT_PTC-SH_SR049_TC04_Cond0 ILT_PTC-SH_SR049_TC05_Cond0 ILT_PTC-SH_SR049_TC07_Cond0 ILT_PTC-SH_SR049_TC12_Cond0 LT_PTC-SH_SR049_TC13_Cond0
58	Latency	The radio must support a latency for high priority messages (of up to 256 bytes) sent over the air between the wired side of one radio and the wired side of another radio which is not greater than 15 seconds for at least 99.9% of messages. This applies to all in-bound and out-bound messages and does not include Wayside status related messages.	Less than 99.9% of long broadcast messages are received due to long broadcast drop	ILT_PTC-SH_SR049_TC10_Cond0 ILT_PTC-SH_SR049_TC13_Cond0 ILT_PTC-SH_R-xxx_TC006_Cond0 ILT_PTC-SH_R-xxx_TC007_Cond0 ILT_PTC-SH_R-71_TC006_Cond0 ILT_PTC-SH_R-71_TC007_Cond0

Req ID	Category	Requirement Summary	Status	Test Case ID
			defect.	
59	Latency	The system must support a latency for high priority messages (application to application) which is not greater than 60 seconds for at least 99.9% of messages. This applies to all in-bound and out-bound messages and does not include Wayside status related messages.	Fails if Back office area is configured with multiple TNS or if long broadcast load becomes high enough to produce excessive drops.	
65	Load	The radio must support one or more beacon/status messages each beacon cycle from each WIU.	X	ILT_PTC-Cap_065_TC01_Cond3
68	Load	The radio must give preference to transmitting beaconed status messages over any other type of message.	X	ILT_PTC-SpclHdlng_068_TC01_Cond3

Req ID	Category	Requirement Summary	Status	Test Case ID
69	Load	The system design must support 30 beacon/status messages per cycle from Waysides under the coverage of a single Base.	X	ILT_Radio_069_TC001_Cond0
71	Load	The radio must support beaconing of the most recently received Wayside status message from the WIU.	X	ILT_PTC-SH_R-71_TC001_Cond0
71.1	Load	The radio must not beacon the same message (received once from the WIU) more than once.	X	ILT_PTC-SH_R-71_TC001_Cond0
80	Load	The system design must support two way communications from the Locomotive to the Wayside.	X	ILT_ConfCN_SR-009_TC006_Cond0 ILT_PTC-SH_R-71_TC002_Cond0 ILT_PTC-SH_R-71_TC003_Cond0 ILT_PTC-SH_R-71_TC007_Cond0 ILT_PTC-SH_R-xxx_TC002_Cond0 ILT_PTC-SH_R-xxx_TC003_Cond0 ILT_PTC-SH_R-xxx_TC007_Cond0 ILT_PTC-SH_SR-064_TC002_Cond0 ILT_PTC-SH_SR049_TC04_Cond0 ILT_PTC-SH_SR049_TC05_Cond0 ILT_PTC-SH_SR049_TC07_Cond0 ILT_PTC-SH_SR049_TC12_Cond0 LT_PTC-SH_SR049_TC13_Cond0
80.1	Load	The system design must support a message from the Locomotive to the Wayside to turn on a sleeping beacon.	X	ILT_PTC-SH_R-xxx_TC001_Cond-0 ILT_PTC-SH_R-xxx_TC007_Cond-0
80.2	Load	The system design must support a message from the Locomotive to the Wayside to reset a beacon's timer.	X	ILT_PTC-SH_R-xxx_TC001_Cond-0 ILT_PTC-SH_R-xxx_TC007_Cond-0

Req ID	Category	Requirement Summary	Status	Test Case ID
81	Load	The system design must support two way communications from the Back Office to the Wayside.	X	ILT_ConfCN_SR-009_TC006_Cond0
83	Load	The system design must support the use of unused PTC capacity (e.g. unused headroom) for business messages (at a lower priority).	X	ILT_PTC-SH_SR049_TC08_Cond0 ILT_PTC-SH_R-xxx_TC005_Cond-0 ILT_PTC-SH_R-71_TC005_Cond0
104	Mobility	The system design must support the ability for a Locomotive to detect and transition to a different Base Station without a dependency on information in a track database.	X	ILT_Mob_SR-076_TC01_Cond0 ILT_Mob_SR-076_TC13_Cond0
116	Network	The radio must use QoS to make necessary decisions about what RF Channel a message should be transmitted on.	X	ILT_PTC-SH_SR049_TC08_Cond0 ILT_PTC-SH_R-xxx_TC005_Cond-0 ILT_PTC-SH_R-71_TC005_Cond0

Table 14 – Systems management requirements mapping

Req ID	Category	Requirement Summary	Status	Test Case ID
CMX-7	General	The ITCC Asset Manager shall be able to transfer a named “Security Kit” to an ITCC Asset.	X	ILT_SMS_Asset Bootstrap with CSR_TC001_Cond1 ILT_SMS_Asset Bootstrap with CSR_TC001_Cond2 ILT_SMS_Asset Bootstrap with CSR_TC001_Cond3

Req ID	Category	Requirement Summary	Status	Test Case ID
CMX-8	General	The ITCC Asset shall verify using the appropriate security functions that the transferred Kit was sent from its ITCC Asset Manager.	X	ILT_SMS_Asset Bootstrap with CSR_TC001_Cond1 ILT_SMS_Asset Bootstrap with CSR_TC001_Cond2 ILT_SMS_Asset Bootstrap with CSR_TC001_Cond3
CMX-15	General	The ITCC Asset shall notify the back office via the ITCC Asset Manager when a kit transfer is completed.	X	ILT_SMS_Asset Bootstrap with CSR_TC001_Cond1 ILT_SMS_Asset Bootstrap with CSR_TC001_Cond2 ILT_SMS_Asset Bootstrap with CSR_TC001_Cond3
CMX-16	General	The ITCC Asset shall notify the back office via the ITCC Asset Manager when a file transfer completes.	X	ILT_SMS_Asset Bootstrap with CSR_TC001_Cond1 ILT_SMS_Asset Bootstrap with CSR_TC001_Cond2 ILT_SMS_Asset Bootstrap with CSR_TC001_Cond3
CMX-42	General	The ITCC Asset Manager shall notify the back office when a Kit is loaded on an ITCC Asset.	X	ILT_SMS_Asset Bootstrap with CSR_TC001_Cond1 ILT_SMS_Asset Bootstrap with CSR_TC001_Cond2 ILT_SMS_Asset Bootstrap with CSR_TC001_Cond3
SEC-9	General	All ITCC Asset Manager communications between an ITCC Asset Manager and ITCC Asset shall be authenticated using SMPKs when sensitive data is being transferred or when ITCC Assets will be changed.	X	ILT_SMS_AssetBootstrap_WOCSR_TC001_Cond1 ILT_SMS_AssetBootstrap_WOCSR_TC001_Cond2 ILT_SMS_AssetBootstrap_WOCSR_TC001_Cond3

Req ID	Category	Requirement Summary	Status	Test Case ID
SEC-51	General	The ITCC Asset's Operational Private Keys shall be maintained by Security Kit updates.	X	ILT_SMS_OPK Security Kit Refresh_TC001_Cond1 ILT_SMS_OPK Security Kit Refresh_TC001_Cond2 ILT_SMS_OPK Security Kit Refresh_TC001_Cond3 ILT_SMS_OPK Security Kit Refresh_wLargeFile_TC001_Cond3
SEC-53	General	The ITCC Asset shall support the update of an Operational Private Key when received in a valid Security Kit from its ITCC Asset Manager.	X	ILT_SMS_OPK Security Kit Refresh_TC001_Cond1 ILT_SMS_OPK Security Kit Refresh_TC001_Cond2 ILT_SMS_OPK Security Kit Refresh_TC001_Cond3 ILT_SMS_OPK Security Kit Refresh_wLargeFile_TC001_Cond3
SEC-55	General	The ITCC Asset shall provide a "factory reset" capability that shall place the ITCC Asset in a state where no Kits are present and no ability to perform any ITCC Asset operations other than systems management security bootstrap functions are possible.	X	ILT_SMS_Asset Bootstrap with CSR_TC001_Cond1 ILT_SMS_Asset Bootstrap with CSR_TC001_Cond2 ILT_SMS_Asset Bootstrap with CSR_TC001_Cond3
SEC-56	General	The ITCC Asset can utilize One Time Use Passwords instead of Systems Management System (SMS) Certificates for sent and received systems management messages while in the "factory reset" state.	X	ILT_SMS_Asset Bootstrap with CSR_TC001_Cond1 ILT_SMS_Asset Bootstrap with CSR_TC001_Cond2 ILT_SMS_Asset Bootstrap with CSR_TC001_Cond3

Req ID	Category	Requirement Summary	Status	Test Case ID
SEC-60	General	The ITCC Asset Manager shall be capable of transferring an Initialization Security Kit that it encrypts with an ITCC Asset's One Time Use Password.	X	ILT_SMS_AssetBootstrap_WOCSR_TC001_Cond1 ILT_SMS_AssetBootstrap_WOCSR_TC001_Cond2 ILT_SMS_AssetBootstrap_WOCSR_TC001_Cond3
SEC-63	General	The ITCC Asset shall be capable of accepting Load Initialization Security Kit commands while in the "factory reset" state.	X	ILT_SMS_AssetBootstrap_WOCSR_TC001_Cond1 ILT_SMS_AssetBootstrap_WOCSR_TC001_Cond2 ILT_SMS_AssetBootstrap_WOCSR_TC001_Cond3 ILT_SMS_Asset Bootstrap with CSR_TC001_Cond1 ILT_SMS_Asset Bootstrap with CSR_TC001_Cond2 ILT_SMS_Asset Bootstrap with CSR_TC001_Cond3
SEC-64	General	The ITCC Asset shall no longer be in "factory reset" state once the Initialization Process has been completed. Normal systems management operations proceed from this point.	X	ILT_SMS_AssetBootstrap_WOCSR_TC001_Cond1 ILT_SMS_AssetBootstrap_WOCSR_TC001_Cond2 ILT_SMS_AssetBootstrap_WOCSR_TC001_Cond3 ILT_SMS_Asset Bootstrap with CSR_TC001_Cond1 ILT_SMS_Asset Bootstrap with CSR_TC001_Cond2 ILT_SMS_Asset Bootstrap with CSR_TC001_Cond3

Req ID	Category	Requirement Summary	Status	Test Case ID
CTL-24	General	The ITCC Asset Manager shall support testing the communications path to an ITCC Asset. (note: analogous to icmp: Ping)	X	ILT_SMS_PingTest_TC001_Cond1 ILT_SMS_PingTest_TC001_Cond2 ILT_SMS_PingTest_TC001_Cond3
CMX-1	General	The ITCC Asset Manager shall be able to manage an ITCC Asset in a secure way. The security where sensitive data is used or ITCC Assets are changed shall be implemented by the use of SMS Certificates. The SMS Certificates shall be unique for each ITCC Asset/SMA.	X	ILT_SMS_Asset Bootstrap with CSR_TC001_Cond1 ILT_SMS_Asset Bootstrap with CSR_TC001_Cond2 ILT_SMS_Asset Bootstrap with CSR_TC001_Cond3
DR-189	General	The ITCC Asset Manager shall be able to manage an ITCC Asset in a secure way. The security where sensitive data is used or ITCC Assets are changed shall be implemented by the use of SMS Certificates. The SMS Certificates shall be unique for each ITCC Asset/SMA.	X	ILT_SMS_Event_Alert_TC001_Cond1 ILT_SMS_Event_Alert_TC001_Cond2 ILT_SMS_Event_Alert_TC001_Cond3
DR-193	General	The ITCC Asset Manager shall be able to manage an ITCC Asset in a secure way. The security where sensitive data is used or ITCC Assets are changed shall be implemented by the use of SMS Certificates. The SMS Certificates shall be unique for each ITCC Asset/SMA.	X	ILT_SMS_Asset Bootstrap with CSR_TC001_Cond1 ILT_SMS_Asset Bootstrap with CSR_TC001_Cond2 ILT_SMS_Asset Bootstrap with CSR_TC001_Cond3
DR-199	General	The ITCC Asset Manager shall be able to manage an ITCC Asset in a secure way. The security where sensitive data is used or ITCC Assets are changed shall be implemented by the use of SMS Certificates. The SMS Certificates shall be unique for each ITCC Asset/SMA.	X	ILT_SMS_AssetBootstrap_WOCSR_TC001_Cond1 ILT_SMS_AssetBootstrap_WOCSR_TC001_Cond2 ILT_SMS_AssetBootstrap_WOCSR_TC001_Cond3

Req ID	Category	Requirement Summary	Status	Test Case ID
DR-200	General	The ITCC Asset Manager shall be able to manage an ITCC Asset in a secure way. The security where sensitive data is used or ITCC Assets are changed shall be implemented by the use of SMS Certificates. The SMS Certificates shall be unique for each ITCC Asset/SMA.	X	ILT_SMS_OPK Security Kit Refresh_TC001_Cond1 ILT_SMS_OPK Security Kit Refresh_TC001_Cond2 ILT_SMS_OPK Security Kit Refresh_TC001_Cond3 ILT_SMS_OPK Security Kit Refresh_wLargeFile_TC001_Cond3

6. Key performance indicators

Key performance indicators (KPIs) are quantifiable metrics that reflect certain performance levels of the PTC communication system. KPIs provide a metric to compare various system configurations, software releases, and hardware versions. Additionally, KPI measurements are used to validate some requirements. A list of PTC communication System KPIs and their associated performance requirements follow.

Table 15 – PTC communication system KPIs

Category	Description	Requirement	Req. Ref.	Applicable to CTT 1	Notes
Message Rate	Back office message rate	7500 messages/sec (6900 to remotes, 600 from remotes)	SR-086		Minimum measurement time is 8 hrs
Message Rate	Mobile message rate	33 messages/sec (32 in, 1 out)	SR-087	X	Minimum measurement time is 8 hrs
Message Rate	Wayside Message Rate	6 messages/sec (5 in, 1 out)	SR-088	X	Minimum measurement time is 8 hrs
Message Routing	Message routing updates	Process 50 routes/sec	SR-149		
Message Routing	Path updates	Respond to new paths and update routing info < 1000ms	SR-084		
Message Routing	Message path updates between offices	propagate addition/removal of paths < 3 sec	SR-085		
Message Latency	Locomotive segment	TBD	SR-185	X	

Category	Description	Requirement	Req. Ref.	Applicable to CTT 1	Notes
Message Latency	Wayside segment	TBD	SR-186	X	
Radio Network Latency	Latency for high priority over the air messages.	<15 s, 99.9% of high priority messages (<=256 bytes)	R58		Over the air: wired side of one radio to the wired side of another radio.
Radio Network Latency	Latency for high priority over the air messages, Locomotive travelling <=110 MPH	<15 s, 99.9% of high priority messages (<=256 bytes)	R62		Locomotive is transitioning from one Base Station to another Base Station.
Radio Network Traffic Load	System must support a minimum number of wayside beacon/status messages.	30 beacon/status messages per cycle	R69	X	Under the coverage of a single base. Loading model: PTC_Demand_Study_Version_03.xls
Radio Network Traffic Load	Base to the Locomotive message traffic bit rate.	4 Kbits/sec of traffic over and above the PTC traffic load	R82.1	X	Not including link level overhead
Radio Network Traffic Load	Locomotive to the Base message traffic bit rate.	4 Kbits/sec of traffic over and above the PTC traffic load	R82.2	X	Not including link level overhead

Category	Description	Requirement	Req. Ref.	Applicable to CTT 1	Notes
Radio Network Traffic Load	Operational PTC trains under a single Base Station.	>= 24	R85		