**Recommended Guidelines for Troubleshooting Messaging Network Connectivity
for ITC Type PTC**
New 2023 (4 pages)

A.   <u>Purpose</u>

This document is intended to be a high-level introduction to troubleshooting issues with connectivity between Interoperable Train Control Messaging (ITCM) instances for ITC type PTC. ITCM includes utilities to help determine if the system is working as expected. These utilities are bundled into the System Management Utility (SMU), which has a separate manual that describes all of its commands.

B.   <u>General</u>

It is recommended that ITCM administrators complete a training course to gain experience in working through the configuration and deployment of ITCM instances. Training should provide hands-on practice with all ITCM tools and with the standard messaging utilities that can be used to examine the core messaging functionality upon which ITCM is built.

C.   <u>Overview of ITCM Network Connectivity</u>

ITCM leverages the availability of two network types: the 220 MHz radio network and IP-based networks. There are utilities for checking the availability of each type of network. After a network is configured and available, ITCM can be run along with its supporting utilities to determine if ITCM can successfully make connections between instances, and to see if those connections are registered as available routes in the Message Router (MR) route table. This route table is key to delivering messages between remotes and the Office Segment; every message going between ITCM instances needs a valid route in the route table. All references to message type and protocols such as a Class D message should be referenced to the latest version of the ITCM specifications.

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- 1 –
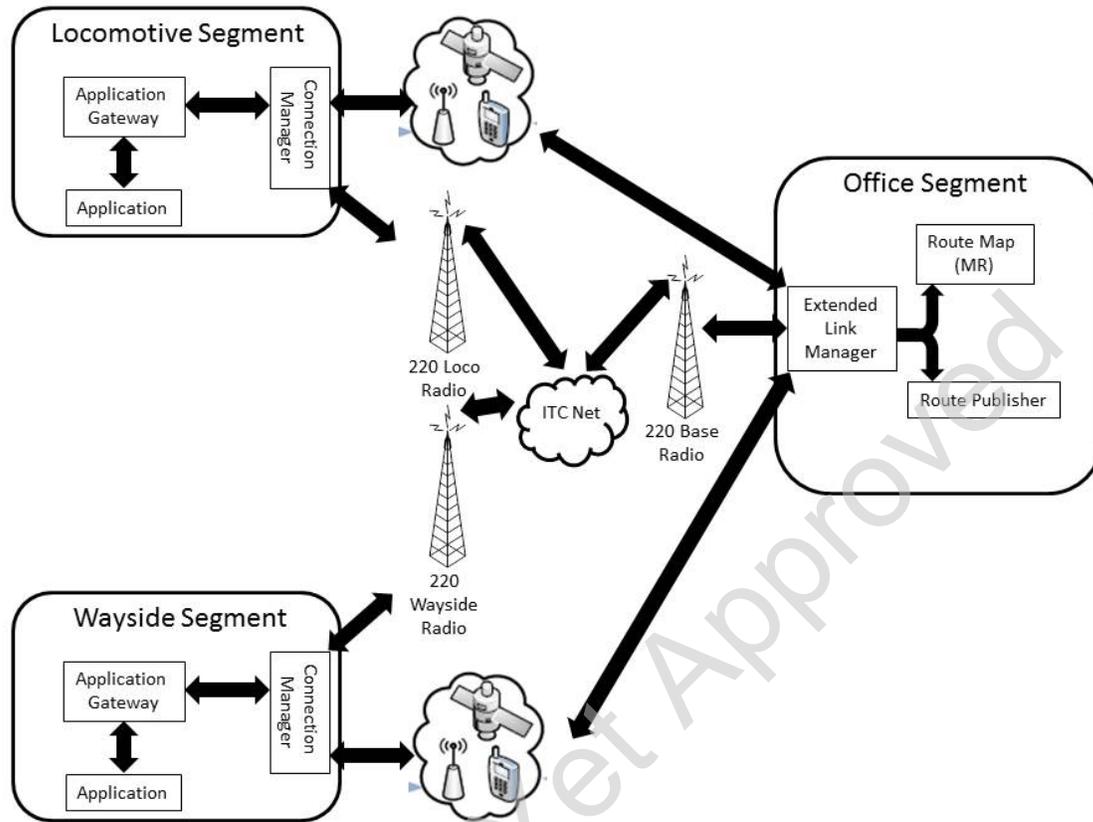
Figure 2433-1 ITCM Block Diagram

1. **220 MHz Connectivity, Office Segment**

   The 220 MHz network is accessed in the Office Segment through an External Link Manager (ELM). Each ELM should be configured to connect to multiple Base radios through a Class D connection, and configuration of each Class D connection must be appropriate for both the client and the server sides. The client and server must agree on complementary timeouts and keep-alive values because Class D connections do not have a dynamic way to negotiate these, only the static configuration is available.

   For additional reliability, multiple ELMs can be configured for the same Base radio to provide a backup connection in case the primary ELM fails.

   Executing a command that provides a list of all radios the ELM has configured and the state of the connection to each radio can provide the Class D connection properties for each base radio and verifies that they are appropriate. It can also provide a list of all remote ITCM areas connected to each base radio for verification of connectivity.

Note that because of the dynamic nature of the 220 MHz connection (especially to locomotives), it is difficult to predict which ELM or base radio is going to have the connection to the remote.

Each active connection to the remote also appears in the message router (MR) route map. Note that each MR maintains its own route map, and these route maps should all be the same. If there are problems propagating the routing data, the route maps may be out of sync for a short period of time, but they should be re-synched within 10 to 15 seconds as the Route Publisher (RP) updates the routes across the system.

Note also that the route map in the MR has routes for all remotes across the system. If the Office Segment is federated to another Office Segment, both sets of routes are included in the route table. Because this can be a very large amount of data, the MR includes filtering options for retrieving smaller sets of routing data.

2.   **220 MHz Connectivity, Remote**

The Connection Manager (CM) in a remote maintains connections to the Locomotive or Wayside radio. A remote is relatively simple because it has only a small number of connections (typically no more than two or three). Connection information may be obtained directly from the remote MR using a command at the remote or the Back Office to obtain the route maps.

3.   **IP Connectivity, Office Segment**

IP connections are made directly from the CM on the remote to the Transport Network Subsystem (TNS) in the Back Office. When a remote CM connects, a queue that includes the name of the remote ITCM area is added to the broker. If the queue for a remote ITCM area exists, then there is a valid IP connection to that remote area.

4.   **IP Connectivity, Remote**

Checking for IP connectivity on a remote is the same as checking for 220 MHz connectivity. Route map commands can be used to examine the route table in the MR and look for connections for the IP transports.

D.   <u>**Testing Network Connectivity**</u>

If ITCM appears to be up and connecting correctly across the network, use a command trace route utility that cannot interfere with PTC messaging to deliver a message and see if it is processed correctly. The traceroute utility should send a

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message to a source Application Gateway (AG) which inserts it into the normal message flow. The message should be routed like other application messages, but be deleted before the AG can deliver it to a target application. This makes a traceroute command safe to use against any destination address while the system is in revenue service. Note that these messages will use some amount of bandwidth.

Each ITCM component sends a reply when it receives the message and when it passes the message along. Those replies are captured and displayed. Messages can then be tracked as to where the message went and how far it got before being discarded. A successful test to an application that is up and running correctly results in replies from the AG when it receives the message and when it sends it back before deleting it.

```
[INFO] Connecting to broker: localhost:13000
[INFO]  request: {'destinationAddress': 'b.rrrr.test', 'methodName': 'Traceroute',
        'messageSize': 0, 'specialHandling': 0, 'priority': 1, 'messageTtl': 10,
        'classOfService': 0, 'replyToAddress': 'l.rrrr.rr+3333.$sys.$smu.$traceroute',
        'networkPreference': 0}
[INFO] reply_to: l.rrrr.rr+3333.$sys.$smu.$rrrr+l+rr+3333+AG+0
[INFO] Sending message
[INFO] Awaiting response
[INFO] Awaiting traceroute responses from components...
Hop             RequestID          Timestamp  Direction            Location  FragID
--------------------------------------------------------------------------------
  0       36931A6D5CA103F2   1524694419.675       Sent  rrrr.l.rr.3333.AG.0
  1       36931A6D5CA103F2   1524694419.705   Received  rrrr.l.rr.3333.MR.0
  1       36931A6D5CA103F2   1524694419.705       Sent  rrrr.l.rr.3333.MR.0
  2       36931A6D5CA103F2   1524694419.750   Received  rrrr.l.rr.3333.CM.0
  2       36931A6D5CA103F2   1524694419.750       Sent  rrrr.l.rr.3333.CM.0
  3       36931A6D5CA103F2   1524694419.647   Received  rrrr.b.TNS.0.ML.in.0
  3       36931A6D5CA103F2   1524694419.647   Received  rrrr.b.TNS.0.IML.0
[INFO] Timeout received - stopping receiver...
[INFO] Overall time from earliest hop to last: -0.028
```

Figure 2433-2 An Example of a Vendor's Output Sample of an *ITCM* Traceroute Command

Note that an application to test connectivity to a remote is not required. A message with a valid Edge Message Protocol (EMP) address with a dummy topic will be sent to the remote before being placed in a retry queue where it will time out. A message will still be received in a reply from the remote CM when the message passes through it.