

## **UNLICENSED MICROWAVE POINT-TO-MULTIPOINT TEST PLANS**

### **1. DEVICE NAMING COORDINATION**

- 1.1. The System Integrator shall coordinate with the TMC/ROC to identify the device names for each device.
- 1.2. The System Integrator shall then send a request to TOTS to identify the network name, IP address, and any pertinent configuration information.

### **2. EXPLANATION – STANDALONE (SALT) TESTING**

- 2.1. The System Integrator shall work with the DEVICE VENDOR (if required by the testing form) and complete the NDOT specified SALT tests (non-network) on each unit of equipment after installation.
- 2.2. Conduct SALT testing on each unit of equipment as outlined on the NDOT provided testing form.
- 2.3. The System Integrator shall coordinate through the Resident Engineer and the Construction Crew to have an appropriate NDOT representative present for the onsite inspection.
- 2.4. The System Integrator shall submit the DEVICE vendor commissioning documents with the SALT testing to the Engineer for review and approval.
- 2.5. Supply a bucket truck and operator, or suitable equivalent equipment necessary to carry out procedures as required by the testing documents, at no direct payment.

**UNLICENSED MICROWAVE POINT-TO-MULTIPOINT RADIO (UL PMP) SALT TEST  
PROCEDURE**

TEST #	SALT TEST PROCEDURE	EXPECTED RESULT	PASS / FAIL
<b>UL PMP Name:</b>		<b>IP Address:</b>	<b>GPS:</b>
<b>TOTS Network Name:</b>		<b>Associated Cabinet Name:</b>	
<b><i>Purpose and General Verification</i></b>			
<p><b>System Integrator:</b> This SALT tests the proper installation of a functional UL PMP. The system integrator will use a laptop to perform this test. Using the manufacture's software, the integrator will be able to verify the UL PMP is operational.</p> <p><b>General Verification:</b> For each test below, complete the UL PMP SALT Matrix, circling the "Pass" or "Fail" in the appropriate cell. Only indicate a "Pass" on this form if the entire matrix column related to the tested function passes for EACH UL PMP being tested.</p>			
<b><i>UL PMP Information</i></b>			
<b>1.</b>	Verify UL PMP Information using the manufacturer software or device label.	<b>Manufacturer:</b> _____ <b>Model:</b> _____ <b>Serial Number:</b> _____ <b>Firmware Version:</b> _____	Pass / Fail
<b>2.</b>	Verify transmit frequency range.	<b>Transmit High:</b> _____ <b>Transmit Low:</b> _____	Pass / Fail
<b>3.</b>	Verify receive frequency range.	<b>Receive High:</b> _____ <b>Receive Low:</b> _____	Pass / Fail
<b>4.</b>	Verify bandwidth range.	<b>Bandwidth High:</b> _____ <b>Bandwidth Low:</b> _____	Pass / Fail
<b>5.</b>	Manufacturer's commissioning of UL PMP equipment.	Manufacturer confirmation of full operation of all UL PMP -associated equipment.	Pass / Fail
<b><i>Equipment Verification</i></b>			
<b>6.</b>	Verify UL PMP controller is securely mounted in cabinet/rack.	UL PMP controller is securely mounted in cabinet/rack.	Pass / Fail
<b>7.</b>	Verify UL PMP radio is securely and properly mounted on communication tower.	UL PMP radio is securely mounted on communication tower with galvanized and thick-walled pipe or equivalent (approved by Engineer) and stiff-arm bracing.	Pass / Fail
<b>8.</b>	Verify UL PMP antenna is securely and properly mounted on communication tower.	UL PMP antenna is securely mounted on communication tower with galvanized and thick-walled pipe or equivalent (approved by Engineer) and stiff-arm bracing.	Pass / Fail

9.	Verify the installation of ice shields.	Ice shields properly cover the antennas. Ice shields are securely mounted on communication tower.	Pass / Fail
10.	Verify power supply energizes the system. *Includes Power over Ethernet (POE) injector & POE surge protector, if applicable	UL PMP is accessible through its Graphical User Interface (GUI). *POE components properly function	Pass / Fail
11.	<b>If using non-integrated antenna network radio</b> Verify the installation and connection to the external antenna.	Connection is made with LMR-400 radio frequency (RF) transmission line and non-solder appropriate connectors. Antenna connections are weather proofed for RF connections. Presence of polyphaser lightning protection and proper grounding.	Pass / Fail
12.	<b>If using non-integrated antenna network radio</b> Using appropriate RF testing equipment, verify the RF transmission line.	RF transmission line passes basic continuity testing. Must be 0 ohms from shield to shield and from conductor to conductor and open from conductor to shield. (Meets manufacturer's recommended passing criteria).	Pass / Fail
13.	<b>If using integrated antenna network radio</b> Using appropriate CAT6 testing equipment, verify the CAT6 transmission line.	CAT6 transmission line passes NDOT Ethernet Cable Testing (Meets manufacturer's recommended passing criteria).	Pass / Fail
14.	Verify all cabling is labeled with the to/from on each end and at any major transition point and is neatly managed throughout the cabinet.	All premise or inside plant cables originating and ending in the cabinet are properly terminated and labeled. Labeling material rated for Outside Plant (OSP) use. Cables are neatly managed using adjustable hook-and-loop fastener straps.	Pass / Fail
15.	Verify grounding kits are installed on CAT6 or transmission line of both non-integrated and integrated antenna radios.	Grounding kits are properly installed.	Pass / Fail
16.	Using a meter, verify the system is properly bonded to earth ground.	Meter reading of 5 Ohms or less.	Pass / Fail
17.	Verify UL PMP operations locally via User Interface (UI).	UL PMP turns on/off via User Interface (UI).	Pass / Fail
18.	Ensure all PMP subscriber network radios are operating individually at highest bandwidth achievable at a RSSI of -80 or better but not to exceed -55 at full power output.	All PMP subscriber network radios operate individually at highest bandwidth achievable at a minimum RSSI of -80 and maximum RSSI of -55 at full power output.	Pass / Fail

**Verification of Settings**

<b>19.</b>	Verify Communication Settings are set to appropriate values per the IP plan.	<b>IP:</b> _____ <b>MASK:</b> _____ <b>GATEWAY:</b> _____ <b>UDP/TCP PORT:</b> _____	Pass / Fail
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**Signatures**

DATE	AGENCY/FIRM	PERFORMED BY (Print Name) (Integrator)	INTL	AGENCY/FIRM	WITNESSED BY (Print Name) (NDOT)	INTL
<b>Integrator Signature</b>						
<b>NDOT RE Signature</b>						
<b>NDOT TOTS Signature</b>						

### 3. **EXPLANATION - SUBSYSTEM (SST) TESTING**

- 3.1. At the beginning of the SST phase, the System Integrator shall submit, in PDF format and original signed hard copies of the certified SALT results for approval by the Engineer.
- 3.2. The Engineer shall approve all SALT testing prior to the System Integrator starting the SST testing.
- 3.3. Conduct SST testing in accordance with NDOT's testing documentation for all field and related equipment once the system has been interconnected to form a complete subsystem (i.e. Network connectivity).
- 3.4. The SST test shall demonstrate connectivity to all field equipment utilizing NDOT's current freeway management system (FMS).
- 3.5. The SST test consists of a 45-day period of operations without major failure of equipment. The Resident Engineer can require the SST be restarted if any major failure occurs. A major failure for the Unlicensed Point-To-Multipoint Microwave is defined as:
  - 3.5.1. Any failure of the equipment associated with the PRIMARY FUNCTION of the Unlicensed Point-To-Multipoint Microwave.
- 3.6. Demonstrate that the total system (hardware, firmware, software, materials, and construction) are properly installed, free from problems, exhibits stable and reliable performance, and meets project requirements.
- 3.7. Once per week, the System Integrator shall demonstrate that all system functions tested in the SST are operational and meets requirements.
- 3.8. The System Integrator shall coordinate through the Resident Engineer and the Construction Crew to have an appropriate NDOT representative present for the onsite inspection.
- 3.9. The System Integrator must provide proof that each device has been tested each week for the duration of the testing period witnessed by an NDOT representative.
- 3.10. The testing time must be scheduled a minimum of one week prior and coordinated and approved by the Resident Engineer and the Construction Crew.

**UNLICENSED MICROWAVE POINT-TO-MULTIPOINT RADIO (UL PMP) SST TEST  
PROCEDURE**

TEST #	SST TEST PROCEDURE	EXPECTED RESULT			PASS / FAIL
UL PMP Name:		IP Address:		GPS:	
TOTS Network Name:		Associated Cabinet Name:			

***Purpose and General Verification***

***System Integrator:*** This SST tests the proper installation of a functional UL PMP. The system integrator will use an Operator Workstation at the TMC/ROC to perform this test.

***General Verification:*** For each test below, complete the UL PMP SST Matrix, circling the "Pass" or "Fail" in the appropriate cell. Only indicate a "Pass" on this form if the entire matrix column related to the tested function passes for EACH UL PMP subscriber unit being tested.

***System UL PMP Information***

**Site (Path) Name:** \_\_\_\_\_ **\* One SST required for each site (path) \***

<b>1.</b>	Verify network connectivity by issuing a ping test from the UL PMP workstation located at the TMC/ROC.	UL PMP responds to the ping test.	Pass / Fail
<b>2.</b>	Conduct throughput testing.	Throughput testing results fall within manufacturer's recommended levels.	Pass / Fail
<b>3.</b>	Verify latency when located at the TMC/ROC.	Latency is below 50 milliseconds (ms).	Pass / Fail
<b>4.</b>	Verify maximum transmission unit (MTU) & if it will support shortest path bridging (SPB) protocol (IEEE 802.1aq) to form an adjacency.	MTU: _____ MTU supports SPB.	Pass / Fail
<b>5.</b>	Verify access to the Web User Interface (UI) from the TMC/ROC.	Web User Interface (UI) is accessible.	Pass / Fail
<b>6.</b>	If full streaming video is implemented, verify video to TMC/ROC.	Video is visually free of ghosting, hesitation, and pixilation when viewing from TMC/ROC.  Refer to NDOT Video Testing Requirement (Fixed / PTZ CCTV)	Pass / Fail / N/A
<b>7.</b>	Verify ping to end-devices.	End-devices respond to ping.	Pass / Fail
<b>8.</b>	Conduct throughput testing.	Throughput testing results fall within manufacturer's recommended levels.	Pass / Fail

***Signatures***

SST DAY	DATE	PERFORMED BY (Print Name) (Integrator)	INTL	WITNESSED BY (Print Name) (NDOT)	INTL
<b>1</b>					

<b>8</b>					
<b>15</b>					
<b>22</b>					
<b>29</b>					
<b>36</b>					
<b>45</b>					
<b>Integrator Signature</b>					
<b>NDOT RE Signature</b>					
<b>NDOT TOTS Signature</b>					