A4 4G/LTE-M1 Metered Gatekeeper PJ1118 APS Field Trial Specifications

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Revision History

Rev.	Date	Author	Description
1	March 04, 2021	Holt, John	Initial draft
2	April 05, 2021	Holt, John	Added APS Meter Shop to description
3	April 15, 2021	Holt, John	Added Annex 2, mesh radio emission designator
4	April 20, 2021	Holt, John	Limited BG95 emissions to Cat-M1 Band 13 uplink
5	April 22, 2021	Holt, John	BG95M6 Not Co-located, Annex 3 added
6	April 23, 2021	Holt, John	Cat-M1-only added, possible co-location added back

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Introduction

The section introduces the APS Field Trial Test Specifications for the Honeywell ALPHA Metering Gatekeeper (A4MGK).

1.1 Purpose

The purpose of this document is to describe the field trial experiment to be conducted for Arizona Public Service (APS) beginning in 2021, in order to obtain an FCC Conventional Experimental License.

1.2 Scope

This document will describe the experiment in sufficient detail as required to obtain the experimental license authorization. Test results and criteria used to grade the success of the experiment and impact to future deployments are not within the scope of this document.

The experiment is part of the Honeywell A4MGK project, PJ1118. In general, the APS Field Trial is designed to test the feasibility of deploying Honeywell ALPHA (A4) electricity meters, configured as Gatekeepers (network routers), in the APS utility electrical energy grid. The Honeywell APLHA A4 metering Gatekeeper (A4MGK) is a new device, incorporating the features of a traditional utility pole-mounted network router in a conventional ANSI electricity meter, mounted in electric utility meter sockets on the sides of commercial and residential buildings.

Since the effects of collocated radio transmitters on electricity metering accuracy are well understood and controlled, this experiment will focus on the radio network performance with the A4 metering gatekeepers installed in a typical environment within the APS electrical grid.

1.3 Intended Audience

The intended audience for this document is the FCC Office of Engineering Technology, Honeywell Product Management team and APS representatives engaged in the A4MGK Project.

1.4 Terms, Acronyms and Abbreviations

Below are the terms, acronyms, and abbreviations used within this document.

Term, Acronym, Abbreviation	Definition
EUT	Equipment Under Test
A4MGK	Alpha A4 Metering GateKeeper
FCC	Federal Communications Commission
APS	Arizona Public Service
NAN	Neighborhood Area Network
WAN	Wide Area Network

Field Trial

The Field trial will be conducted in the city of Casa Grande, in Pinal County, Arizona. The city of Casa Grande is a non-contiguous, self-contained segment of the APS service territory, making it a good choice for this experiment.

1.5 Electronic Design Test Goal

The goal of the Experiment is to demonstrate viability of deploying low power, limited coverage in-meter routers using LTE Cat-M1 backhaul communications in typical residential and commercial communities as a primary means of Smart Grid Mesh Network communications.

1.6 Equipment Under Test

The Equipment Under Test (EUT) is the Honeywell ALPHA 4 Metering Gatekeeper (A4MGK). The A4MGK is a communications option card with antennas that are wholly contained within an Alpha 4 (A4) electricity meter. The A4MGK Option Card contains two radios with low power transmitters. Radio 1 is a 900 MHz ISM band mesh network radio to communicate with up to 100 individual electricity meters. Its flex circuit antenna is mounted inside the electricity meter's outer cover, near the face of the meter. Radio 2 is a pre-certified 4G/LTE Cat-M1 radio module made by Quectel. While the Quectel radio module is capable of operating with multiple Mobile Network Operators, it will be used in Cat M1 mode, with Verizon exclusively, during this experiment. The LTE antenna is located on the meter socket collar, between the meter and the meter socket.

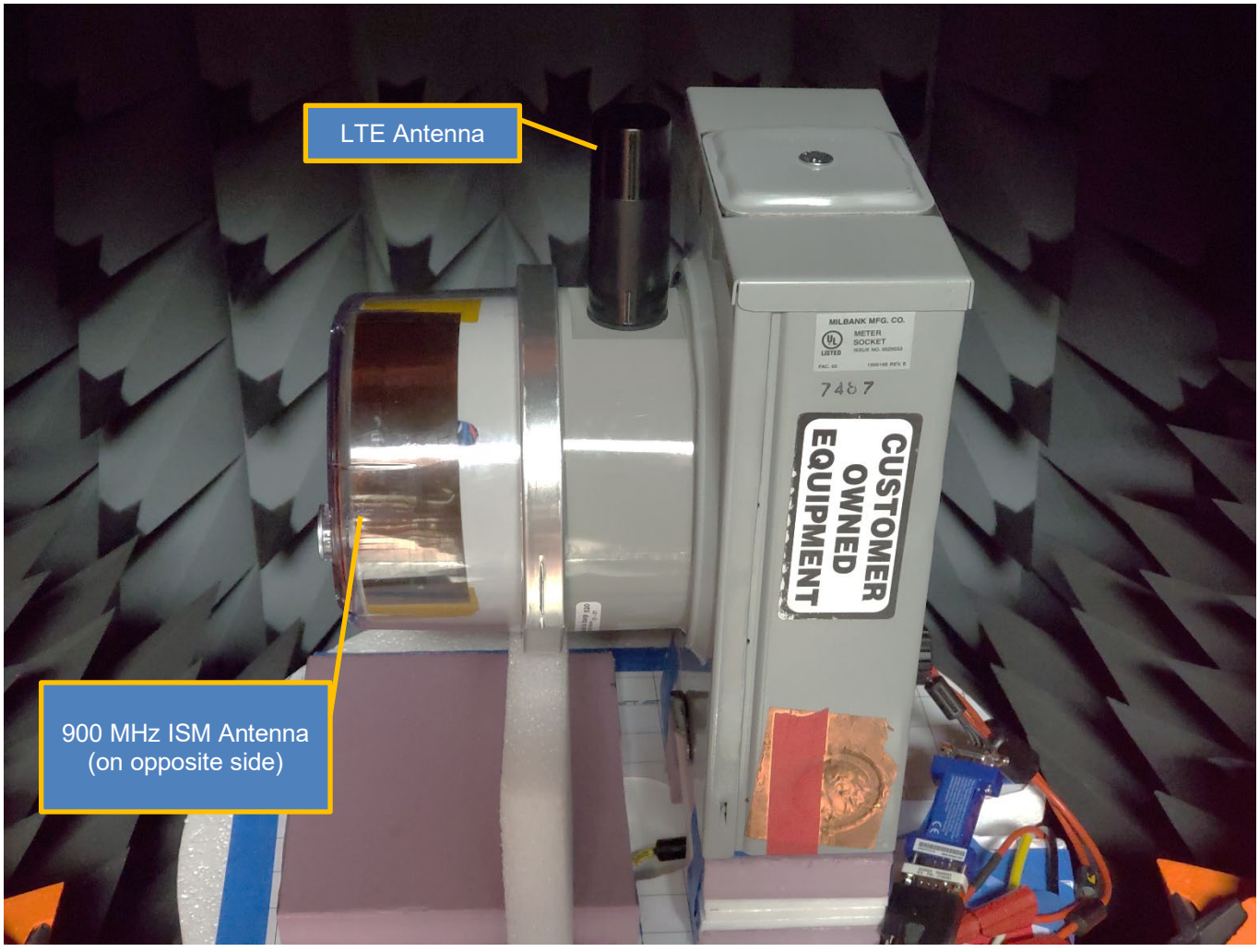


Figure 1: Antenna Locations

1.6.1 Radio 1: 900 MHz ISM Band (FHSS) per CFR47 part 15.247

1.6.1.1 TX Frequency Range 1 (MHZ)	902.4 – 927.6
1.6.1.2 Output/ERP (W)	0.250 /.407
1.6.1.3 Output Peak/Mean	Peak
1.6.1.4 Frequency Tolerance (%)	0.001
1.6.1.5 Number of Channels	25
1.6.1.5.1 Channel Separation (KHz)	400
1.6.1.5.2 Supported Data Rates (kbps)	142.2
1.6.1.5.3 Modulation Format	FSK
1.6.1.5.4 Occupied BW (KHz)	332.7
1.6.1.5.5 Emission Designator	333KQ1D (based on occupied BW)
1.6.1.6 Antenna	Internal Omnidirectional – 2.1 dBi

1.6.2 Radio 2: LTE Cat-M1

Terms of this device's grant will be followed with one exception: Certain test conditions may allow co-located transmission of the two transmitters. Device firmware can ensure that both transmitters do not transmit simultaneously, however some testing may be needed with that restriction removed. Of interest, is how much message latency is experienced when the radios are operated as non-co-located transmitters.

1.6.2.1 FCC ID:	XMR202007BG95M6
1.6.2.2 Antenna	Omnidirectional – 2.0 dBi

1.6.2.3 Verizon will be the MNO, using LTE Cat-M1 Band 13 Uplink as the Radio 2 operating frequency range

1.6.2.4 Operating mode is restricted by firmware to Cat-M1 (1Mbps uplink, SC-FDMA 16QAM)

1.6.2.5 See Annex 2 for emission designators in this frequency band.

1.6.3 Host Device: Alpha A4MGK Electricity Meter

1.6.3.1 A4R Residential ANSI Form 2S Class 200A with Service Disconnect and A4MGK Comms Option

Figure 2: A4 Meter representative of 2S, 12S, 16S & 9S

1.6.3.2 A4C Commercial ANSI Form 12S Class 200A with Service Disconnect and A4MGK Comms Option

1.6.3.3 A4C Commercial ANSI Form 16S Class 320A with A4MGK Comms Option

1.6.3.4 A4C Commercial ANSI Form 9S Class 200A with A4MGK Comms Option

1.7 High Level Test Plan

1.7.1 Background

Normally, the routers used in typical Smart Grid mesh network deployments are mounted on utility poles, well above street level. Such routers are typically contained in weatherproof boxes with optimum mounting conditions for their antennas and therefore they have large coverage areas, supporting up to 500 or 1,000 nodes and end points. In some cities, using underground electrical power distribution, there are very few utility poles available for traditional routers. In those situations, it is proposed to install routers that are contained within the ANSI-compliant electricity meters already used on virtually every home residence and commercial building within the electric utility's service area. These new routers will operate on a smaller scale compared to traditional pole-mounted routers, supporting up to 100 nodes and end points.

The A4MGK in-meter router uses Radio 1, described in 1.8.1, to communicate with the nodes and end points in its local coverage area (NAN) and it uses Radio 2, described in 1.8.2, for communications through the cellular 4G network to the head end utility office (WAN).

The areas of interest in this experiment relate primarily with the network performance, given the limited coverage area of the A4MGK, the noisy environment within the electricity meter and the use of data-limited Cat-M1 for the backhaul communications link to the utility office. Data throughput and latency will be examined as well as overall coverage within test area. Another focus of this experiment is network performance during the very high ambient temperatures and sun loading present during Summer.

Tests are planned to begin in June 2021. EUTs will be configured and tested for proper operation at the APS Meter Shop prior to deployment at the Casa Grande Test Site. It is expected that tests will conclude during the ensuing 18 months or upon FCC certification of the A4MGK devices.

1.7.2 Test Plan

1.7.2.1 Verizon will exclusively be the Mobile Network Operator used during this test.

1.7.2.2 The initial deployment will be 20 A4MGK meters, targeted for June 2021.

1.7.2.2.1 A4MGK Meters will be configured, calibrated and tested at APS Meter Shop (Test Site 1) prior to deployment at the larger test site, Test Site 2.

1.7.2.3 Between 200 and 500 additional A4MGK meters may be installed over the ensuing 18 months, to be capped at 520 EUTs.

1.7.2.4 During the trial period, with planned duration of 1.5 years beginning June 2021, coverage, data throughput and data latency will be evaluated.

1.7.2.5 It is planned to obtain FCC certification (modular approval) for the A4MGK in the A4R/A4C electricity meter before conclusion of the experiment, after which the EUTs can be replaced with certified devices.

1.7.3 Test Sites

1.7.3.1 Test Site 1

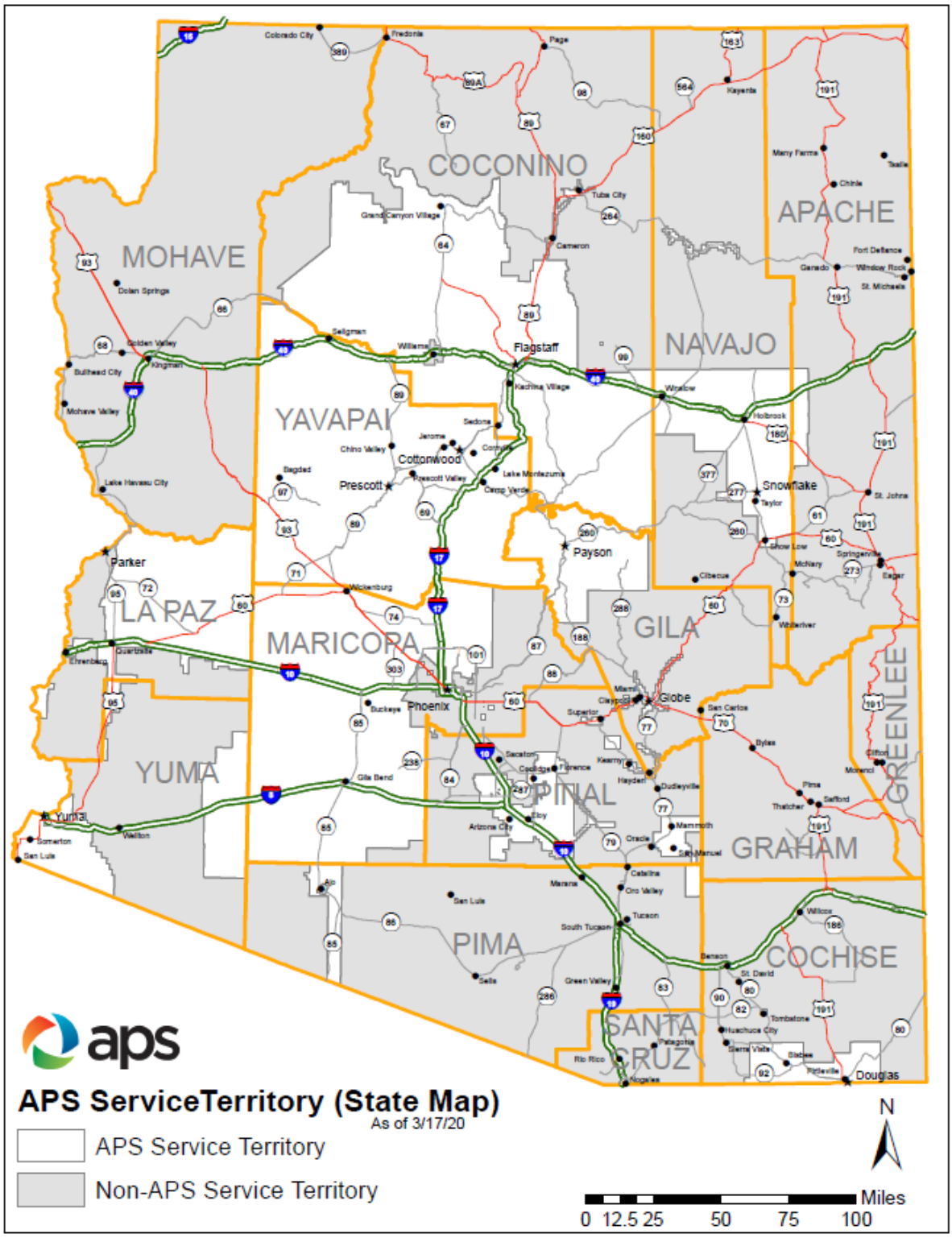
The EUTs will be configured and tested for proper operation at the APS Meter Shop, Test Site 1, prior to deployment at the larger site, Test Site 2. The APS Meter Shop is located at 33° 34' 4.6" N Latitude (33.5679°), 112° 6' 20" W Longitude (-112.1056°) center, with a radius of operation of 160 Meters (0.160 KM).

1.7.3.2 Test Site 2

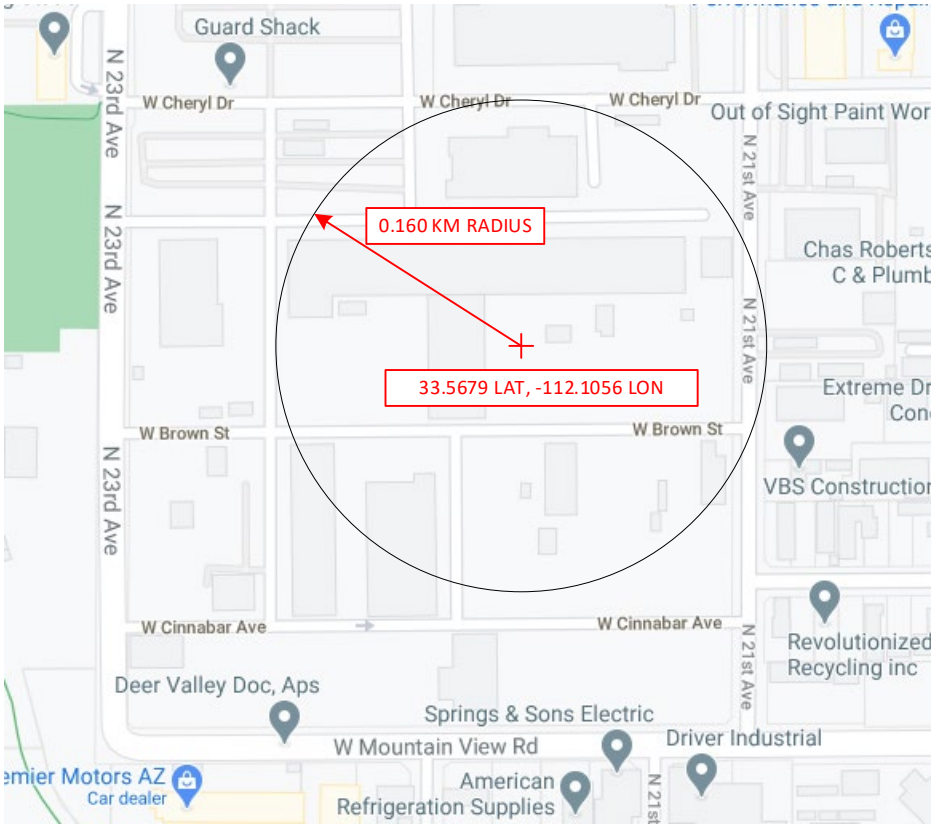
The center of mobile operations for Test Site 2 will be 32° 54' 43" N Latitude (32.9119°), 111° 46' 20" W Longitude (-111.7722°) center, with a radius of operation of 15.18 KM.

1.8 Annex 1

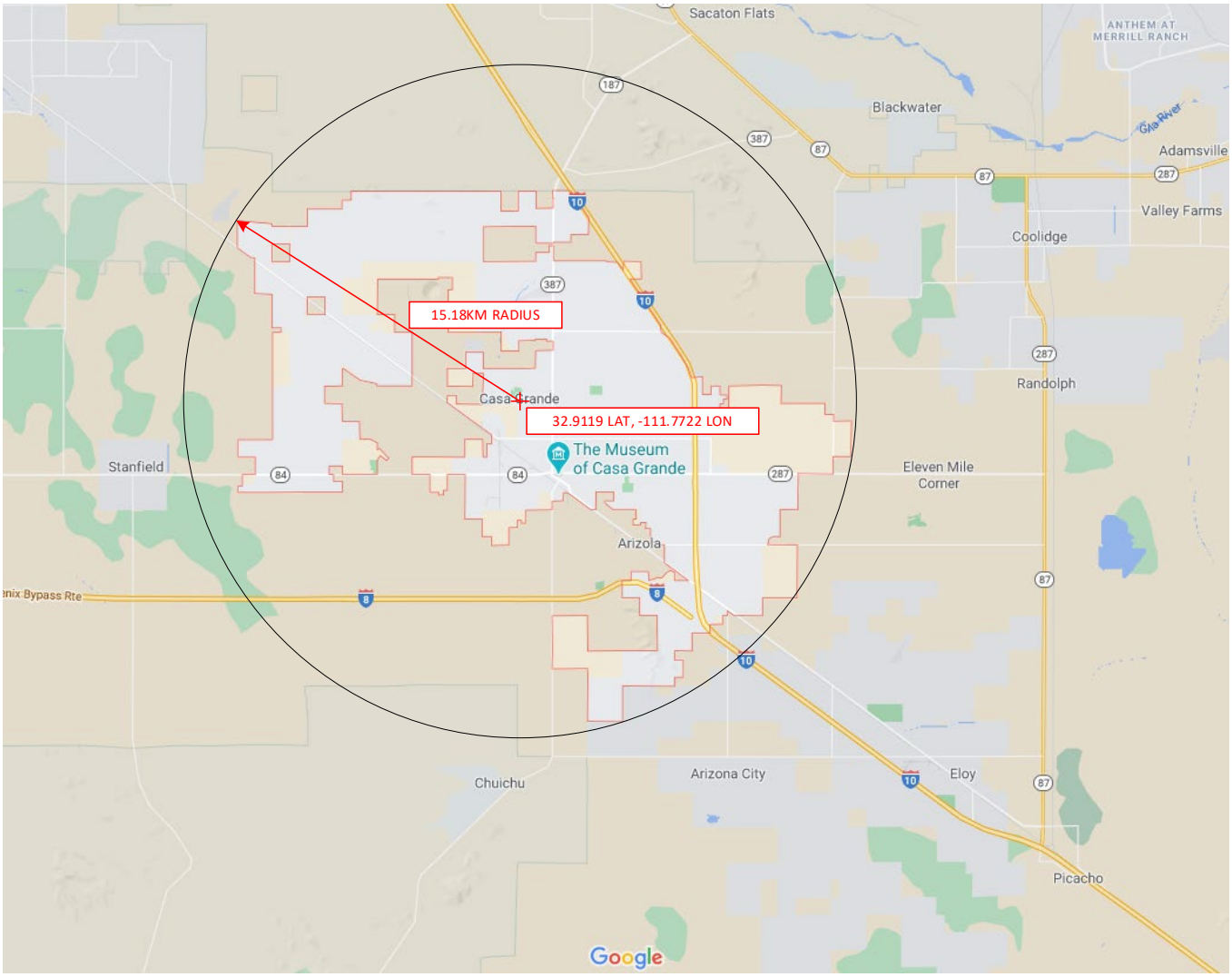
1.8.1 APS Service Territory (State Map)



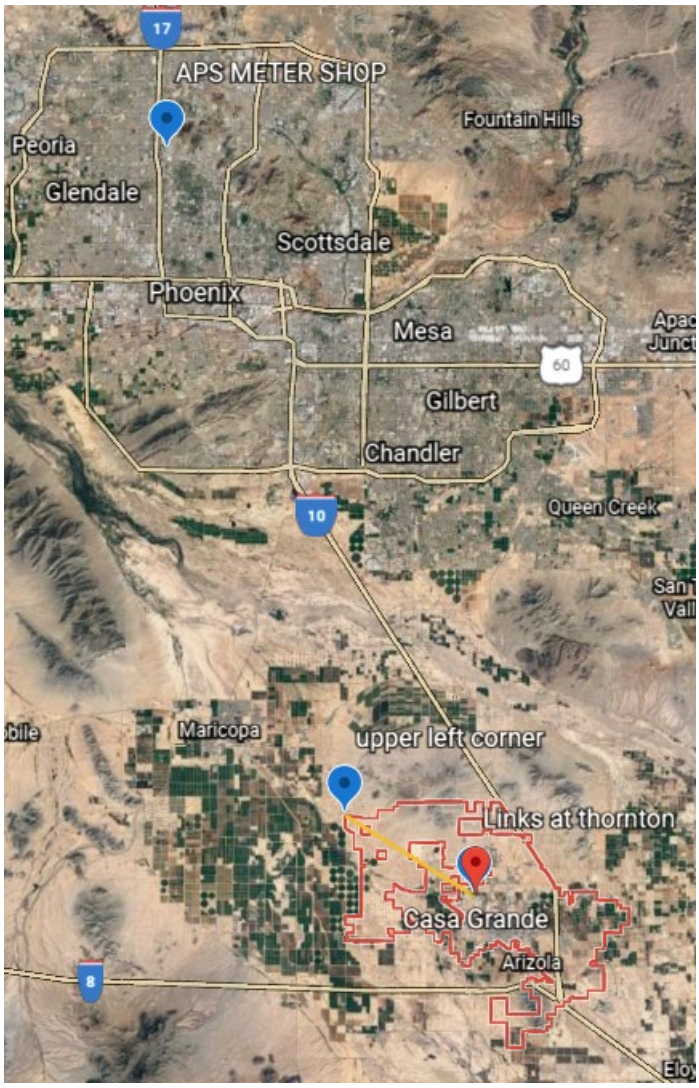
1.8.2 APS Meter Shop (Test Site 1)



1.8.3 City of Casa Grande (Test Site 2)



1.8.4 APS Meter Shop & Casa Grande Test Site



1.9 Annex 2

1.9.1 Quectel XMR202007BG95M6 Emissions

Below are the emissions listed for the frequencies of operation, LTE Cat-M1 Band 13 Uplink, in the certification for the XMR202007BG95M6.

FCC Rule Parts	Frequency Range (MHz)	Output (Watts)	Output (dBm)	Frequency Tolerance	Emission Designator
27	779.5 – 784.5	.214	23.304	0.00929 PM	1M12G7D

1.10 Annex 3

1.10.1 Calculated Necessary Bandwidth for Radio 1 (900 MHz ISM Band)

1.10.1.1 Symbols Definitions

- B_n = Necessary Bandwidth
- D = Peak Deviation = 64 KHz

- R = Total Bit Rate = 142.2 Kbps

1.10.1.2 Formula for Binary FSK where $0.03 < \frac{2D}{R} < 1.0$ (from *NTIA Manual of Regulations and Procedures for Federal Radio Frequency Management*, Annex J)

- $\frac{2D}{R}$ = 0.90
- B_n = 3.86D + 0.27R

  $3.86(64 \times 10^3) + 0.27(142.2 \times 10^3)$

  285.4 KHz

1.10.1.3 Occupied Bandwidth

- Measured Occupied Bandwidth = 332.7 KHz

1.10.2 Necessary Bandwidth for Radio 2 (LTE Cat-M1)

1.10.2.1 Occupied Bandwidth

- FCC ID = XMR202007BG95M6
- Occupied Bandwidth from grant = 1.12 MHz
- Emission Designation = 1M12G7D