Module 4

Deploying the On-Ramp Network

Module 4 - Outline

- On-Ramp Network Deployment Roles
- On-Ramp Network Planning and Design
- On-Ramp Back Office Network Deployment
- On-Ramp Base Station Deployment
- “Connected by On-Ramp” Endpoint Deployment
- Network Verification and Testing Activities

Network Deployment Roles Summary

- **Network Specialist**
  - Monitors Access Point commissioning progress and initial network health
  - Monitors Endpoint installation progress and health
- **Access Point Network Installer**
  - Physically installs Base Stations in the field
  - Could be customer internal resources or outside contractors
- **Network Operator**
  - Works with endpoint manufacturers to acquire and input endpoint keys into EMS
- **Back office IT Administrator**
  - Appliance installation
- **Applications Specialist**
  - Monitors initial application data and performance
  - Engages with application manufacturer on installation procedures
- **Applications Operator**
  - Works with installers to input meta data of newly installed endpoints

On-Ramp Network Planning and Design

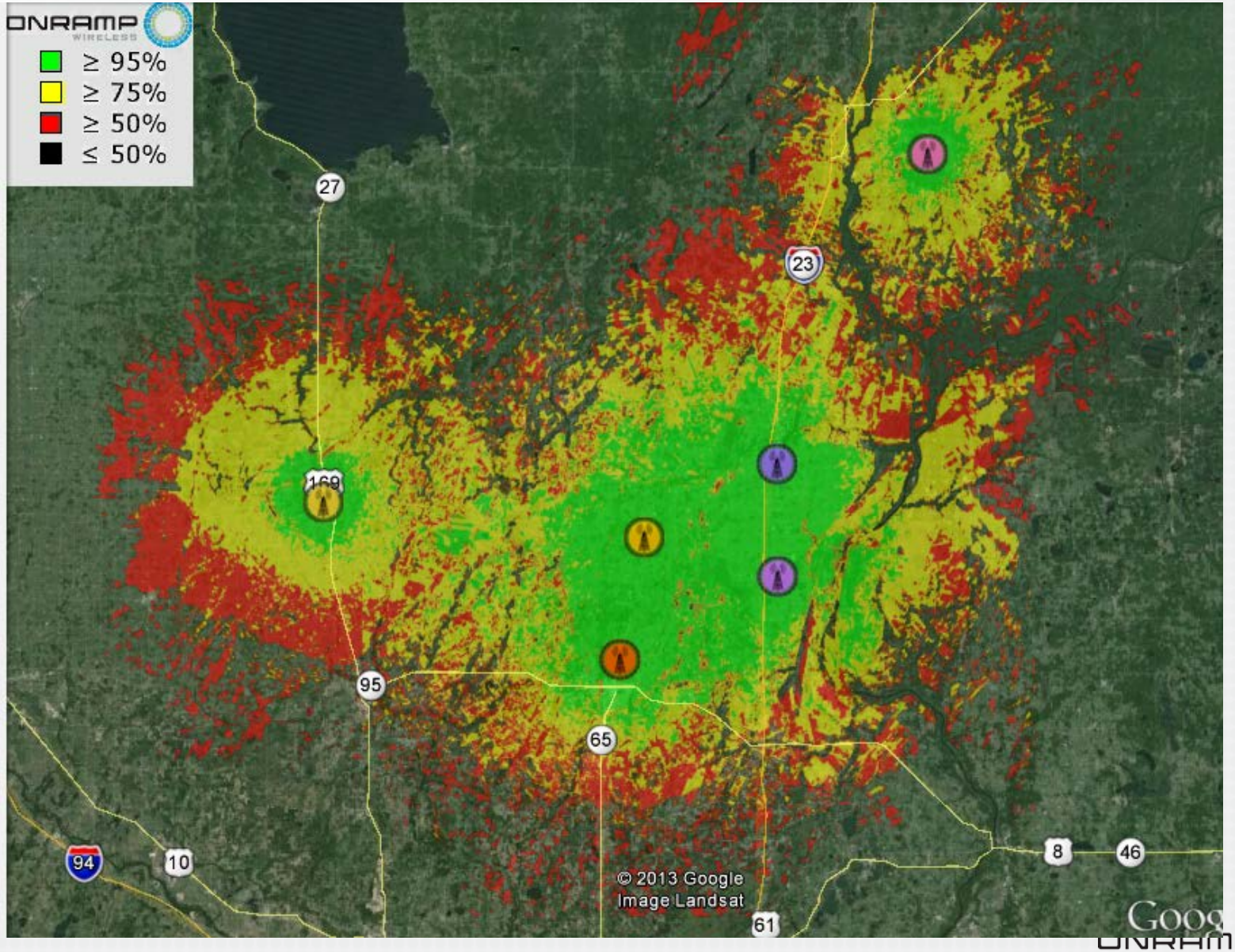
RF Network Planning Process - Inputs

- Determine network coverage requirements
  - Area to be covered, map with polygon marked if available
  - Endpoint locations and priorities if available
  - Endpoint characteristics
    - Diversity or non-diversity
    - Endpoint height
- Identify potential Base Station locations in the desired coverage area
  - Company or partner sites with towers or significant elevation above the average terrain including rooftops, water tanks and distribution poles
  - Tower company sites, such as American Tower or Crown Castle
  - Other sites with towers or significant elevation above the average terrain
  - Longitude and latitude of candidate Base Station sites
  - Estimated antenna height above ground for each candidate
  - Identify any sites where the AP antenna will be below the clutter
  - Identify any sites where 2.4 GHz Wi-Fi is being used

RF Network Planning Process - Activities

- Network Planning runs predictions for each site using the EDX propagation tool and On-Ramp prediction tools that consider:
  - Terrain
  - Clutter
  - Margin (for high probability of coverage)
  - Interference
  - Dynamic Link
  - Access Point Macro-Diversity
  - Node-side Antenna Diversity
- Rank candidate sites based on the predicted coverage
- Provide a Google Earth KMZ map showing the predicted coverage probability for region in three colors:
  - Green = 95% or greater
  - Yellow = 75% or greater
  - Red = 50% or greater
- Color coded percentage represents the probability of an installed endpoint has 95% or greater data reliability

Example: 6 AP ECE Pilot



RF Network Planning Process - Design

- Best candidates visited during a “Site Walk” to gather site specifics:
  - Antenna height and location on the tower
  - Anticipated antenna cable length
  - Observed clutter (foliage, buildings)
  - Availability of suitable backhaul
    - Corporate WAN connection
    - 3G cellular modem
    - Dedicated radio or microwave link
    - Satellite link
  - Site Survey spreadsheet completed with photos
  - Confirm availability of the site
- Network plans are updated and reviewed with customer; some iterations to address site issues and optimize customer needs if required
- Once optimum site candidates have been selected and the plan is approved, next steps:
  - Complete a preliminary design for each site, including Base Station type and location
  - Order Base Station equipment
  - Initiate Base Station installation process
    - Develop scope of work document
    - Contractor selection and bidding

RF Network Planning – Site Selection Summary

- Site coverage objectives
- Antenna height above surrounding terrain - Higher is better!
- Availability of power
- Site access considerations
- Available backhaul solutions
- Equipment location, indoor or outdoor
- Site security
- Site installation and recurring costs

On-Ramp Back Office Overview

On-Ramp Back Office Network Options

- On-Ramp Network Cloud
  - Back office hosted and managed at the San Diego Data Center
  - Authenticated customer access to On-Ramp Total View Data visualization tool
- On-Ramp Network Appliance
  - OTV Appliance installed in Customer Network (redundant hardware option available)
  - Load Balancing for additional redundancy
  - VPN support required for hands-on On-Ramp Network Operations management

On-Ramp Network Cloud Features

- Cloud Features
  - Redundant 2N power from two power grids
  - Redundant internet connectivity from multiple Tier 1 service providers
  - Physical and data security
  - Virtualized back office services
  - Managed hardware and software
  - Real-Time hardware, network, and software monitoring
  - Reduced network build time
  - Local data recovery RAID 10
  - Optional off-site data backup

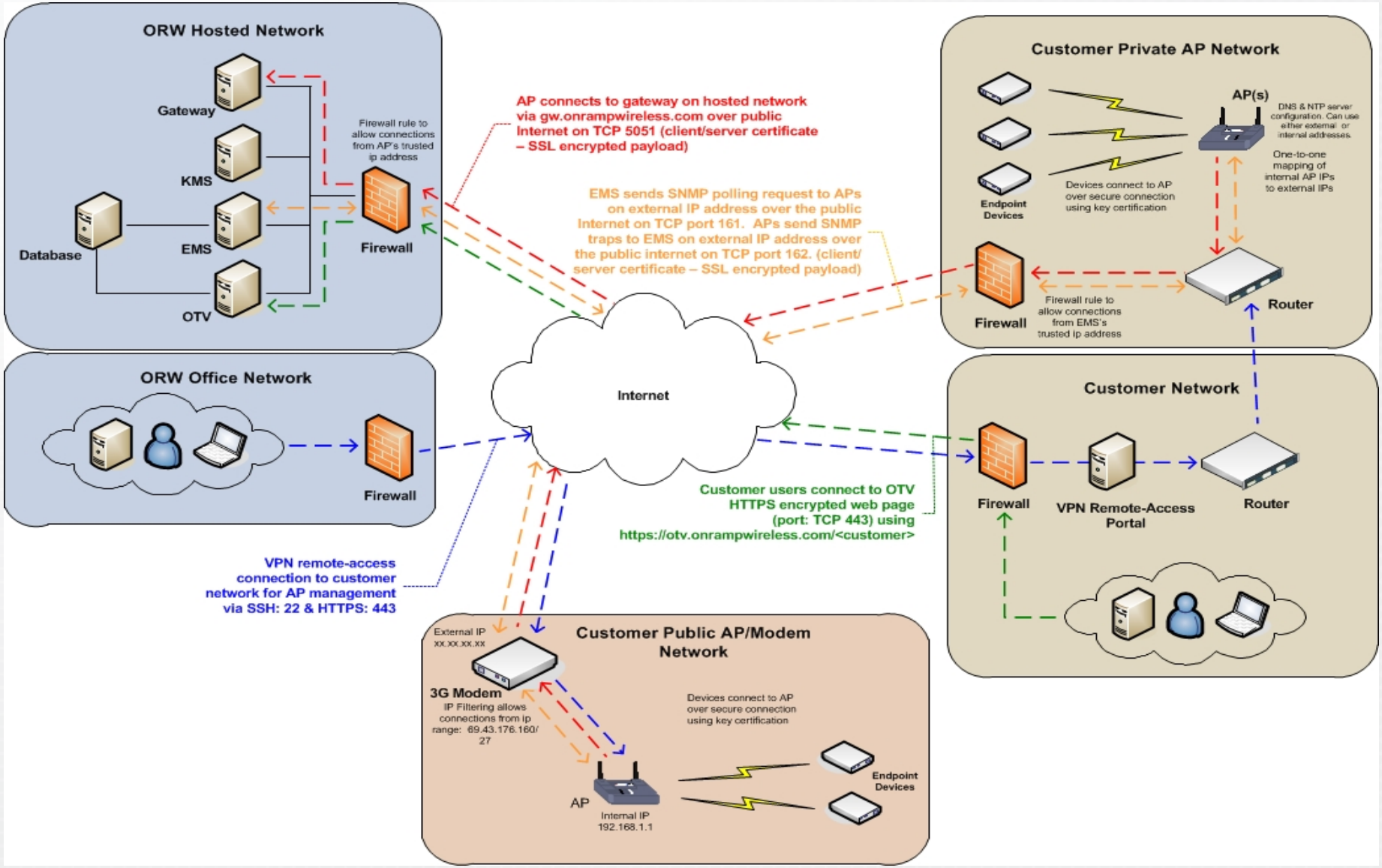
On-Ramp Network Appliance Features

- Appliance Features
  - All On-Ramp Wireless back office software on a single server
  - Local data recovery via RAID 10
  - Redundant power supplies
  - Redundant SSD drives
  - Redundant Hypervisor SD cards
  - Real-Time hardware, network, and software monitoring
  - Dual server option for High Availability (HA)
  - Using Load Balancing for redundancy
  - VPN option for On-Ramp management
- Appliance Planning
  - 1-2 OTV servers need to be ordered and built (6 week lead time)
  - IP Range provided by Customer
  - VPN setup by Customer

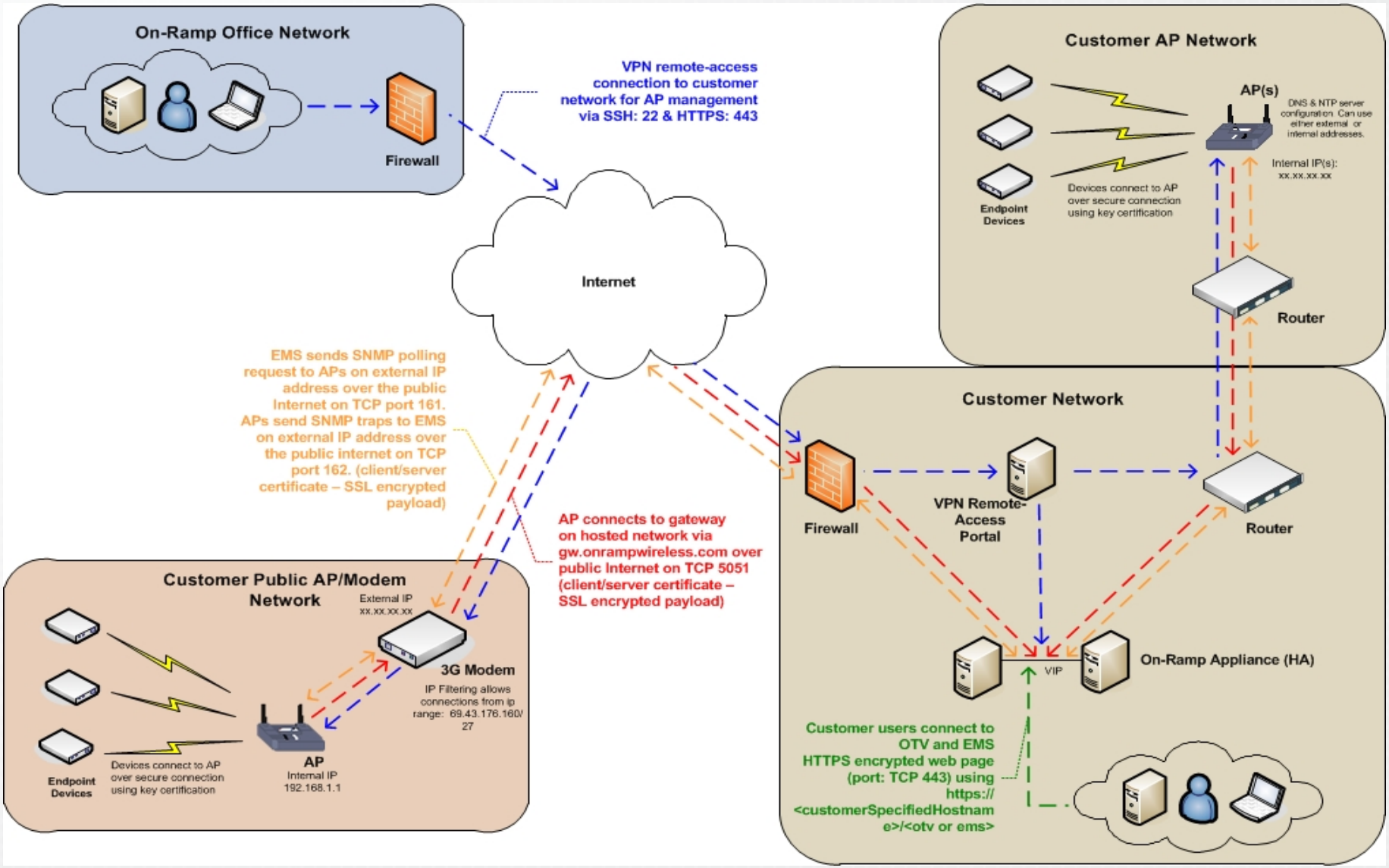
On-Ramp IT Network – Appliance Applications

- Preinstalled Applications
  - On-Ramp Gateway
  - On-Ramp Key Management System
  - On-Ramp Total View
  - On-Ramp Element Management System
  - HA Proxy load balancer
  - VMware ESXi
  - MySQL database
  - Nagios infrastructure monitoring tool
  - Cacti network monitoring and graphing tool

On-Ramp Hosted Network Architecture

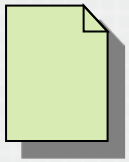


On-Ramp Appliance Network Architecture



IT Back Office Network References

- Reference Documents
  - 010-0039-00 On-Ramp Wireless Appliance Data Sheet
  - 010-0108-00 On-Ramp Wireless Appliance Installation Guide (1.4)
  - 010-0109-00 On-Ramp Wireless Appliance Installation Guide (2.1)
  - 010-0045-00 EMS Operator Guide (1.4)
  - 010-0107-00 EMS Operator Guide (2.1)



ONRAMP WIRELESS

Base Station Deployment Overview

Base Station Installation Considerations

- Base station location
  - Indoor or Outdoor?
  - Does a suitable equipment room exist?
  - How long are the AP and GPS antenna cable runs?
  - Where is power available?
  - Physical security
- Base station power considerations
  - Does customer require battery back-up?
  - 120/240 VAC
    - Without UPS
    - With UPS, size dependent on the number of hours required
    - 120 VAC outdoor base station with 8 hours of battery backup is available
  - 48 VDC
    - 48 VDC systems typically include battery backup
    - May be available in customer's equipment room
    - Frequently used with indoor rack mount base stations
  - Outdoor solar powered base station is available

Base Stations

- On-Ramp offers four base station kits:
  - TRN-1011 Outdoor Base Station – 120/240 VAC powered
  - TRN-1021 Outdoor Base Station – solar powered
  - TRN-1031 Rack Mount Base Station – 19” shelf with indoor AP
  - TRN-1032 Rack Mount Base Station – 19” shelf with outdoor AP
- All On-Ramp base stations utilize the TRN-1000 Access Point (AP)
- Base Station kits include GPS and AP antennas
- The outdoor base stations support customer provided 3G cellular modems (Digi DC-WAN-U805)

TRN-1011 Outdoor Base Station (120/240 VAC)

- Applications
  - 3rd party communication sites
  - Customer sites without equipment shelters
  - Electric utility distribution poles with available 120 VAC power
- Secure, outdoor, NEMA 4, single cabinet solution
- 34”Hx24”Wx10”D cabinet mounts to H frame or wall
- Provides integral cellular and GPS antennas
- Provides a minimum of 8 hours of battery backup
- Ready for installation of customer provided 3G cellular modem for backhaul
- Provides remote monitoring and alarming of power system and environmental conditions over the backhaul
- Preassemble and tested system for easy installation by contractor
- Required connections: AC power, AP antenna line and ground wire

- Additional Documentation:
  - 010-0036-00 TRN-1011 Base Station Installation Guide
  - 010-0006-00 AP Deployment Guide 1.4
  - 010-0021-00 AP Deployment Guide 2.1

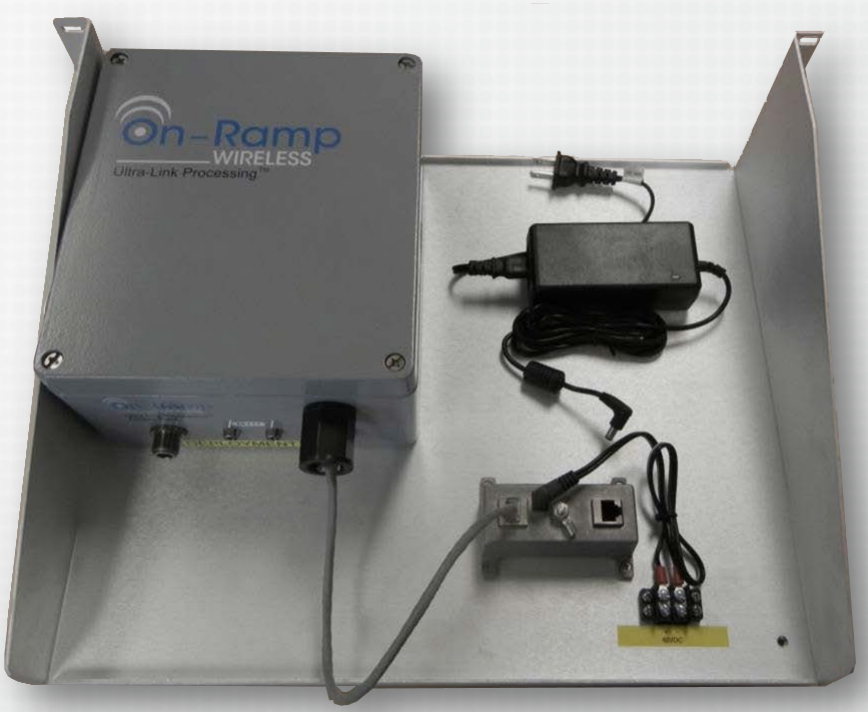
TRN-1021 Outdoor Base Station (Solar Powered)

- Applications
  - Remote sites without commercial power
  - Electric utility transmission towers and poles
- Designed to support southwest solar zones 1 and 2
- Capable of providing seven days of normal AP operation without any sunlight
- Includes outdoor, NEMA 3, equipment cabinet 23.5”H x 19”W x 18”D
- Provides integral cellular modem antennas for backhaul
- Mounts on a 3-1/2” pipe (4” OD), other sizes may be accommodated
- Due to weight and wind considerations not suitable for most rooftop applications
- Ready for installation of customer provided 3G cellular modem for backhaul
- Remote power system diagnostics capability

- Additional Documentation:
  - 010-0034-00 TRN-1021 Base Station Installation Guide
  - 010-0006-00 AP Deployment Guide 1.4
  - 010-0021-00 AP Deployment Guide 2.1

TRN-1031 and TRN-1032 Rack Mount Base Station Kits

- Applications
  - Customer owned communications sites with an equipment room or shelter
  - 3rd party communications sites with an equipment room or shelter
- Comprised of the following items:
  - TRN-1000 Access Point
  - 3RU, 5-1/2” high, 19” aluminum shelf with;
    - PoE injector
    - 120/240 VAC 48VDC power supply, or
    - 48 VDC power terminal strip
    - 12” Cat 5E Ethernet cable
  - RF surge suppressor
  - 40 dBi gain GPS antenna
  - 9 dBi omni directional antenna



- Additional Documentation:
  - 010-0040-00 TRN-1031 and TRN-1032 Base Station Installation Guide
  - 010-0006-00 AP Deployment Guide 1.4
  - 010-0021-00 AP Deployment Guide 2.1

Base Station Deployment Planning Activities

1. Determine Base Station model required at each site based on the information collected during the Site Walks
2. Plan the physical Base Station deployment at each site with detailed scope of work documents and drawings if required
3. Network Planning will provide Channel and Reuse Code assignments for each site
4. Plan the backhaul configuration for each site
5. Configure the AP network parameters and setup backhaul solution
6. Add the AP to the EMS system on the network back office

Planning worksheets and templates are provided to aid in the data gathering and planning

Base Station Physical Installation Activities

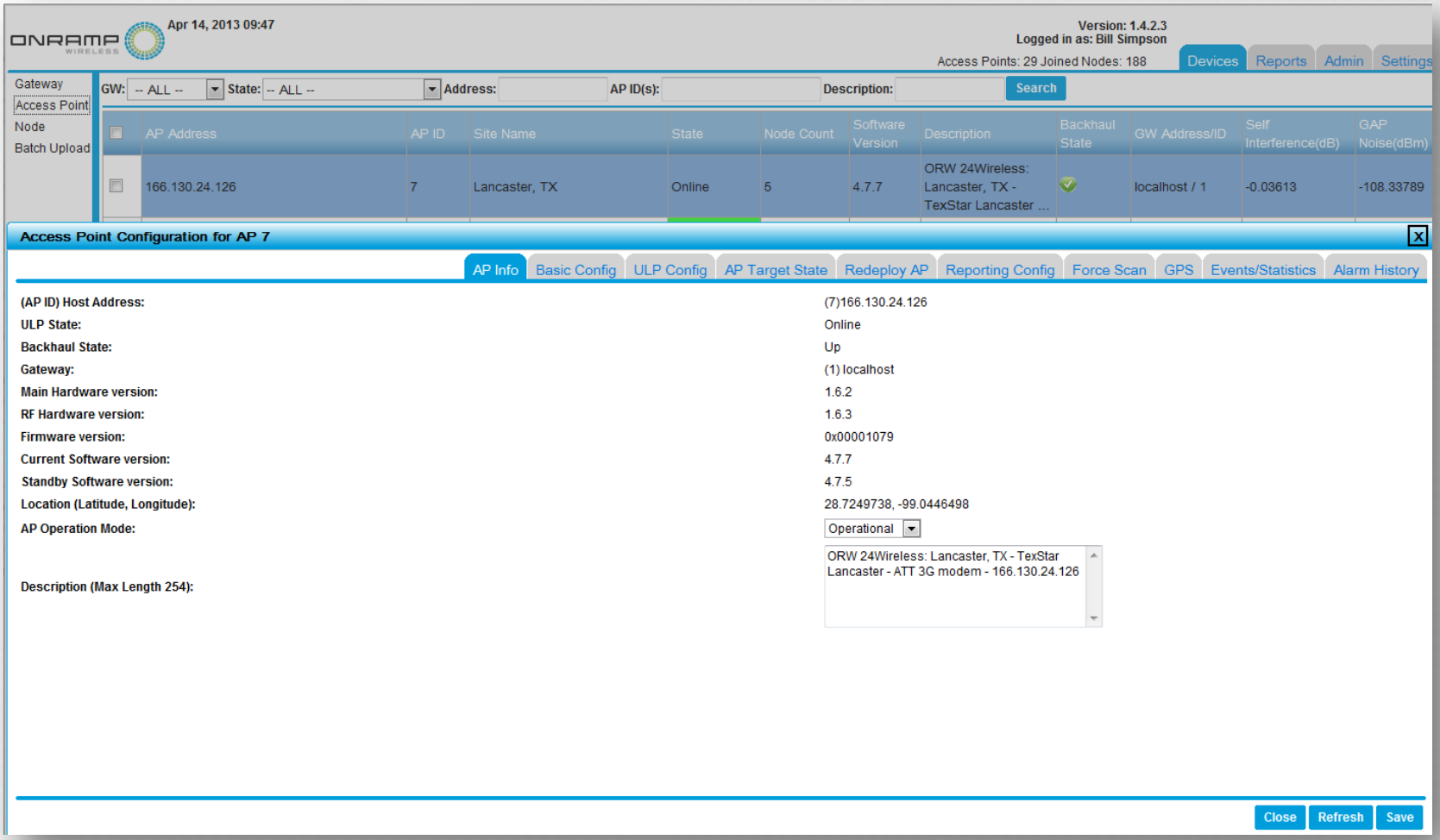
1. Install the antenna system with industry accepted practices
2. Install the GPS antenna
3. Mount the base station
4. Connect the antenna to the base station
5. Connect the GPS antenna to the base station
6. Connect a suitable ground wire to the base station
7. Connect power to the base station
8. Verify that the green Status LED on the AP is solid or flashing
9. Verify remote connectivity to the base station
   - If using an outdoor base station with a 3G modem, remotely ping the 3G modem's public IP address
   - If the AP has been assigned an AP address on an IP network, verify that address is reachable

Base Station Go Live Activities

- Contact Network Operations* and request the new base station be commissioned
- Network Operations will:
  - Verify the backhaul is operational and the AP is reachable
  - Commission the new base station by configuring the AP in in the Gateway and setting the AP's parameters
  - Verify the AP's GPS receiver is seeing the satellites
  - Put the base station "on-line", this could take 15 minutes or more for a new base station
  - Advise when the AP's state has changed to "on-line"
  - Run the "AP Site Survey" utility, this utility will measure average and peak noise on all 38 TRN channels
  - Work with the field team to verify that a nearby node (endpoint) can successfully "join" the new base station

* Network Operations refers to either On-Ramp Network Operations or Customer Network Operations for non-managed appliance environment

AP Info Screen in 1.4 EMS



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AP Info Screen in 2.1 EMS

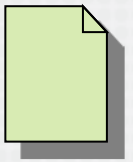
Network Status Details

Edit Network Configuration

Config State	Enabled
AP Reported State	
Broadcast Service Domain	EOTA
Network State	Registered
Backhaul State	Connected
RF Status	Online
GPS State	Online
Last Connection Time	Aug 14, 2013 16:54:11 +0000
Last Connnection Gateway	079dc877-2947-4fcf-a556-725f24e40af8
Last Connection Result	
Last Connection Address	
Last Disconnection Time	
Last Disconnnection Gateway	
Last Disconnection Reason	

Base Station Deployment References

- Reference Documents
  - 010-0006-00 AP Deployment Guide (1.4)
  - 010-0021-00 AP Deployment Guide (2.1)
  - 010-0032-00 Backhaul Selection and Configuration Manual
  - 010-0036-00 TRN-1011 Base Station Installation Guide
  - 010-0034-00 TRN-1021 Base Station Installation Guide
  - 010-0040-00 TRN-1031 and TRN-1032 Base Station Installation Guide



ONRAMP WIRELESS

Endpoint Deployment

Endpoint Deployment Summary

- Each type of endpoint will have specific installation instructions provided by the device's manufacture
- "Connected by On-Ramp" endpoints are securely provisioned for each network
- Deploying an endpoint on an On-Ramp network involves the following steps:
  - Provisioning of security keys and network channel assignments on the endpoint by the manufacturer prior to shipping
  - Installing the endpoint within Access Point coverage
  - Monitoring the network join status of the endpoint via the On-Ramp Total View application or EMS
  - Many endpoints also provide visual network status feedback to endpoint installer

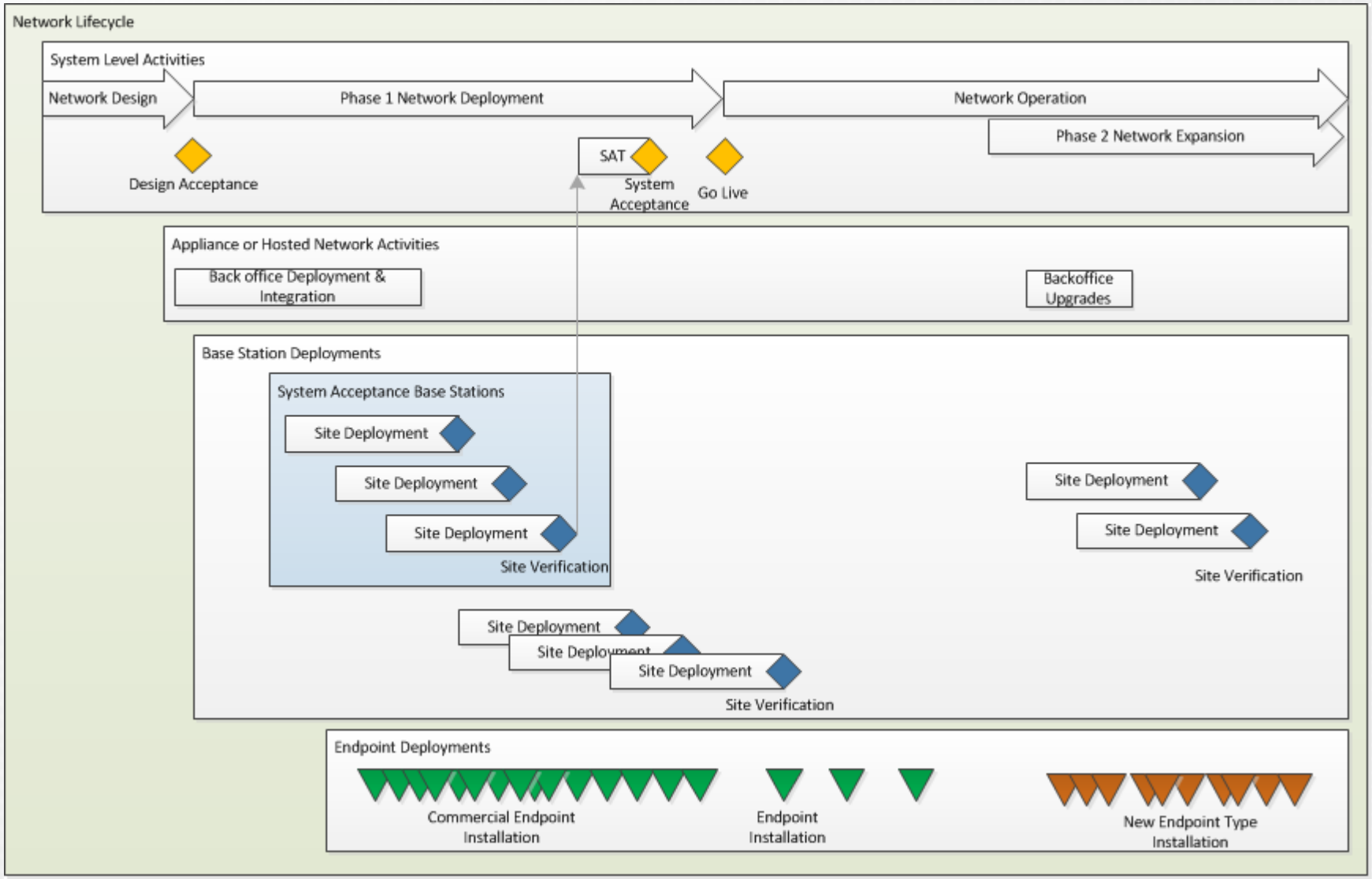
Endpoint Status Indicator Examples

- SEL WSO-11
  - Mechanical red/white target flag indicating network join and device arm state
- GE WiYZ
  - Front panel LEDs indicating network scanning, tracking, join status
  - LED's turn off after 30 minutes
- Gridsense TIQ
  - Detachable LED dongle to indicate network join status
- GE Meters
  - Front Panel LCD screen indicating network status and signal strength

ONRAMP WIRELESS

Acceptance Testing and Network Verification

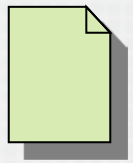
Network Lifecycle Overview



Field Testing and Network Verification

- Contractual activity with deliverable test plan and results
- Test plan scope proposed by On-Ramp and negotiated with customer
- Test plan timing and schedule to be planned with customer. Test plan execution may be used to signal end of program phases
- Testing typically conducted jointly between On-Ramp and Customer (and in some case endpoint partners). On-Ramp personnel on-site requirements to be negotiated
- Test results archived and officially signed-off by On-Ramp and customer

- References:
  014-0070-00 On-Ramp System Acceptance Test Specification



Site Verification

- Conducted after each Base Station has been installed and brought online
- Performed before installation team leaves the Base Station site
- Test cases executed jointly with customer, results signed off and archived
- Test Cases may include
  - Verify Base Station Physical Site Installation
  - Verify AP RF Parameter Configuration
  - Verify AP Network Parameter Configuration
  - Verify AP Online Status through EMS
  - Verify Base Station Physical Site Security

System Acceptance Testing

- Conducted after back office network has been setup
- Planned number of Base Stations and endpoints have been installed on the network
- Test cases executed jointly with customer, results signed off and archived with As-Built documentation
- Test cases
  - Verify Basic Tools and Login Capabilities
  - Verify End-to-End AP Network Management
  - Verify End-to-End Device Management
  - Verify End-to-End Back office Management

Module 4 Review Quiz

- What are some examples of network planning inputs?
- What does the “green” area mean on a network coverage map? “Yellow”?
- What are some tradeoffs when choosing between a hosted “cloud” back office system and an appliance system?
- How many On-Ramp Base Station types are there? What are they?
- What is the final stage of Base Station installation?
- What does the AP RF Site Survey do?
- What are some examples of network join status indicators?
- Why do we perform site and system acceptance testing?

Document Reference Summary

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  - 010-0040-00 TRN-1031 and TRN-1032 Base Station Installation Guide
  - 010-0036-00 TRN-1011 Base Station Installation Guide
- System Testing Documents
  - 014-0070-00 On-Ramp System Acceptance Test Specification