



Introduction to Wi-SUN FAN and Certification

March 2022

Introduction to Wi-SUN Alliance



What is Wi-SUN Alliance?



A global ecosystem of member companies seeking to accelerate the implementation of open standards-based Field Area Networks (FAN) and Internet of Things (IoT).

Target Applications

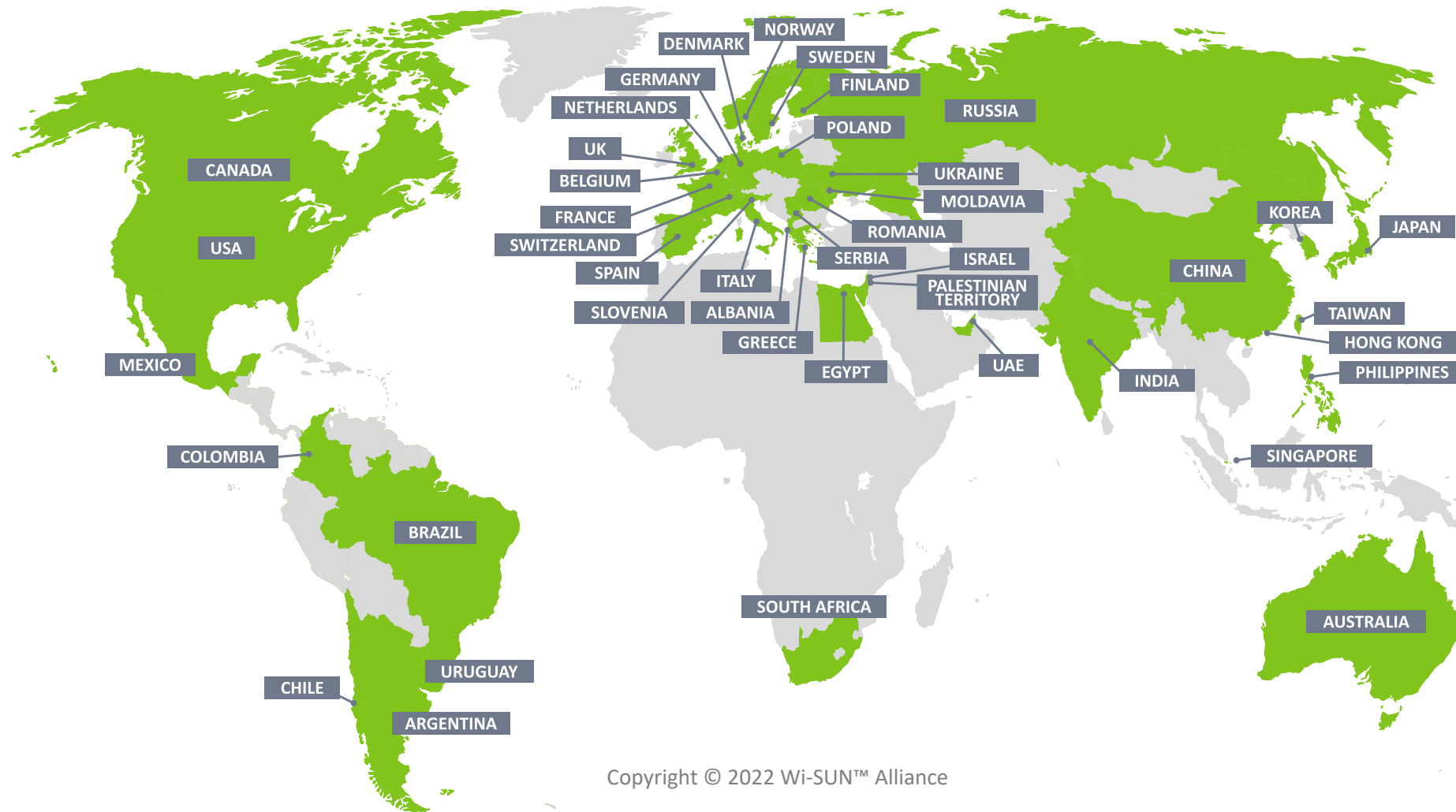


Wi-SUN Alliance delivers communications solutions for applications requiring secure, resilient and scalable networks, including:

- **Smart utilities:** Advanced Metering Infrastructure (AMI), Peak Load Management, Distribution Automation and Smart Metering
- **Smart cities:** Street Lighting, Infrastructure management, Smart Parking, Environmental sensing, traffic and transport systems
- **Smart home:** Smart thermostats, air cond, heating, energy usage displays and health and well-being applications
- **M2M:** Agriculture, structural health monitoring (e.g. bridges, buildings, etc.), monitoring and asset management

Over 300 members representing 46 countries

Growing global membership



Wi-SUN Membership



A Complete Ecosystem from Silicon to Solutions



**>100 Million Wi-SUN
Capable Endpoints
Deployed Worldwide**
– *Navigant Research*

>100 M



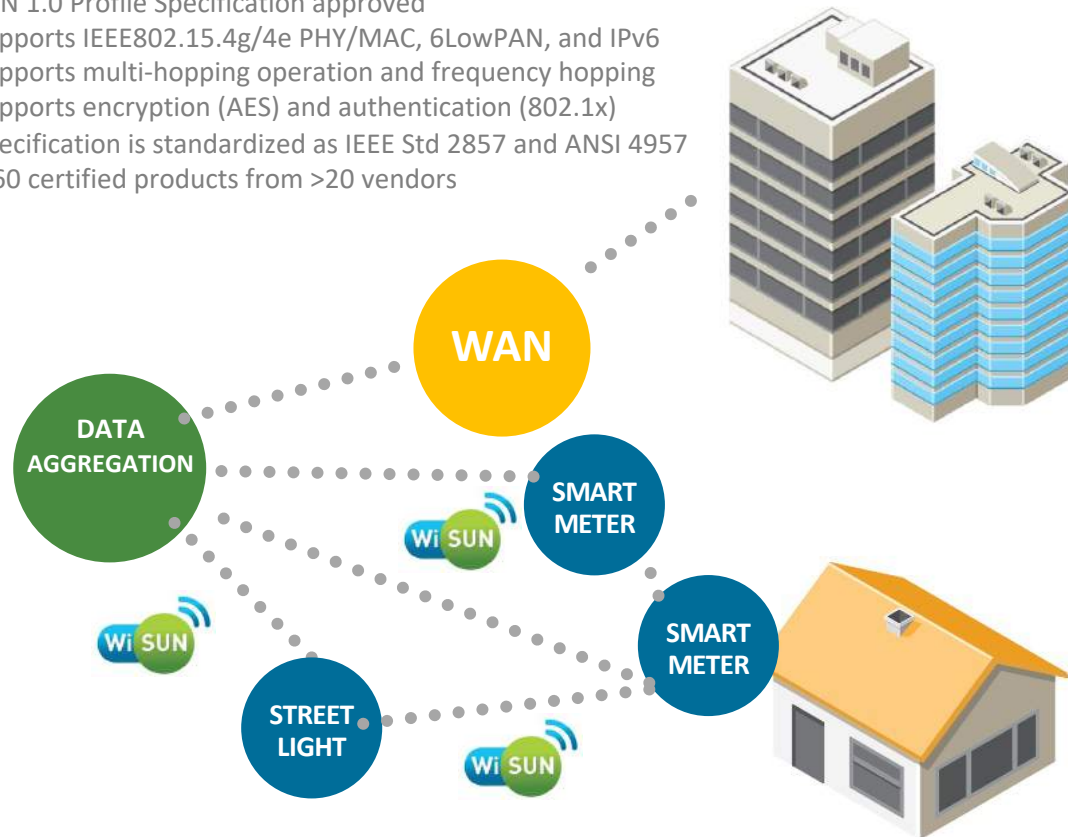
Wi-SUN Technical Profiles



Profile Specifications for Smart City/Utility Applications

FIELD AREA NETWORK (FAN) Profile

- FAN 1.0 Profile Specification approved
- Supports IEEE802.15.4g/4e PHY/MAC, 6LowPAN, and IPv6
- Supports multi-hopping operation and frequency hopping
- Supports encryption (AES) and authentication (802.1x)
- Specification is standardized as IEEE Std 2857 and ANSI 4957
- > 60 certified products from >20 vendors



FAN: Communication Between Smart Meters and Distribution Automation

HOME AREA NETWORK (HAN) Profile

- Profile Specification is approved (Wi-SUN profile for ECHONET Lite)
- Support IEEE802.15.4g/4e PHY/MAC, 6LowPAN, and IPv6
- Support encryption (AES) and authentication(PANA)
- Specification is standardized as TTC JJ300.10
- > 100 certified products



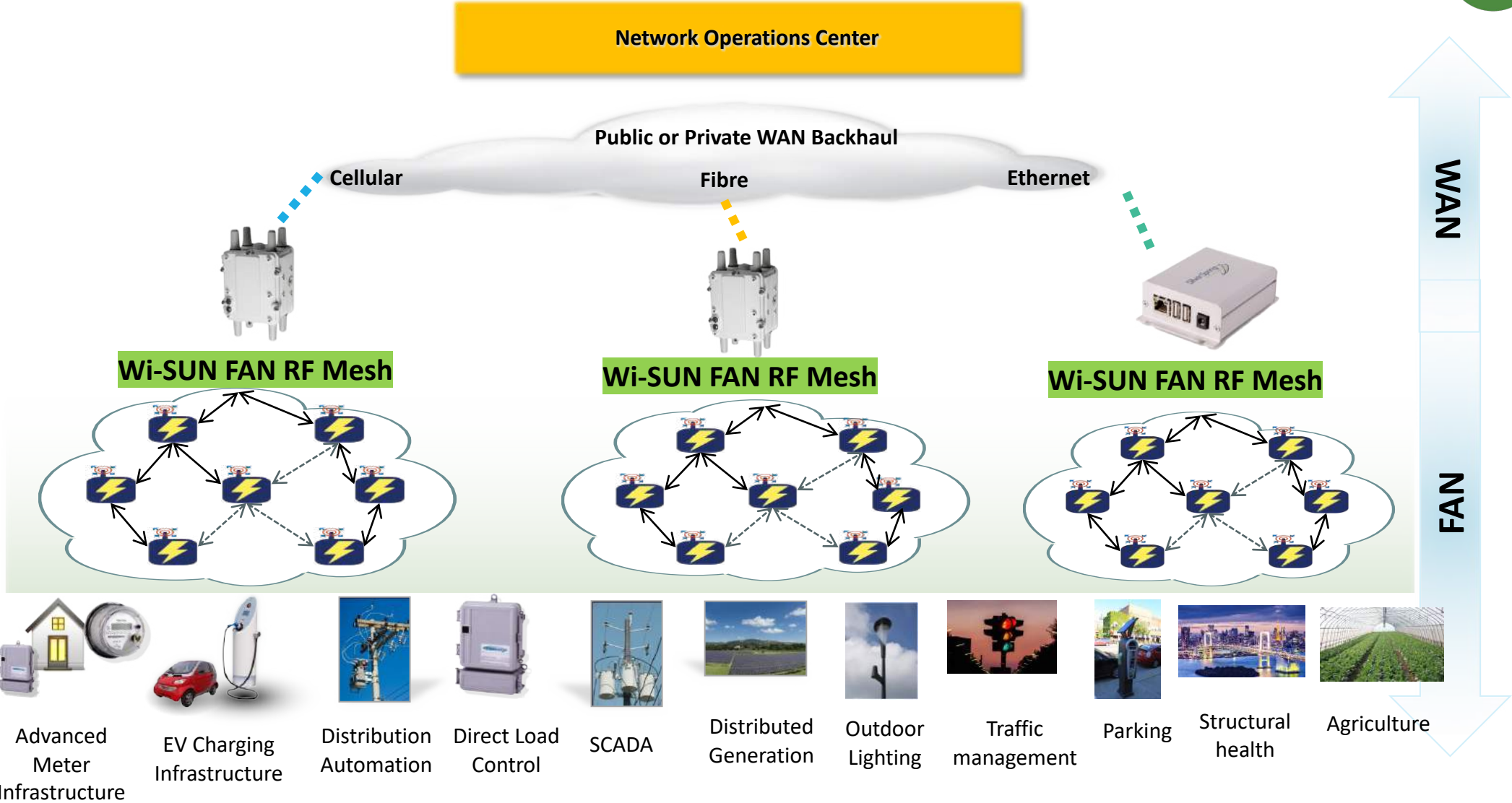
TEPCO B-ROUTE: Communication between Smart Meters and HEMS

HAN: Communication between HEMS controller and HAN device

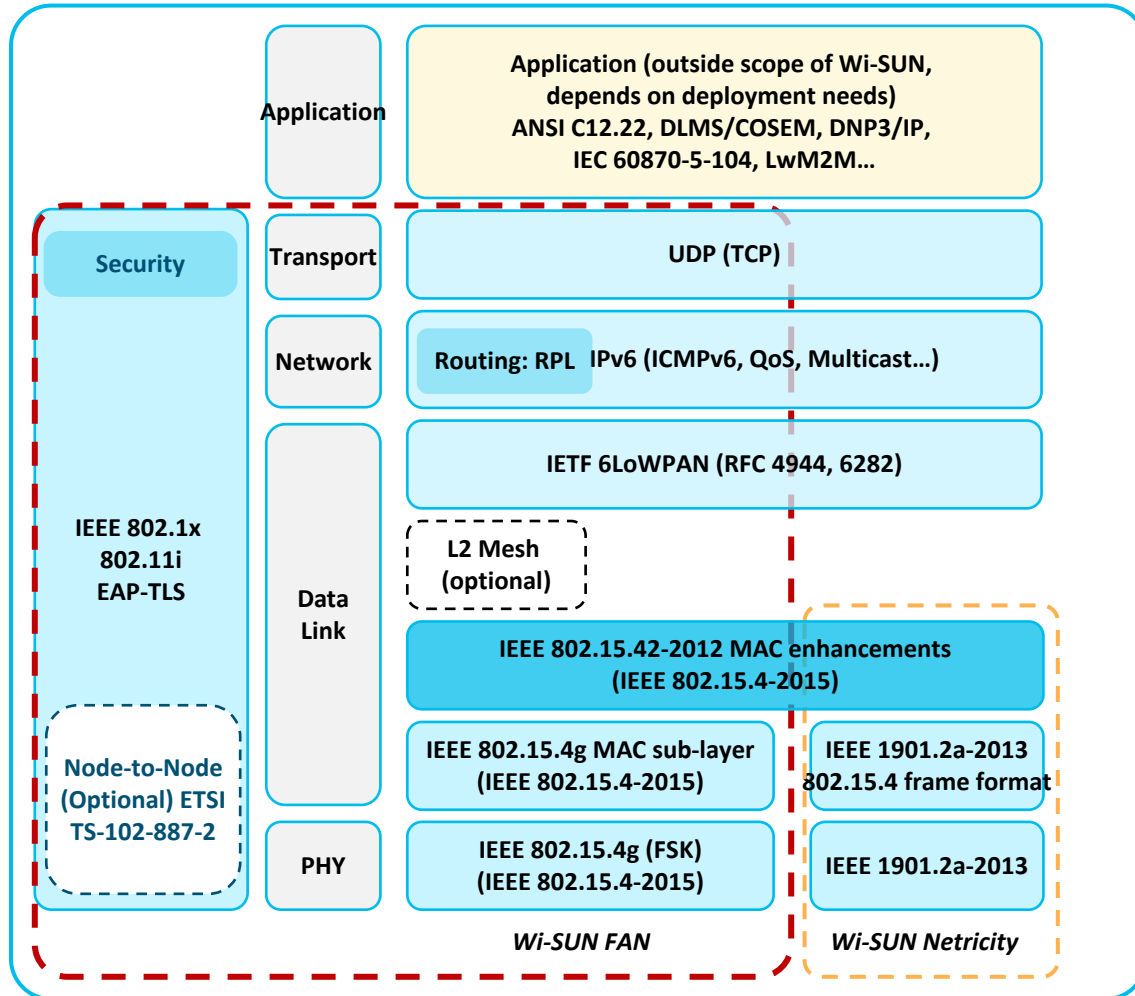
Wi-SUN Field Area Networks (FAN)



Wi-SUN FAN Network and Use Cases



FAN Stack Technical Overview



IPv6 protocol suite

- UDP
- 6LoWPAN Adaptation + Header Compression
- DHCPv6 for IP address management
- Routing using RPL
- ICMPv6
- Unicast and Multicast forwarding

Security

- 802.1X/EAP-TLS/PKI Authentication
- 802.11i Key Management
- Optional ETSI-TS-102-887-2 Node 2 Node Key Management

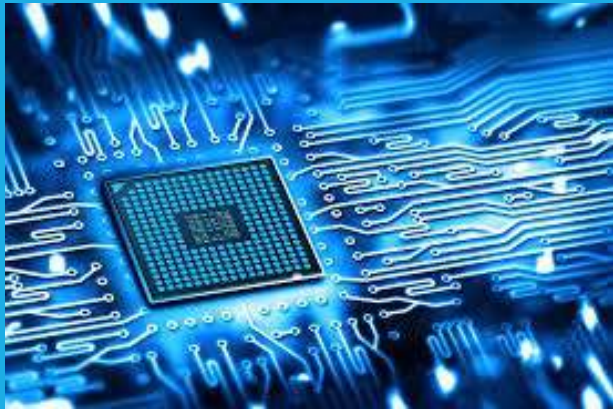
MAC based on IEEE 802.15.4e + IE extensions

- Frequency hopping
- Discovery / Join
- Protocol Dispatch (IEEE 802.15.9)
- Several Frame Exchange patterns
- Optional Mesh Under routing

PHY based on 802.15.4g

- OFDM and FSK modulations, data rates, and regions

The Benefits of a Wi-SUN FAN Network



DELIVERS MARKET LEADING RESILIENCE AND RELIABILITY

- Intelligent self-healing mesh network automatically responds to changing environments

ENABLES HIGHEST LEVEL OF IOT SECURITY

- Supports latest IP-based security technologies for device authentication and encrypted communications

FACILITATES AN ECOSYSTEM OF NON-PROPRIETARY SOLUTIONS

- Certified products will seamlessly interact while leveraging shared network infrastructure

ENSURES FLEXIBILITY AND REDUCED COST

- Select from a broad range of solutions to maximize vendor choice and promote competition

PROVEN IN THE WORLD'S LARGEST OUTDOOR IOT NETWORKS

- More than 100M Wi-SUN capable devices awarded worldwide

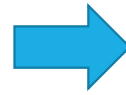
Wi-SUN Test and Certification



Certification delivers Interoperability

Standardization Body

IEEE802.11
Wireless LAN



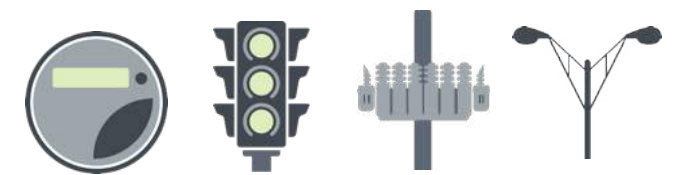
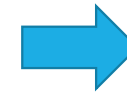
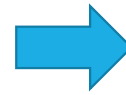
Industry Alliance



Interoperable Products



IEEE802.15.4g
Wireless SUN

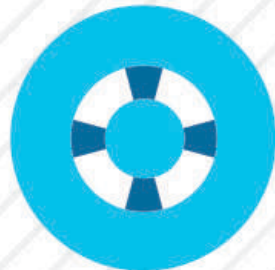


Wi-SUN Alliance is the certification organization for large scale IoT Networks

What are the benefits of FAN Certification?



ecosystem



less risk



standards



interoperability

For utilities, smart cities, FAN Certification ensures interoperability, which results in accelerated time to market.



non-proprietary



new features



time to market



cost savings

Testing and Certification Details



Testing Methodology

- Two Part Testing
 - Conformance component – assessing Device Under Test for conformance to the specification using specialized test environment
 - Interoperability component – assessing Device Under Test for interoperability with reference implementations
- All certification testing is conducted by a Wi-SUN appointed Independent Test Laboratory – Third Party Testing
- Test Laboratory prepares Test Report
- Device Under Test must pass all relevant tests to be eligible for certification

Test Programs

Physical Layer

- North America, Latin America, Australia, SE Asia
- Europe and India

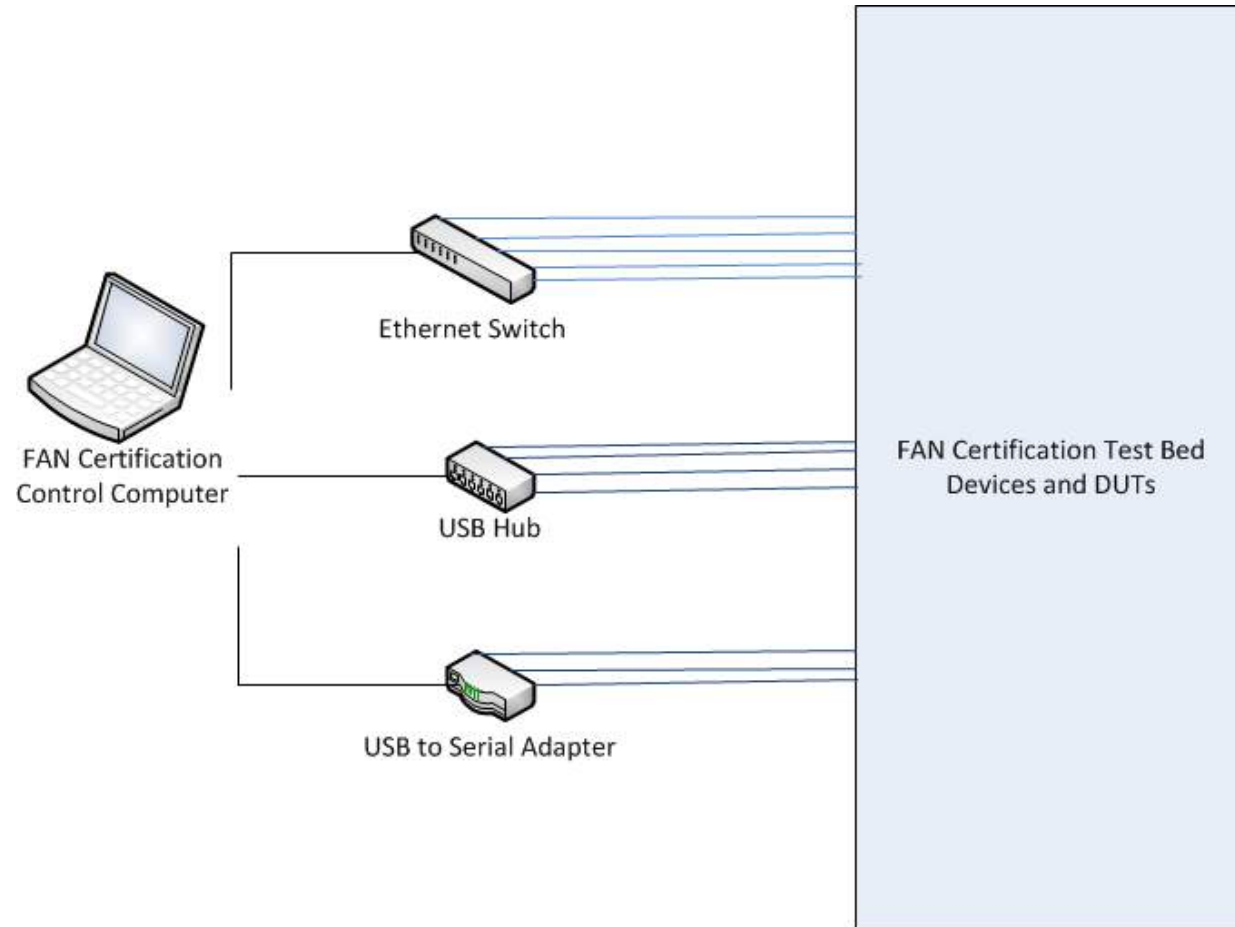
FAN Profile

- FAN 1.0
- FAN 1.1 in Phase 2
- Supporting multiple regulatory domain globally
- North America, Latin America, Australia, South East Asia
- Europe and India in Phase 2

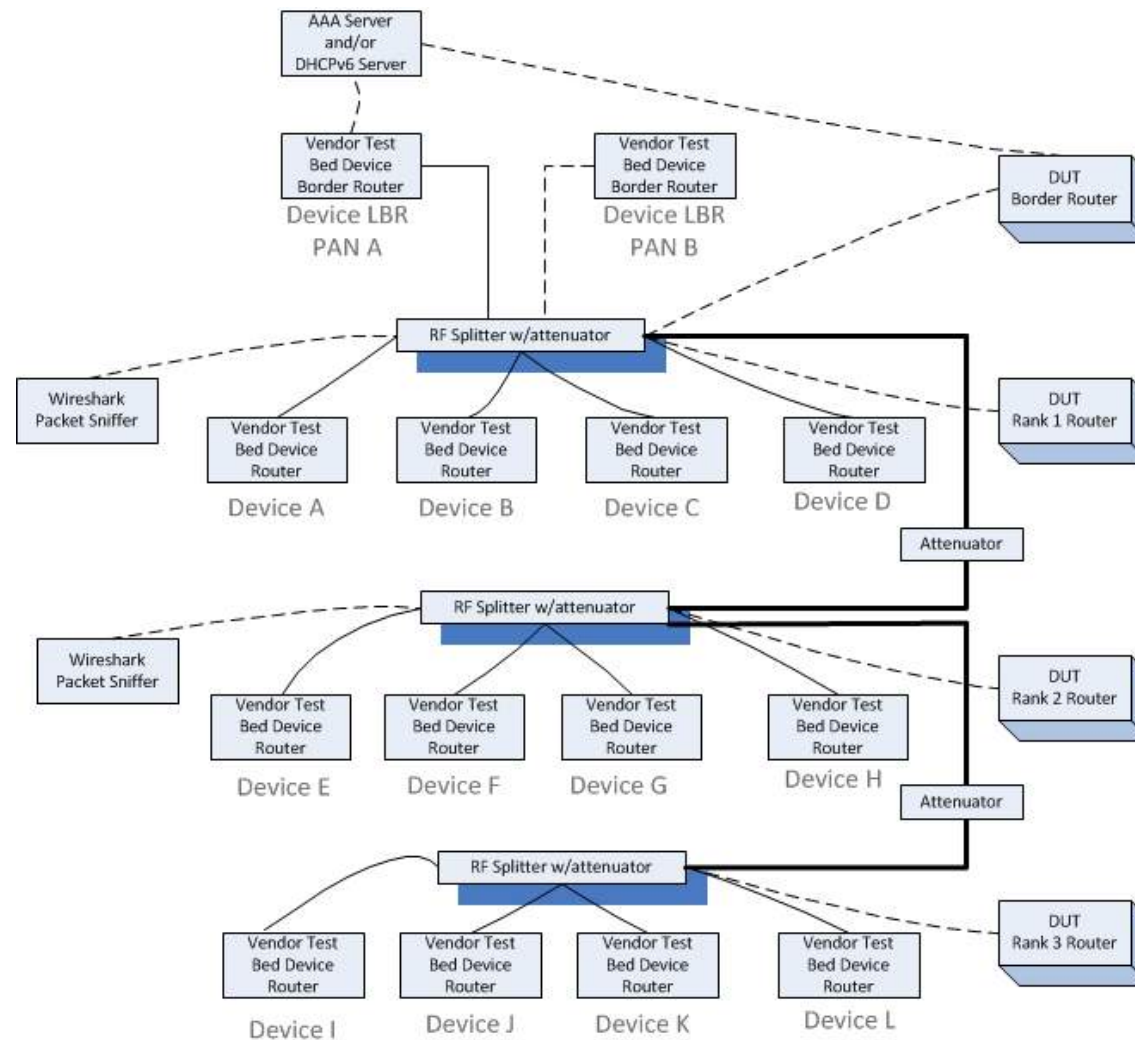
FAN Certification Testing Overview

- FAN Conformance Test Bed
 - **Test Bed Controller**
 - Script driven TBC to automate FAN device certification
 - TBC controls test bed as certification test plan is executed upon a Device Under Test
 - Test Bed Units
 - 14 TBUs constitute the test bed
 - Test Bed Units from multiple vendors
 - TBUs implement the API used by the Test Bed Controller
 - Wireshark protocol decoder
 - Wireshark protocol decoder is integrated into the TBC and test bed

FAN Certification Test Bed Overview



FAN Certification Test Bed Internal Detail



Test Lab Members



Test Lab Members (9)



Allion, JEMIC, TELEC, TUV Rheinland are Wi-SUN Approved Test Labs

Membership



Membership Levels

Promoter Membership

- Direct the activities of the organisation
- A seat on the Board of Directors
- Final approval of specifications

Contributor Membership

- Monitor and contribute to technical profile specifications and test specifications
- Input requirements to the certification program to ensure alignment with both currently deployed systems and future needs
- Attend member meetings and interoperability events
- Develop and certify interoperable products based on open standards
- Contribute to an eco-system of interoperable products

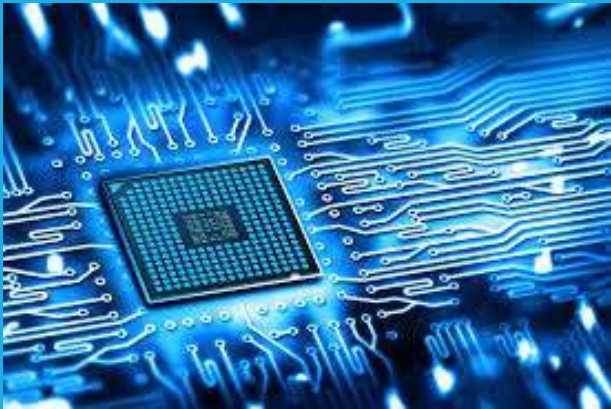
Adopter Membership

- Attend member meetings
- Participation in alliance workshops and developers' conferences
- Approved use of Wi-SUN Alliance logo on promotional materials
- Access to Wi-SUN Alliance marketing collateral and e-newsletter
- Access to a world-class ecosystem of members

Observer Membership (Test Lab/Certification Body)

- Reserved for Test labs and certification bodies

How do I join?



1. [Contact us here](#) to express your interest in joining the Wi-SUN Alliance
2. You will be asked to provide your logo for the Wi-SUN site and you will be supplied the Wi-SUN logo to use on any of your materials
3. You will receive a welcome pack with further information on the Alliance, resources available to members and a timeline of future events which may be of interest to you

For More Information



For more information
or questions contact:

info@wi-sun.org
www.wi-sun.org

Follow us:

www.linkedin.com

Wi-SUN Alliance Group
[@WiSunAlliance](#)

Backup Slides for further information



Field Area Network Technology Overview





Key Themes of the FAN Technology Stack


- Leverage existing standards
- IP protocol suite
- IEEE 802.15.4 sub-GHz wireless
- Enterprise class security
- Interoperability
- Multi-service capabilities


Wi-SUN FAN Secure Network Architecture

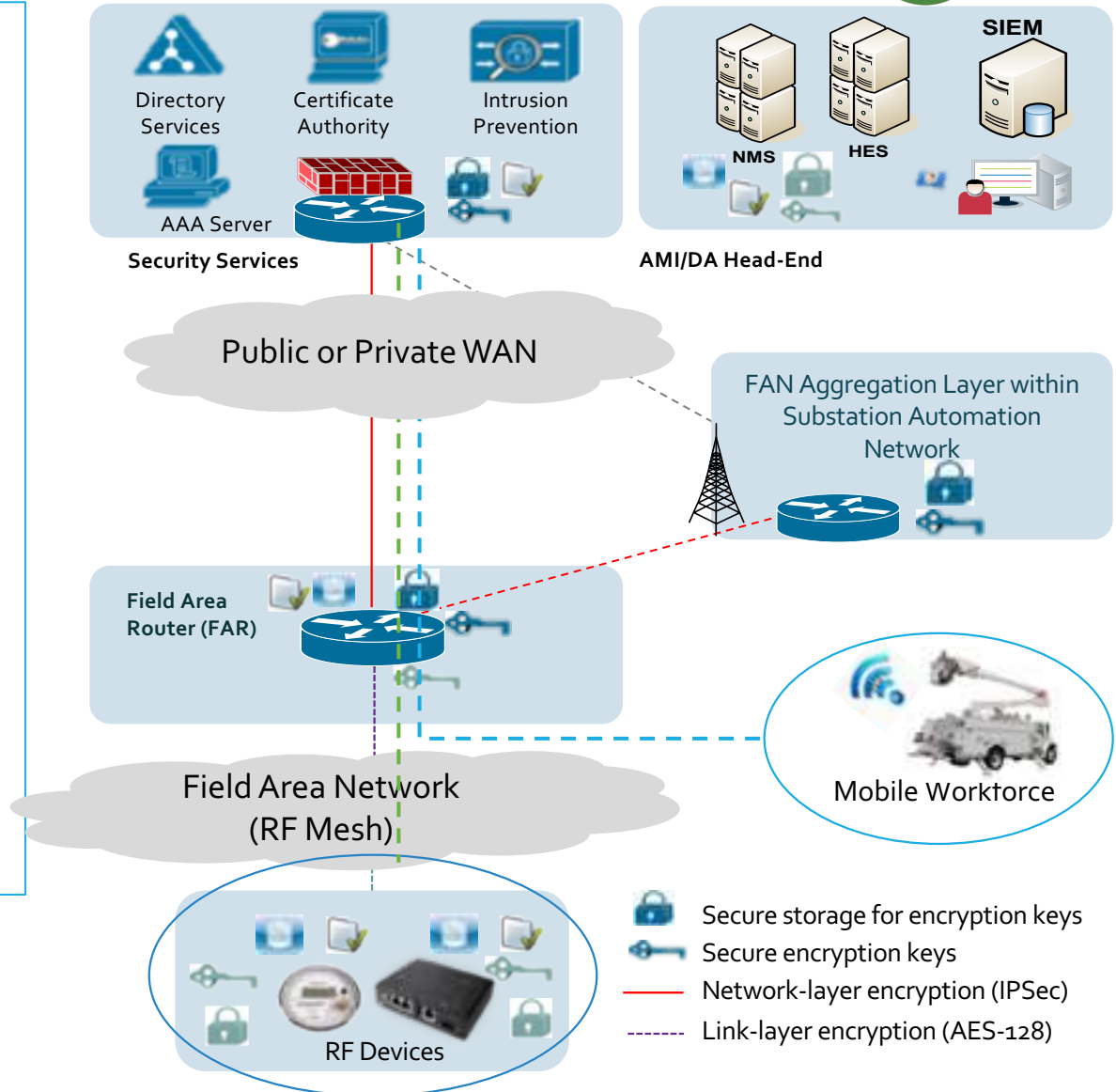
- Network Discovery
- Device hardening with 802.1AR and hardware security chip or PUF
- Network hardening tools
- Certificate-based identities
- Role based Access Control
- 802.1X-based access control for meters, routers, grid devices
- Frequency hopping RF
- Link-layer encryption in RF Mesh
- Group-based key generation and management (mesh)
- Network-layer encryption for WAN Backhaul (IPSec)
- Over the air upgradable devices

 Secure Device Identity via Digital Certificates

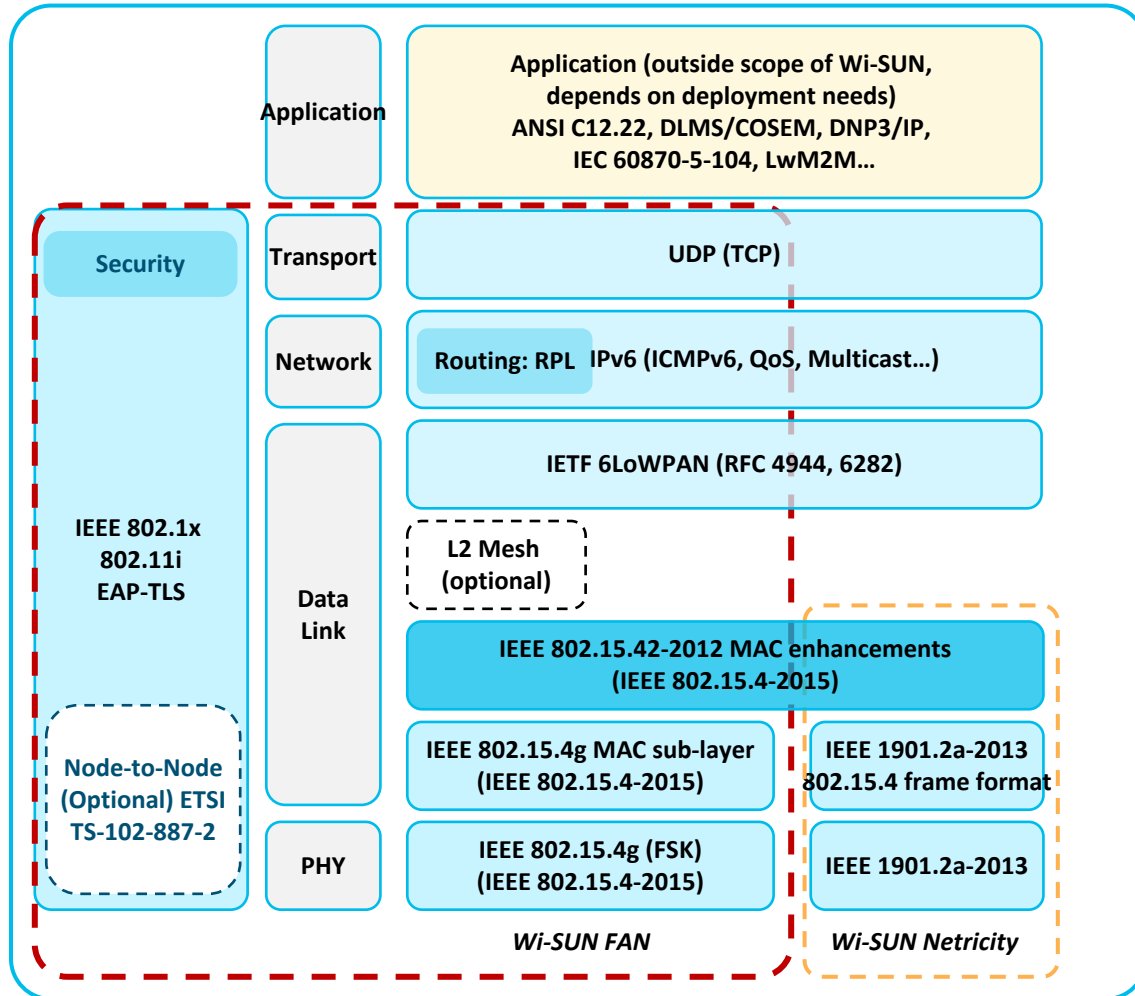
 Strong user identities with Role-Based Access

 Time-stamped logs, correlation at SIEM

 Separation of AMI vs. non-AMI traffic, segmentation



FAN Stack Technical Overview



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PHY based on 802.15.4g

- OFDM and FSK modulations, data rates, and regions

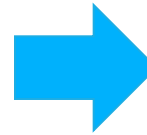
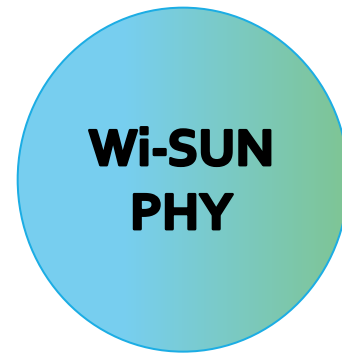
Wi-SUN PHY Overview



Wi-SUN PHY For FAN

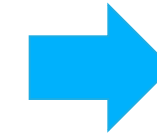


- FAN 1.0 – FSK: data rates to 300 kbps
- FAN 1.1 – FAN 1.0 + OFDM : data rates to 2.4Mbps



SUN FSK

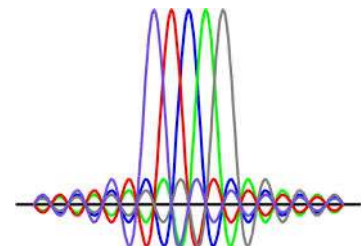
- Multi data rates up to 300 kbps
- Robust error correction



SUN OFDM

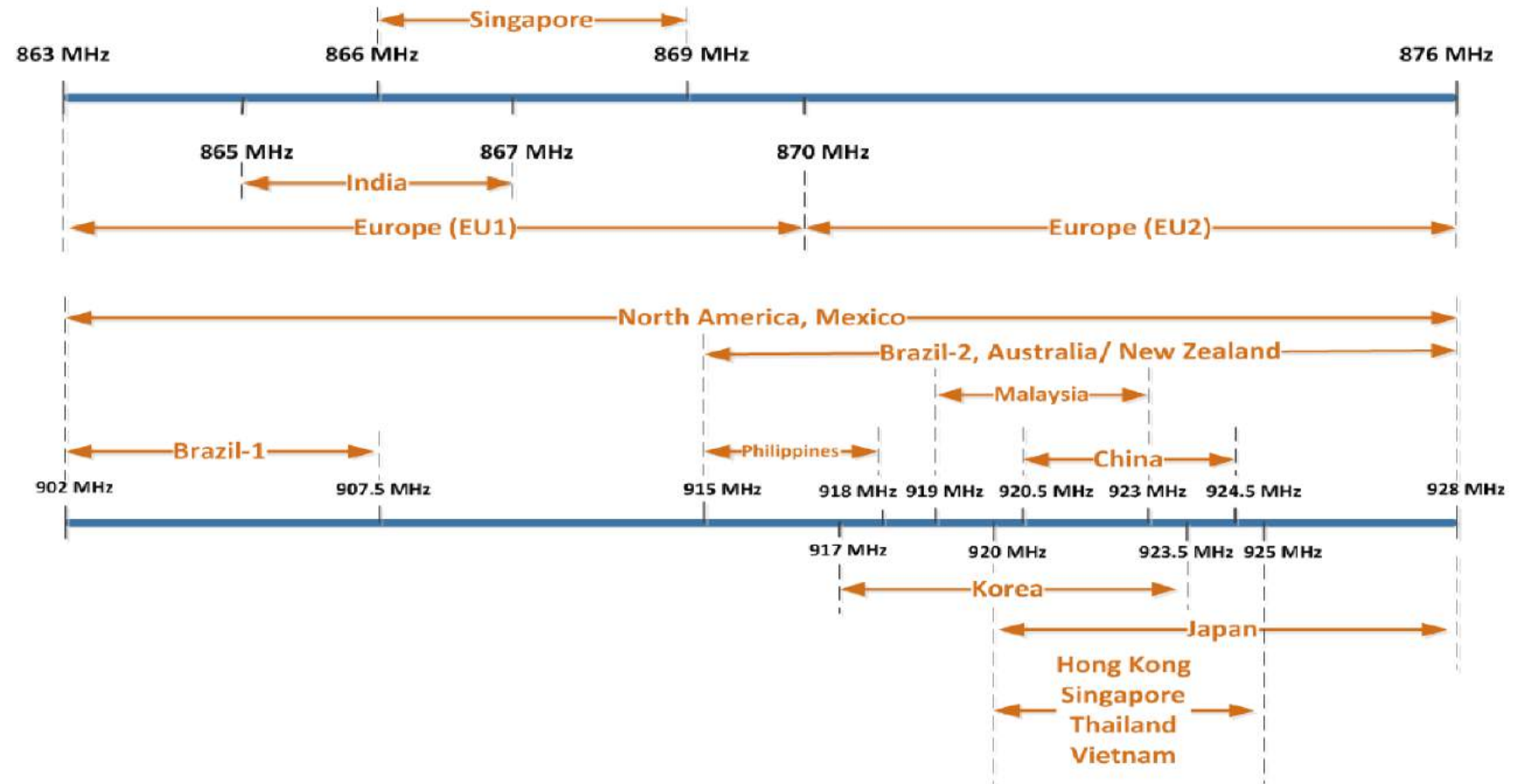
- Data rates support up to 2.4 Mbps
- high spectrum efficiency

- Global Regional frequency bands support
- Flexible Channel Plan usage
- Optional forward error correction
- Robust RF requirements to mitigate interference



Wi-SUN PHY

Global Spectrum



- Multi regional spectrum support provided by same radio/silicon
- Simplified PHY certification and interoperability



Wi-SUN FAN v1.0 TBC Introductory Webinar

March 22, 2022



QualityLogic

About QualityLogic



A Wi-SUN Alliance Test Tool Partner

QualityLogic's Role in the Smart Energy Industry

■ QualityLogic focuses on DER Communications Testing and Certification

- IEEE 2030.5, OpenADR (Approved Certification Test Tools), UL 1741 SB, Wi-SUN FAN Routers
- Standards Training & Consulting

■ QualityLogic is a Contributor to Standards Development

- Member of Wi-SUN Test and Certification Work Group
- Member of IEEE 1547 Work Group, UL 1741 STP
- Member of IEEE 2030.5 Work Group
- Member of SunSpec IEEE 2030.5 Profile Work Group

■ Active in Other Standards and Certification Program Development

- UL 3001, CSIP, SAE, OpenADR, MESA-DER, UL 1741 SC, SunSpec/SAE J3072 Profile for IEEE 2030.5



Test Lab Partners

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eurofins

TELEC Empower the wave!

CSA
GROUP™

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ENGINEERING LABORATORY, INC.

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SGS

UL

- *These are leading independent certification labs in the world.*
- *They rely on QualityLogic for training, test automation tools and support*

A Few Smart Grid Customers



The FAN V1.0 TBC Product

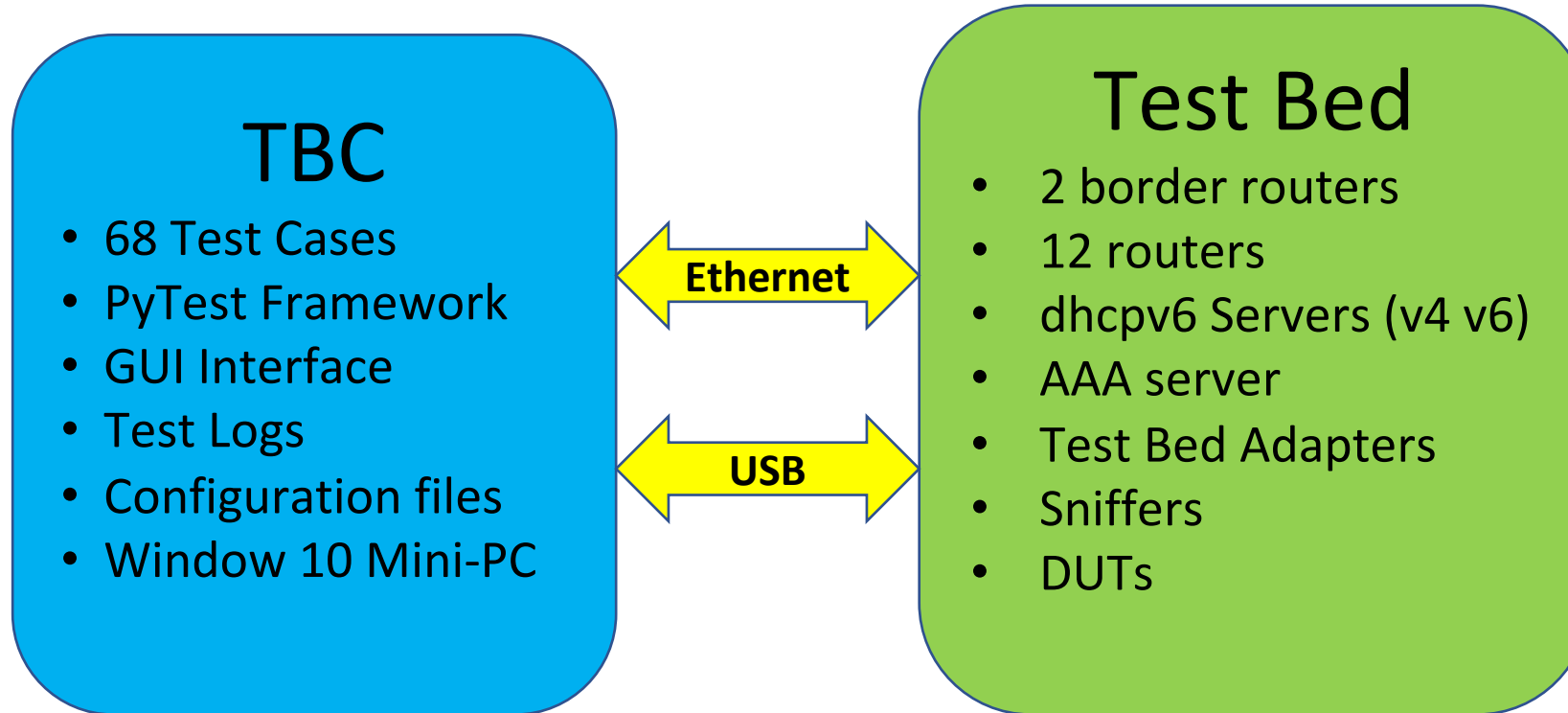


For Pre-certification and Certification Testing of FAN Routers

FAN 1.0 Certification Methodology

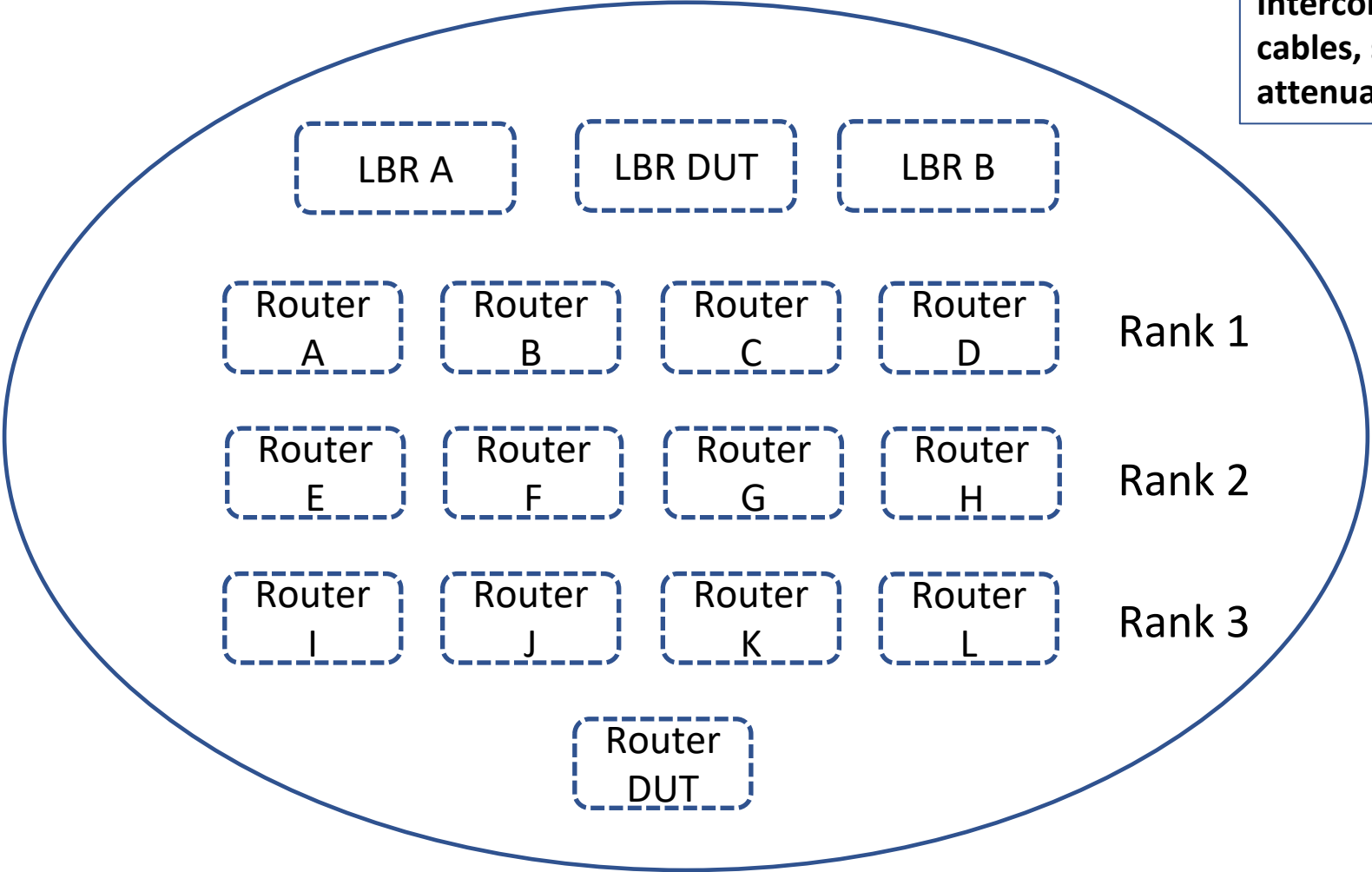
- **Observe the DUT (router or BR) interoperate with other certified routers (TBUs) in a controlled test bed environment**
- **The TBUs can be configured and controlled using a Wi-SUN test API hosted on a server (TBAs) provided by each certified device vendor**
- **The Test Bed Controller (TBC) utilizes the APIs to create test scenarios that force the DUT through permutations of startup and normal operations behaviors**
- **Traffic is captured via over the air sniffers and the API traffic subscription functionality**
- **The TBC validates that each test scenario completes its expected execution flow, and that sufficient captured traffic is available to do conformance analysis**
- **Captured traffic is analyzed for conformance by the test operator**

Big Picture

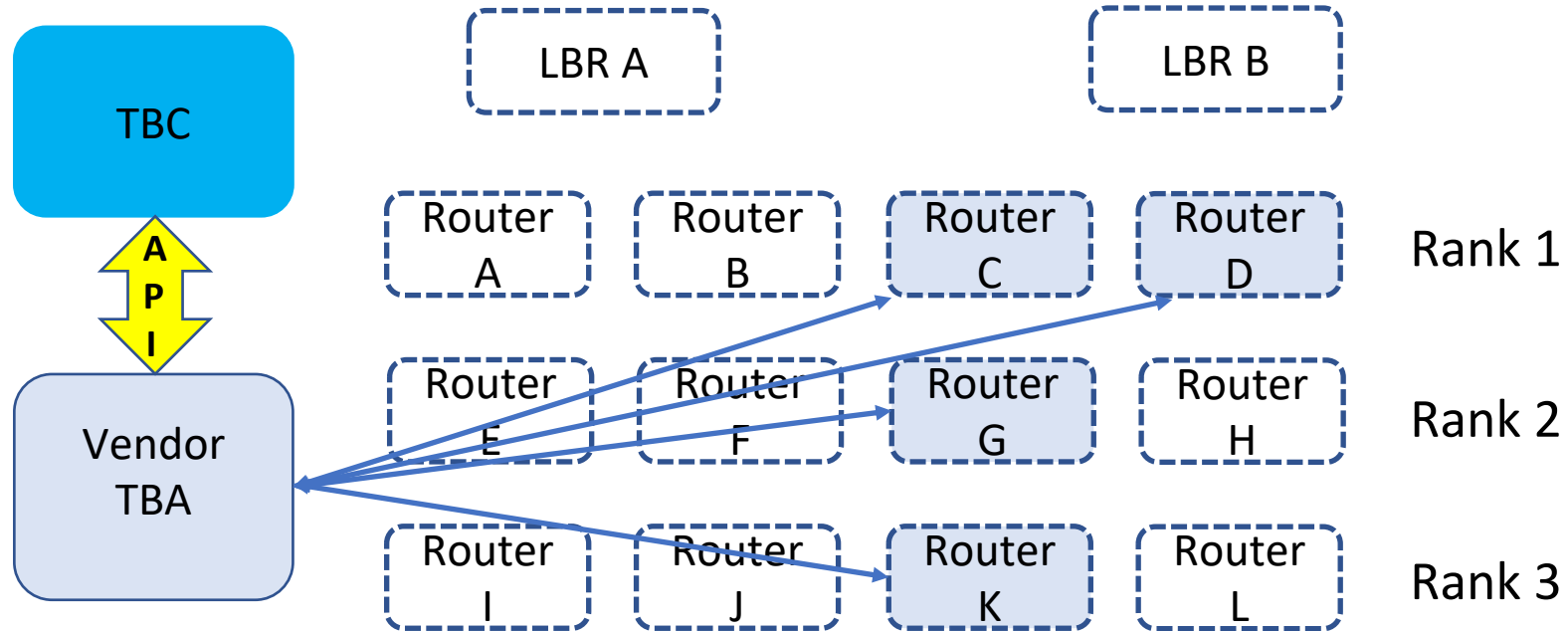


Test Bed Overview

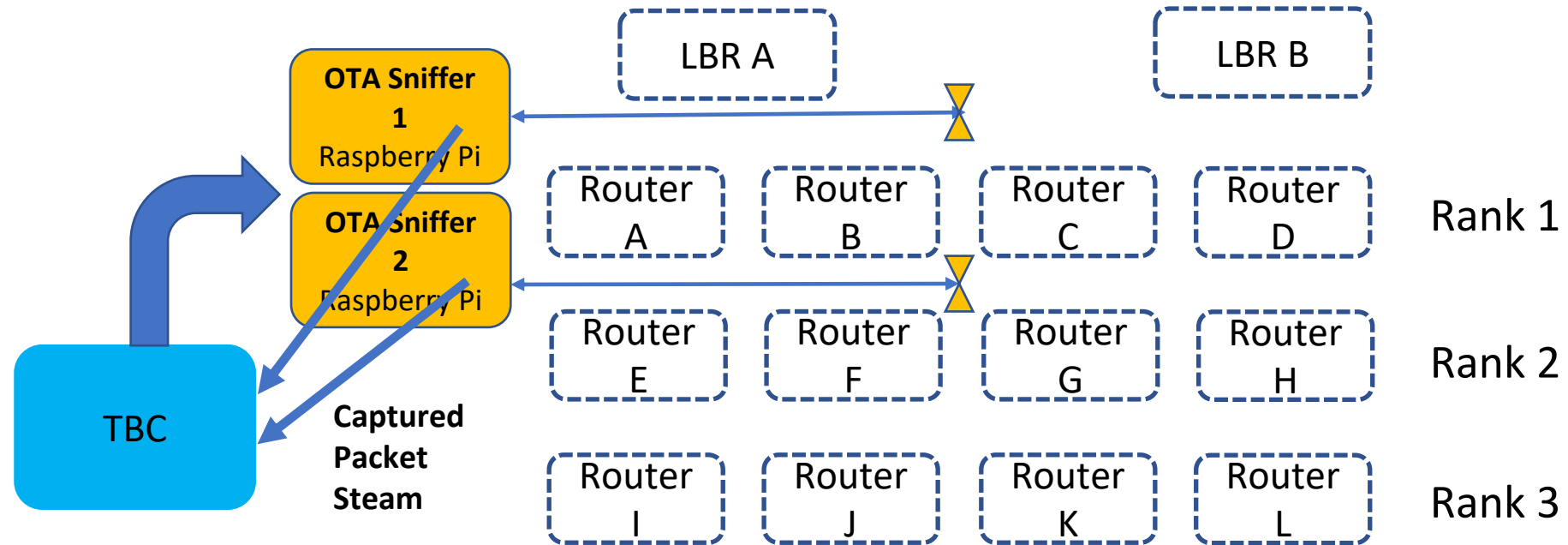
Interconnected via RF
cables, splitters, and
attenuators



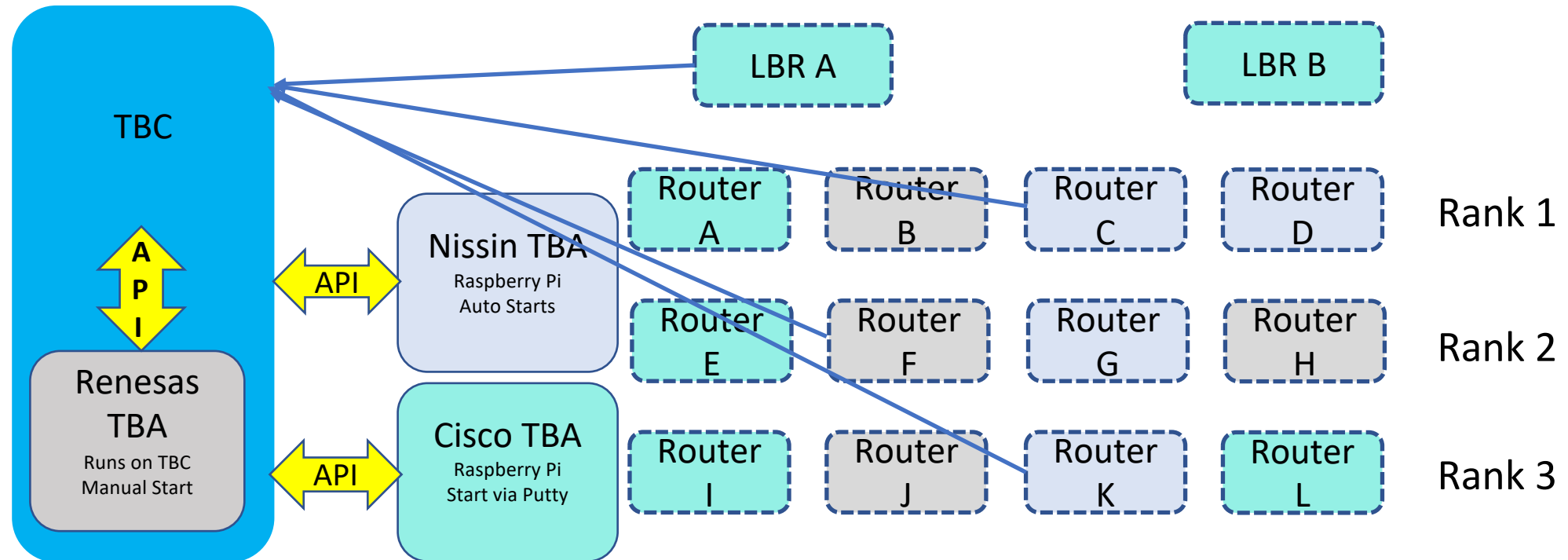
API and Test Bed Adapter



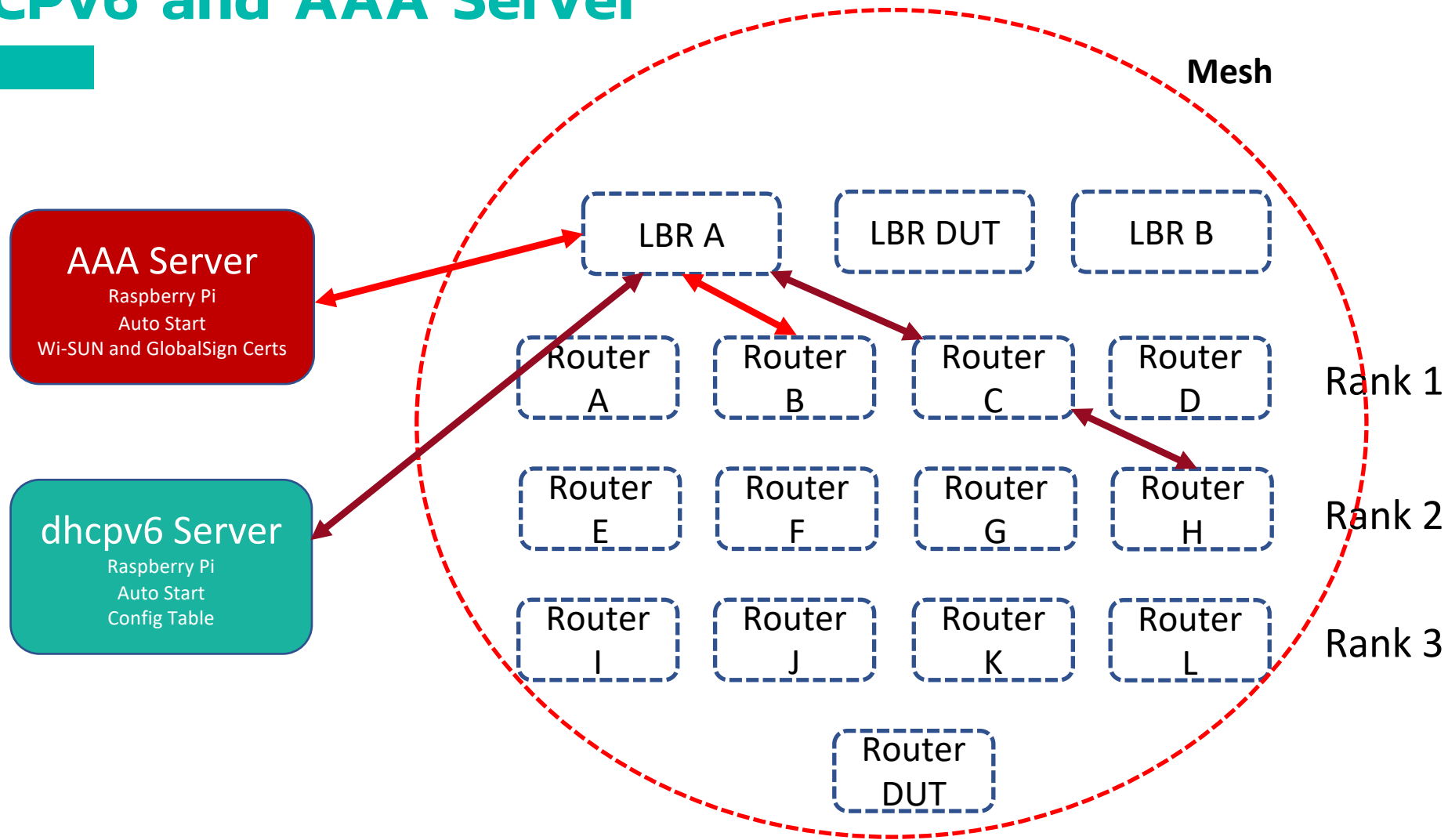
Over the Air Sniffers

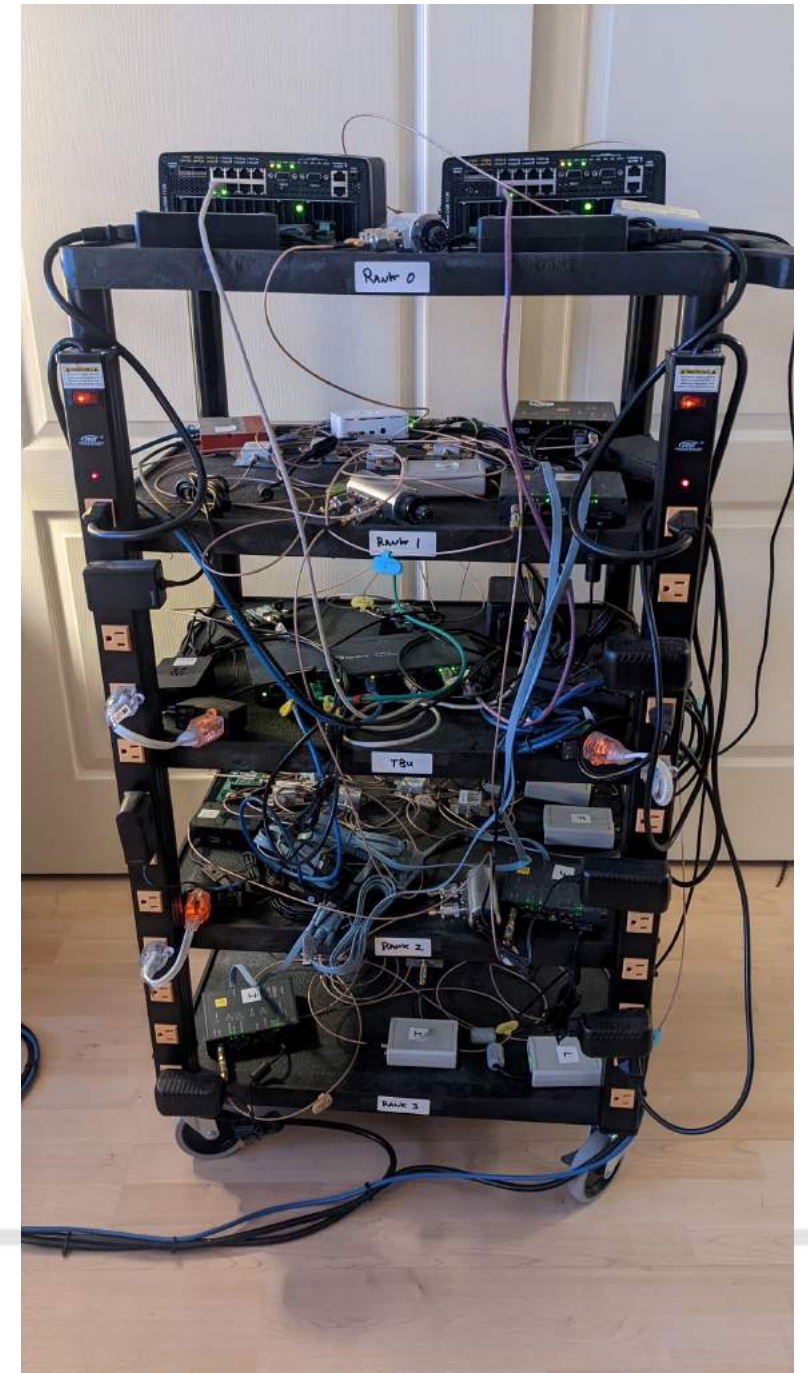
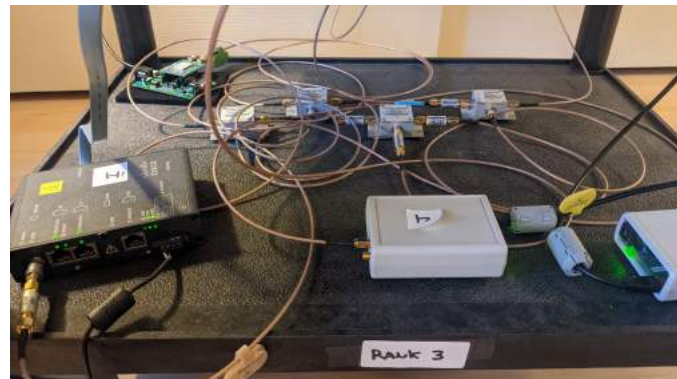
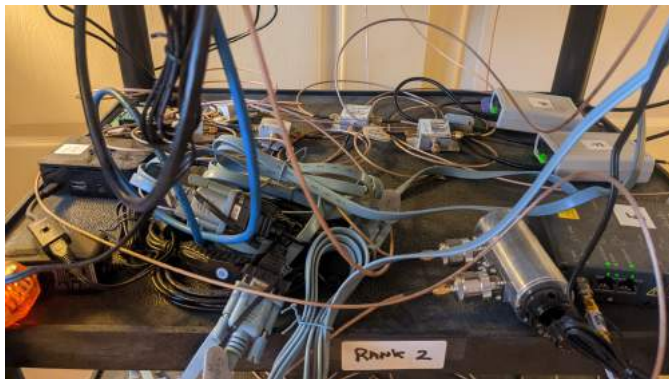


Traffic Subscriptions



DHCPv6 and AAA Server





Test Bed Controller (TBC)



- **The TBC is what QualityLogic sells.**

- Customer's build their own test bed based on Wi-SUN's formal documentation.
- QualityLogic offers a service to assist with this process.

- **TBC Key Features**

- 68 test cases as defined in the Wi-SUN FAN 1.0 certification and interop test specifications
- GUI and command line interfaces for test execution
- Capture of OTA, router subscription, and API traffic
- Test case Python scripts are viewable and editable (for debugging)
- Provisions for fully automated regression testing if DUT support Wi-SUN API
- Documentation, videos, and utilities to assist with TBC integration into your test bed

Live Demo of the TBC

C:\Windows\system32\cmd.exe

```
01:48.421 inf conLog.txt: config_dodag_routes_get (LBR-A)
02:21.015 inf conLog.txt: config_dodag_routes_get (LBR-A)
02:53.921 inf conLog.txt: config_dodag_routes_get (LBR-A)
03:26.812 inf conLog.txt: config_dodag_routes_get (LBR-A)
03:29.249 inf conLog.txt: Found Address: 2020:ABCD::DEAD:BEEF:2
03:29.249 inf conLog.txt: All addresses found
03:29.249 inf conLog.txt: *** Enable Test Case Routers ***
03:29.249 inf conLog.txt: subscription_frames_put (Router-E) {'fwdAddress': '192.168.0.100', 'fwdPort': 9019, 'subscripti
03:29.359 inf conLog.txt: run_mode_mode_put (Router-E) (1)
03:29.390 inf conLog.txt: Confirm Step 3, PAN Advertisement sent by DUT...
03:29.390 inf conLog.txt: Searching for frame.wpan.wisun_uttie_type=='1' in OTA wpan.src64 == 00:17:3b:00:00:00:05 tra
txt: Found frame.wpan.wisun_uttie_type=='1' in packet 73
txt: Searching for frame.wpan.wisun_uttie_type=='0' in OTA wpan.src64 == 74:90:50:00:00:00:02 tra
txt: Found frame.wpan.wisun_uttie_type=='0' in packet 76

txt: Stopping capture of rank1 OTA traffic...
txt: Setting testcase routers to run mode zero...
txt: Group subscription stop...
txt: Stopping subscription on Router-E
txt: Stopping subscription on LBR-A
txt: Stopping subscription on Router-DUT
txt: Pausing 10 seconds
```

Analyze Statistics Telephony Wireless Tools Help

Wi-SUN GUI

| | Destination | Dest Port | Protocol | Length | Info |
|-------------------|-------------------------|-----------|----------|--------|--|
| 00:00:00:00:00:02 | f4:db:e6:10:00:39:3b:11 | | Wi-SUN | 42 | PAN Advertisement Solicit, Netname: WISUN PAN |
| 00:00:00:00:00:02 | f4:db:e6:10:00:39:3b:11 | | EAPOL | 168 | Key (Request) |
| 00:00:00:00:00:02 | f4:db:e6:10:00:39:3b:11 | | Wi-SUN | 30 | Acknowledgment |
| 00:00:00:00:00:02 | f4:db:e6:10:00:39:3b:11 | | EAP | 64 | Response, Identity |
| 00:00:00:00:00:02 | f4:db:e6:10:00:39:3b:11 | | Wi-SUN | 30 | Acknowledgment |
| 00:00:00:00:00:02 | f4:db:e6:10:00:39:3b:11 | | TLSv1.2 | 152 | Client Hello |
| 00:00:00:00:00:02 | f4:db:e6:10:00:39:3b:11 | | Wi-SUN | 30 | Acknowledgment |
| 00:00:00:00:00:02 | f4:db:e6:10:00:39:3b:11 | | EAP | 64 | Response, TLS EAP (EAP-TLS) |
| 00:00:00:00:00:02 | f4:db:e6:10:00:39:3b:11 | | Wi-SUN | 30 | Acknowledgment |
| 00:00:00:00:00:02 | f4:db:e6:10:00:39:3b:11 | | TLSv1.2 | 858 | Certificate, Client Key Exchange, Certificate Verify, Ch |
| 00:00:00:00:00:02 | f4:db:e6:10:00:39:3b:11 | | Wi-SUN | 30 | Acknowledgment |
| 00:00:00:00:00:02 | f4:db:e6:10:00:39:3b:11 | | EAP | 64 | Response, TLS EAP (EAP-TLS) |
| 00:00:00:00:00:02 | f4:db:e6:10:00:39:3b:11 | | Wi-SUN | 30 | Acknowledgment |
| 00:00:00:00:00:02 | f4:db:e6:10:00:39:3b:11 | | Wi-SUN | 30 | Acknowledgment |
| 00:00:00:00:00:02 | f4:db:e6:10:00:39:3b:11 | | EAPOL | 153 | Key (Message 4 of 4) |
| 00:00:00:00:00:02 | f4:db:e6:10:00:39:3b:11 | | Wi-SUN | 30 | Acknowledgment |
| 00:00:00:00:00:02 | f4:db:e6:10:00:39:3b:11 | | EAPOL | 153 | Key (Message 4 of 4) |
| 00:00:00:00:00:02 | f4:db:e6:10:00:39:3b:11 | | Wi-SUN | 30 | Acknowledgment |
| 00:00:00:00:00:02 | f4:db:e6:10:00:39:3b:11 | | EAPOL | 153 | Key (Group Message 2 of 2) |
| 00:00:00:00:00:02 | f4:db:e6:10:00:39:3b:11 | | Wi-SUN | 30 | Acknowledgment |
| 00:00:00:00:00:02 | f4:db:e6:10:00:39:3b:11 | | EAPOL | 153 | Key (Group Message 2 of 2) |
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| 00:00:00:00:00:02 | f4:db:e6:10:00:39:3b:11 | | EAPOL | 153 | Key (Group Message 2 of 2) |
| 00:00:00:00:00:02 | f4:db:e6:10:00:39:3b:11 | | Wi-SUN | 44 | PAN Configuration Solicit, Netname: WISUN PAN |
| l_link | lbrA_link | | ICMPv6 | 86 | Neighbor Solicitation for fe80::f6db:e610:39:3b11 |
| 00:00:00:00:00:02 | f4:db:e6:10:00:39:3b:11 | 547 | DHCPv6 | 114 | Solicit XID: 0x4ee435 CID: 000300074905000000000002 |
| 00:00:00:00:00:02 | f4:db:e6:10:00:39:3b:11 | | Wi-SUN | 36 | Acknowledgment |
| l_gua | lbrA_gua | | ICMPv6 | 118 | Neighbor Solicitation for fe80::f6db:e610:39:3b11 |
| 00:00:00:00:00:02 | f4:db:e6:10:00:39:3b:11 | | ICMPv6 | 155 | RPL Control (Destination Advertisement Object) |
| 30 116.178681 | 74:90:50:00:00:00:00:02 | | Wi-SUN | 36 | Acknowledgment |
| 31 125.605281 | 74:90:50:00:00:00:00:02 | | Wi-SUN | 51 | PAN Advertisement, Routing Cost: 128, Netname: WISUN PAN |
| 32 130.514344 | 74:90:50:00:00:00:00:02 | | Wi-SUN | 101 | PAN Configuration, PAN Version: 12700 |
| 33 137.856235 | routerB_link | ff02::1a | ICMPv6 | 149 | RPL Control (ODDAG Information Object) |
| 34 147.458595 | 00:17:3b:00:00:00:00:05 | | Wi-SUN | 44 | PAN Advertisement Solicit, Netname: WISUN PAN |
| 35 148.611843 | 74:90:50:00:00:00:00:02 | | Wi-SUN | 101 | PAN Configuration, PAN Version: 12700 |
| 36 160.601706 | 74:90:50:00:00:00:00:02 | | Wi-SUN | 51 | PAN Advertisement, Routing Cost: 128, Netname: WISUN PAN |

Wi-SUN TBC GUI

File Edit View Tools Help

- ☐ Test_BR_DIRECT_EXC_CHAN_SEND_LBR_2py
- ☐ Test_BR_DIRECT_HASH_HOP_LBR_1py
- ☐ Test_BR_DIRECT_MIXED_DWELL_LBR_1py
- ☐ Test_BR_DIRECT_SHORT_DWELL_LBR_1py
- ☐ Test_BR_INTEROP_MULTICAST_GROUP_FWD_L
- ☐ Test_BR_INTEROP_UNICAST_DST_LBR_1py
- ☐ Test_BR_MULTICAST_GROUP_FWD_LBR_1py
- ☐ Test_BR_MULTICAST_NONGROUP_FWD_LBR_1
- ☐ Test_BR_MULTICAST_ORIGINATOR_LBR_1py
- ☐ Test_BR_PAN_KEY_TLS_11py
- ☐ Test_BR_PAN_KEY_TLS_2py
- ☐ Test_BR_PAN_KEY_TLS_4py
- ☐ Test_BR_PAN_KEY_TLS_6py
- ☐ Test_BR_PAN_KEY_TLS_8py
- ☐ Test_BR_PAN_PA_SELECT_2py
- ☐ Test_BR_POWERCYCLE_LBR_1py
- ☐ Test_BR_ROLL_RPL_ROOT_1py
- ☐ Test_BR_SEC_UFECYCLE_2py
- ☐ Test_BR_UNICAST_DST_DFE_LBR_1py
- ☐ Test_BR_UNICAST_FWD_DFE_LBR_1py
- ☐ Test_BR_UNICAST_FWD_EDFE_LBR_1py
- ☐ Test_R1_DHCPv6_RELAY.py
- ☐ Test_R1_INTEROP_UNICAST_DST_2py
- ☐ Test_R1_MULTICAST_GROUP_FWD_1py
- ☐ Test_R1_MULTICAST_NONGROUP_FWD_1py
- ☐ Test_R1_MULTICAST_ORIGINATOR_1py
- ☐ Test_R1_PAN_KEY_TLS_1py
- ☐ Test_R1_PAN_KEY_TLS_12py
- ☐ Test_R1_PAN_KEY_TLS_13py
- ☐ Test_R1_PAN_KEY_TLS_3py
- ☐ Test_R1_PAN_KEY_TLS_5py
- ☐ Test_R1_PAN_KEY_TLS_9py
- ☐ Test_R1_PAN_PA_SELECT_1py
- ☒ Test_R1_PAN_PA_SELECT_3py
- ☐ Test_R1_PAN_PA_SELECT_4py
- ☐ Test_R1M_DHCPv6_CLIENT.py
- ☐ Test_R2_5LD_ND_NET_1py
- ☐ Test_R2_BROADCAST_DIRECT_HOP_1py
- ☐ Test_R2_BROADCAST_DIRECT_HOP_2py
- ☐ Test_R2_BROADCAST_DIRECT_HOP_3py
- ☐ Test_R2_DIRECT_EXC_CHAN_LISTEN_1py
- ☐ Test_R2_DIRECT_EXC_CHAN_SEND_1py

Test Case Listing Test Progress Report Section Number Map

*** Test Result Summary ***
c:\temp\test_logs_20220216-104413
PASS: Test_R1_PAN_PA_SELECT_3py test case
*** Pytest Stopped ***

Starting PyTest.
Test execution process stopped

Repeat

1

Run

1 Tests Selected

Final Thoughts



- **The Wi-SUN TBU API opens-up the opportunity to extend the TBC beyond its role as a conformance test execution tool.**
- **If a larger population of routers supported the Wi-SUN API, the TBC could be enhanced to support automated interoperability testing....**
 - Support for an arbitrary number of vendors TBU units
 - Dynamic control of traffic patterns and modulations
 - Dynamic control antenation between routers
 - More diverse traffic types
 - Etc.

Getting the TBC



FAN V1.0 Test Bed Controller



- **Commissioned by Wi-SUN Alliance as a joint Wi-SUN-QualityLogic development project**
 - Goal to make the TBC Controller available at reasonable pricing to accelerate Wi-SUN technology adoption
- **The IP is owned by the Alliance but distributed and supported by QualityLogic**
 - The TBC is available directly from QualityLogic

Getting the TBC



- **The QualityLogic Wi-SUN FAN v1.0 Test Bed Controller is available from QualityLogic**
 - Comes installed on a pre-configured micro-PC that can be plugged into your Test Bed
 - For more information see [Wi-SUN Test Tools – QualityLogic](#)
- **TBC is licensed in perpetuity with an annual Maintenance Contract that gets free or discounted updates**
- **The TBC is priced reasonably, and Wi-SUN Contributor Members receive a significant price discount**
 - Pricing is set to provide a significant benefit to Contributor Members while
 - Encouraging companies to become Contributor Members
- **The TBC comes with**
 - 2-hours of free technical support from QualityLogic in the first 60 days
 - Free updates for 60 days after licensing – after that a Maintenance Contract is required for updates

Turnkey FAN v1.0 Test Bed

- **The FAN v1.0 certification Test Bed is complex to build and includes over 40 (including 14 routers) components that must be assembled and tested to operate correctly.**
 - Test Bed routers and components periodically updated/replaced
- **QualityLogic provides a Wi-SUN FAN v1.0 Turnkey Test Bed as a service.**
 - Includes procurement, pre-assembly configuration and testing, shipping, and support for re-assembling and
 - Shippable globally and with detailed instructions on assembly, operation, and troubleshooting.
 - Initial start-up support.
- **A QualityLogic Turnkey Wi-SUN Test Bed conforms to the most current version of the FANWG Certification Test Bed Specification.**
- **For more information contact info@qualitylogic.com**