Introduction to Thread

Sujata Neidig, VP Marketing Thread Group,
Director of Marketing NXP

September 3, 2020

What is Thread?

Thread is a low power, secure and future-proof mesh networking technology for IoT products.

BUILT FOR IoT

Securely and reliably connect products in homes and buildings

BUILT-IN SECURITY

Provides security at the network layer

LOW ENERGY FOOTPRINT

Based on the power-efficient IEEE 802.15.4 MAC/PHY

OPEN IPv6 BASED PROTOCOL

Provides device-to-device and device-to-cloud connections

SEAMLESS INTEGRATION

Extends the internet into low power end devices

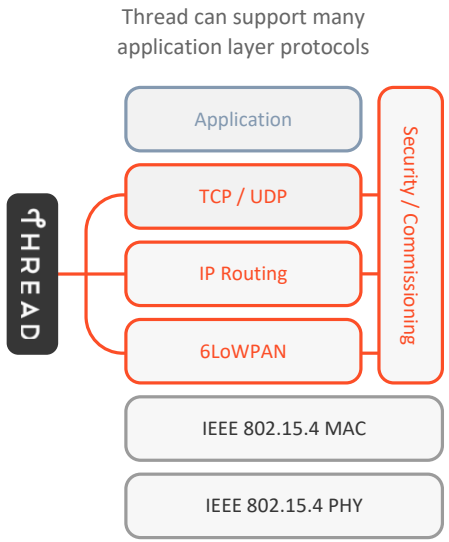
MARKET READY

Broad selection of silicon, stacks and components available globally and active certification program

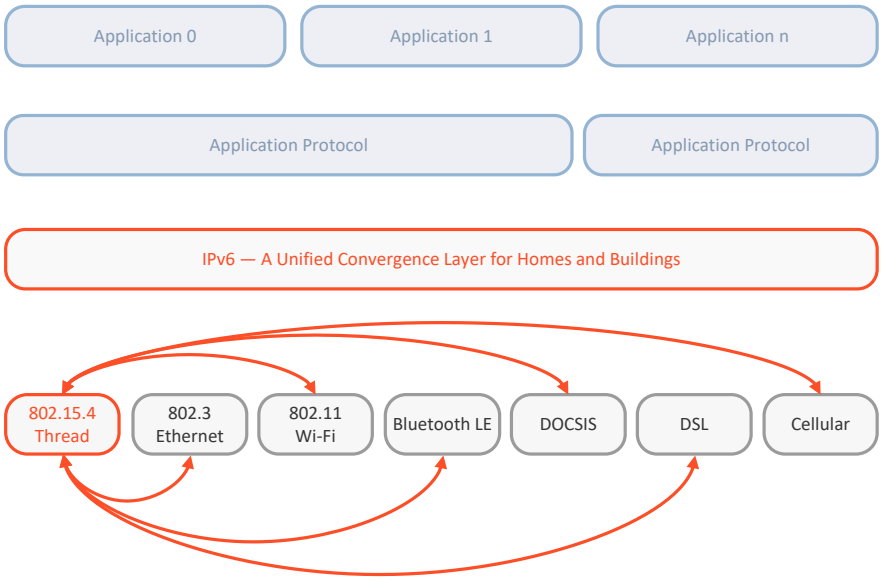
THREAD GROUP | What Thread Delivers

A secure, low power wireless mesh network for connected products in homes and buildings

- Built on proven, widely available and supported technologies
  - Uses IPv6
  - Runs on existing 802.15.4 silicon from multiple providers
- Architected to simply and securely add and remove products, keep communications secret and prove identify
- Tested and trusted to control devices in thousand-person office buildings, simple and affordable enough for a one-room apartment



THREAD GROUP | Thread Is IP



Unified convergence layer across all networks in the home and commercial buildings

- Reuse software stacks

Enables direct device-to-device, device-to-mobile, and device-to-cloud, and one-to-many communication

- Nodes can communicate directly with each other and with multiple apps or backend services

Support for many application layers

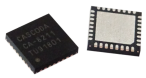
- Any low bandwidth application layer that can run over IPv6 can run over Thread

THREAD | Adoption - Components

Silicon

Stacks

THREAD | Thread Certified Products

Company / Product	Google/Nest	Farm Jenny	Tridonic	WideSky	NXP	Cascoda	Kirale Technologies
							
	Google Nest Wi-Fi Point, Wi-Fi Router, Hub Max	Farm Field Receiver	net4more borderROUTER PoE-Thread, comMODULE un:c-Thread, comMODULE Thread DALI	WideSky Hub	K32W041/61 OpenThread Stack	Cascoda Limited (CA-8211)	KiNOS Thread Stack
Certification Status	BUILT ON THREAD	BUILT ON THREAD	BUILT ON THREAD	BUILT ON THREAD	THREAD CERTIFIED COMPONENT	THREAD CERTIFIED COMPONENT	THREAD CERTIFIED COMPONENT

This is a sample of Thread Certified Products,
for the full list visit www.threadgroup.org

THREAD | **Adoption** - Platforms and Ecosystems

Android Things

ExpressLogic
ThreadX

IoTivity Lite

RIOT OS

Runtime.io

Zephyr

THREAD | Thread Resources

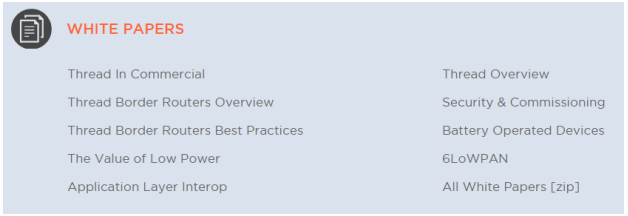
Thread White Papers

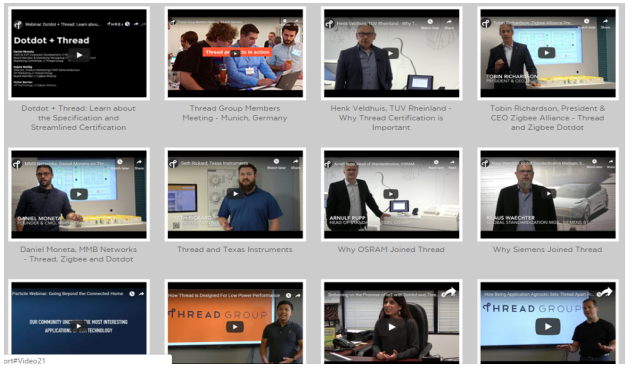
Thread Spec

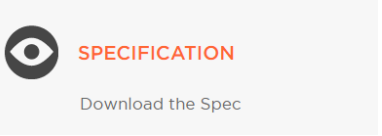
Thread Videos

Thread FAQs

Visit threadgroup.org/developers to see all the stacks, development environments and tools available to get started.





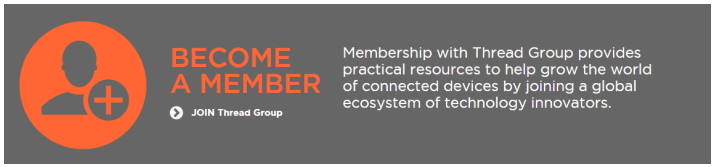


THREAD | Thank You!

Learn more at www.threadgroup.org

SIGN UP FOR OUR NEWSLETTER

- Get started: Smart Home, Commercial, Developer, Case Studies, Resources and Certified Components
- Thread Group Blog



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Thread Group YouTube Channel

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Soltec
Making Tracks,
Building Trust
How to keep your solar plant safe with Google's Full-Wireless OpenThread system
Javier Carpio, General Manager at Soltec Innovations
Jose Alfonso Teruel, CTO at Soltec Innovations
Solar Power World
Soltec INNOVATIONS

How to keep your solar plant safe with Google's Full-Wireless OpenThread system

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Presenter:
Javier Carpio, General Manager at Soltec Innovations

Soltec
INNOVATIONS

OUR HISTORY

2004 Our origin:
Soltec was born in Murcia (Spain), leaded by Raúl Morales, as a photovoltaic projects developer, also doing work as an EPC company.

2011 Launch of Solarfighter:
Soltec launches Solarfighter, a product intended for small-scale household markets. An integrated photovoltaic System for self-consumption.

2012 Creation of SF Utility:
The first large-scale tracker designed to improve costs, being the most competitive tracker on the market, capable of installing on any type of terrain and weather condition.

2013 Chile:
Soltec develops its first project in Latin America: Diego de Almagro (Chile), followed by three other projects in the Atacama desert.

2015 Expanding in Americas:
Soltec establishes factory in Brazil. Opens office and signs its first contract of 150 MW in the U.S. Soltec builds 'La Silla' solar plant (Chile), the first solar tracker specifically designed for bifacial modules installed in a utility scale solar plant.

2016 Keeping the growth:
Soltec developes the biggest project in Brazil in Piauí Region and closes to supply 420 MW between Peru and Mexico, reaching annual sales of +1 GW.

2017 SF7 Launches:
Soltec launches the SF7 single-axis tracker and subsequently the SF7 Bifacial tracker. Solhub is established in headquarters and the indian and australian offices are opened. Furthermore, Soltec expands BoPContracts in Spain up to 90 MW

2018 Asia and Africa expansion:
Soltec closes supply contracts in new markets as Australia, Namibia and Thailand, and keeps expanding market share in Chile, Israel, the U.S. and Brazil, where starts developing 1 GW in EPC projects. With a backlog of 5 GW worldwide, Soltec founds BiTEC (Bifacial Tracker Evaluation Center) in Livemore, CA. Powertis foundation.

2019 Bifacial specialist:
Soltec expands EPC activities in LATAM and Europe, closing up to 3 GW in projects, expanding market in Spain up to 500 MW. Furthermore, developes 2 GW SF7 Bifacial projects worldwide. Powertis starts to develop projects in Brazil of over 700 MW and Soltec Innovations is founded.

OUR COMPANY

Soltec specializes in the manufacture and supply of single-axis solar trackers with global operations and a workforce of over 1600 people, blending experience with innovation.

CURRENT SITUATION

11 GW
Track Record Worldwide

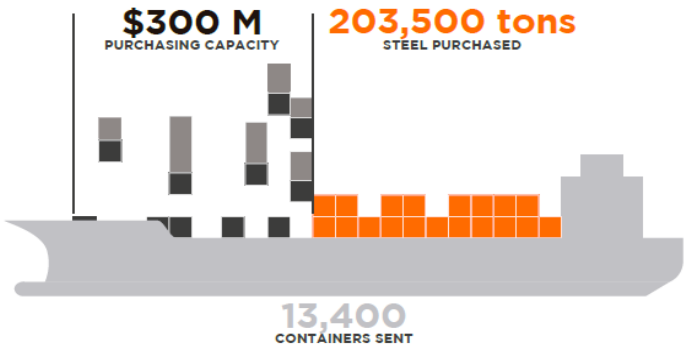
3.6 GW
Solar Trackers Sold 2019

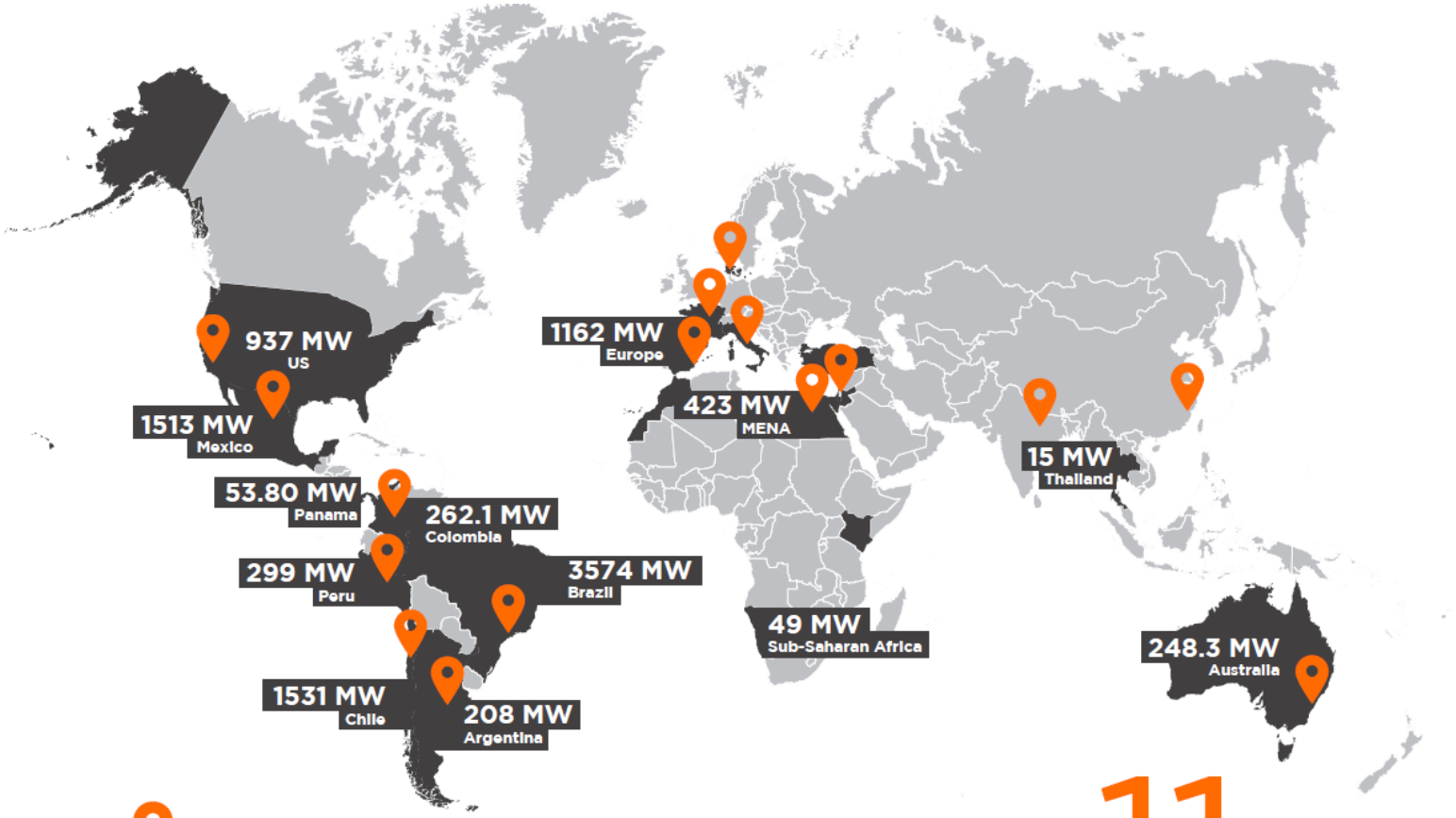
#3
Global Tracker Manufacturer

#1 LATAM
30% Market Share
#2 Europe 18%

FOCUS IN R&D

Investment
Pioneers in 2P configuration
SF7 adaptable to all terrains
First Bifacial Tracker in the world
More than 90 registered patents
Pioneers in wind design validated by RWDI





OUR TEAM

Over **1600 employees** worldwide

11 GW

Track **Record**

How to keep your solar plant safe with Google's Full-Wireless OpenThread system

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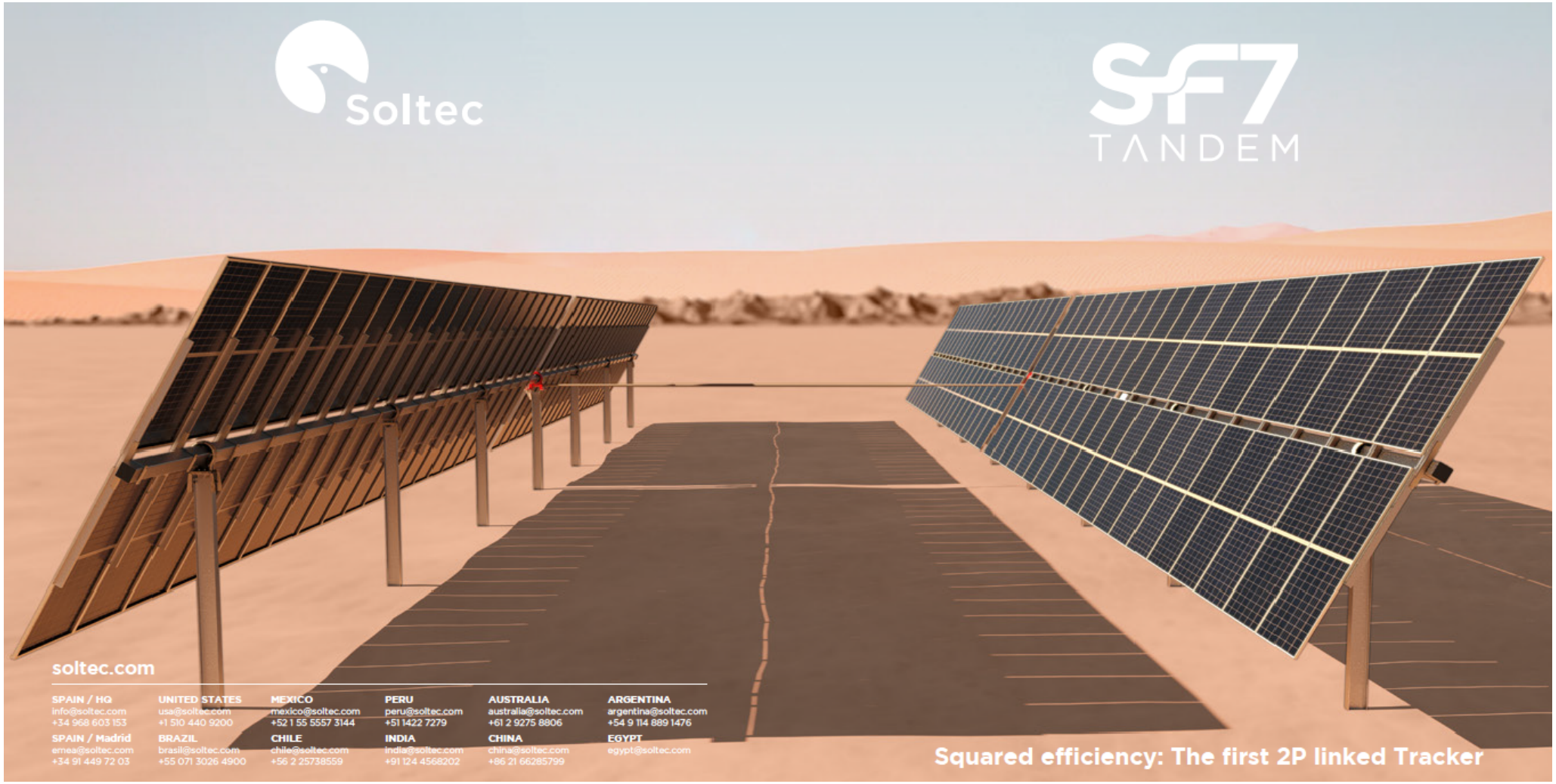


Squared efficiency: The first 2P linked tracker

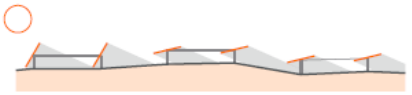
SF7 Tandem combines the best of a 2-portrait tracker with the best of a 2-row tracker resulting in higher efficency, simplicity and reliability.

SF7 TANDEM

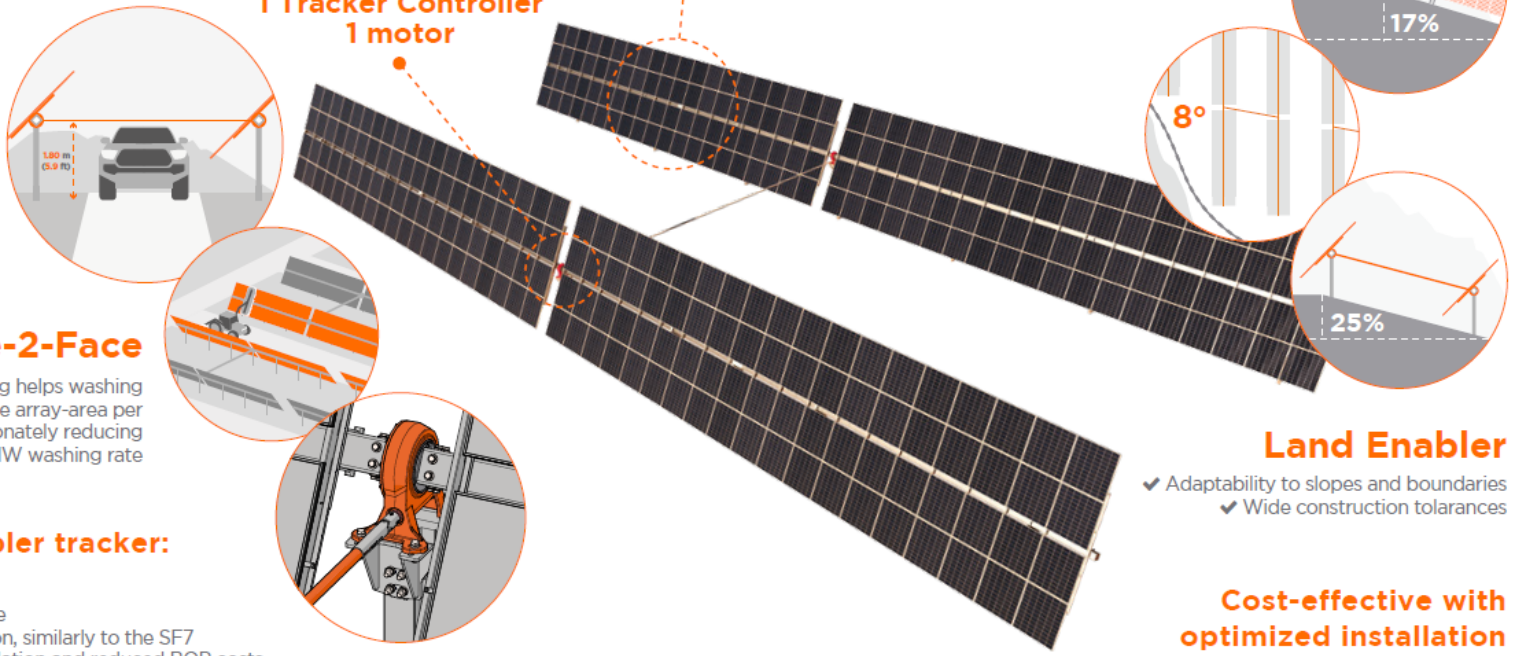
1 Tracker:
2 Slewing-Drives
1 Tracker Controller
1 motor

Same robustness and reliability

- ✔ Self-stow at high tilt angle
- ✔ SPD: Surge Protection Device
- ✔ TMS: Tracker Monitoring System
- ✔ Engineered with the innovative **Dy-Wind** design
- ✔ Independent aisle for less land use and better access
- ✔ 2 drives double torque-blocking capacity for a more safe and robust structure



TeamTrack® Backtracking enabled



Accesible Maintenance

A Cardan shaft conveniently located at **1.8 m (5.9 feet)** eases O&M and ensures system functionality under any weather or terrain circumstances

Face-2-Face

Face-2-Face positioning helps washing vehicles cover twice the array-area per vehicle pass, thus proportionately reducing the hours-per-MW washing rate

Land Enabler

- ✔ Adaptability to slopes and boundaries
- ✔ Wide construction tolarances

Fewer parts, simpler tracker: Higher Efficiency

- ✔ Higher MW installation rate
- ✔ Easier and faster installation, similarly to the SF7
- ✔ Lower material cost, installation and reduced BOP costs
- ✔ Fewer components: **46% fewer piles, 60% fewer screw connections, 20% fewer parts-count** than other 1P dual-row competitors
- ✔ Fewer parts: **50% fewer motors** and **50% fewer Tracker Controllers** than the conventional SF7

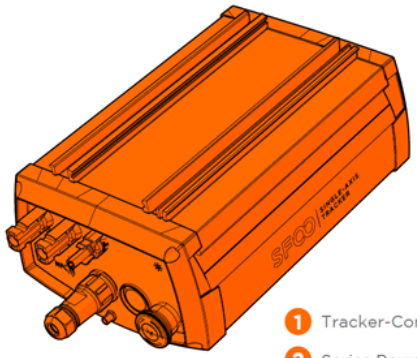
Cost-effective with optimized installation and operation

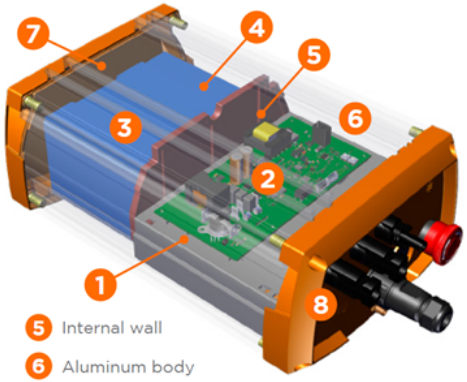
- ✔ Near Field Communication (NFC) at tracker level and Full Wireless Network at plant level, provide robust and cost-effective communication and control operations
- ✔ Self-Powered with PV Series Power Supply 2.0, for lower cost-operational power supply

Soltec

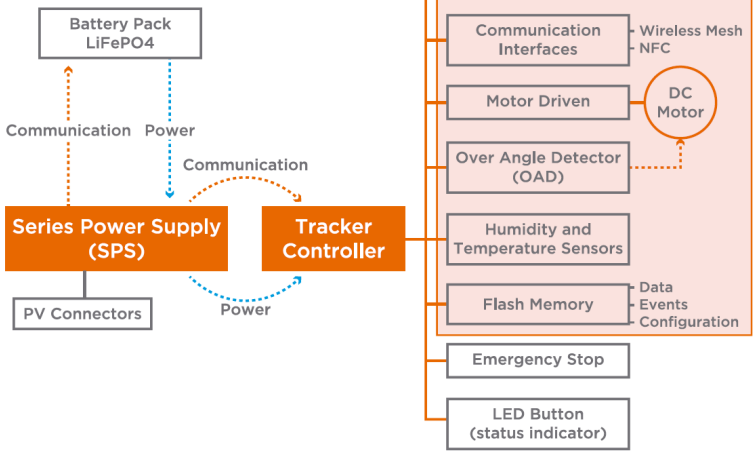
Full-Wireless Solar Tracker Control System

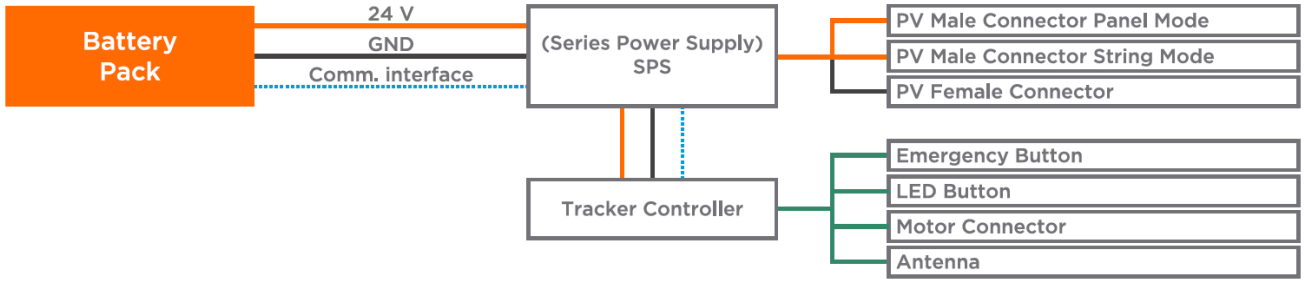
Tracker Control Box





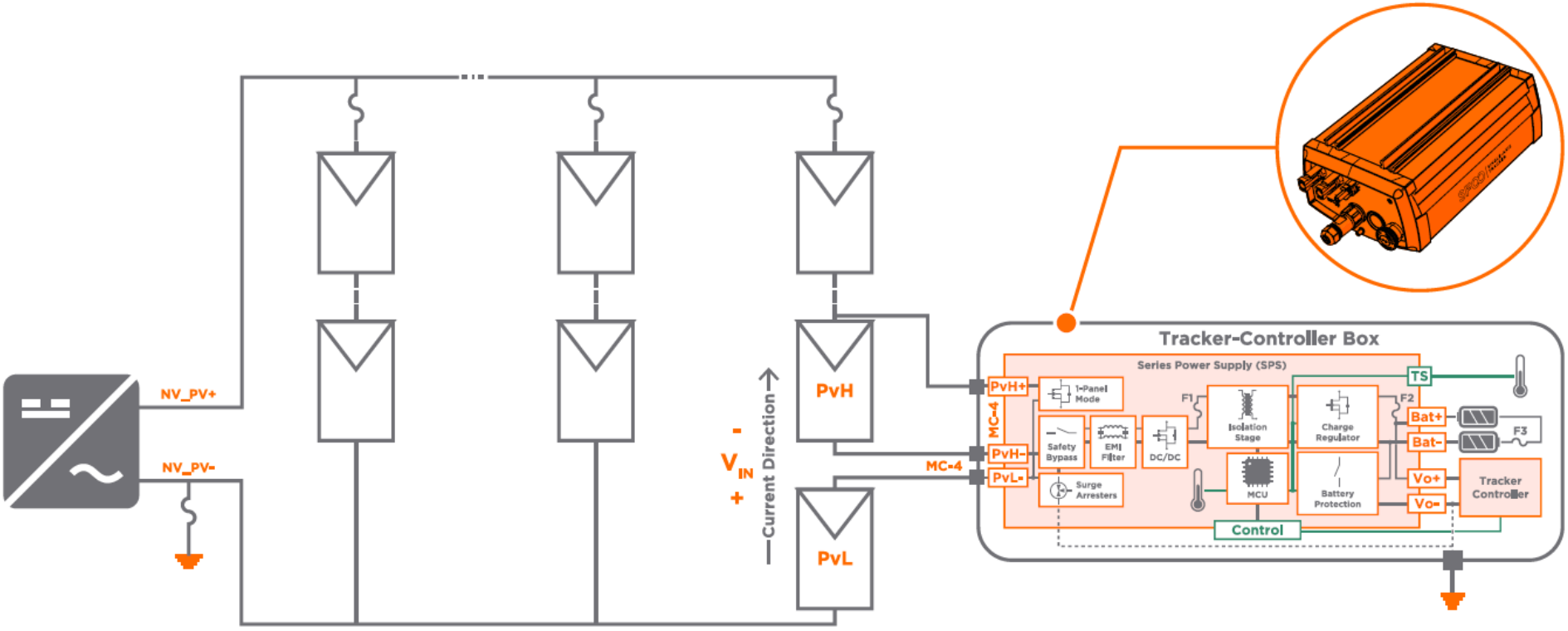
1. Tracker-Controller
2. Series Power Supply
3. Battery bank
4. Temperature sensor
5. Internal wall
6. Aluminum body
7. Rear battery access
8. Front cover with buttons and connectors





Full-Wireless Solar Tracker Control System

Self-Powered Tracker with Series Power Supply (SPS)



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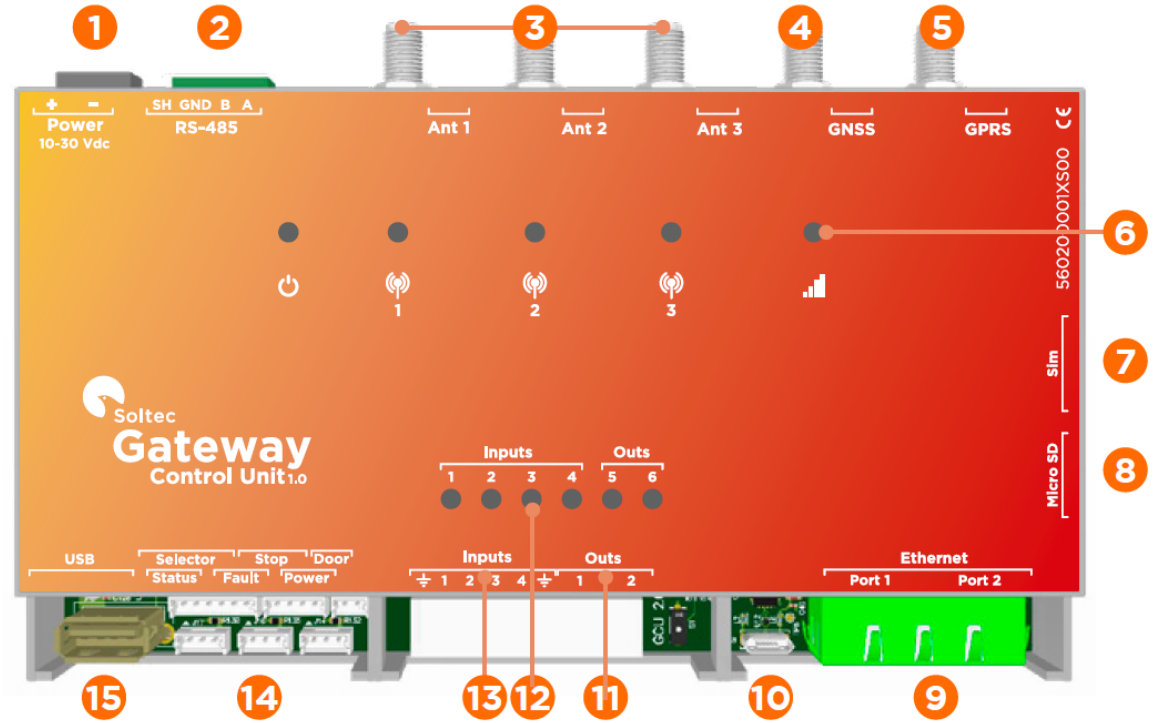
Full-Wireless Solar Tracker Control System

Distributed Control with Gateway Control Unit (GCU)



1. Power
2. RS485
3. Openthread Wireless System Antennas
4. GPS/GNSS Antenna
5. GSM/GPRS Antenna
6. Status LEDs
7. Microsim Card
8. Micro SD Card
9. Ethernet Ports
10. Microusb Debug Port
11. Digital Outputs
12. Digital In/output Status LEDs
13. Digital Inputs
14. Interface Ports
15. USB Port

How to keep your solar plant safe with Google's Full-Wireless OpenThread system

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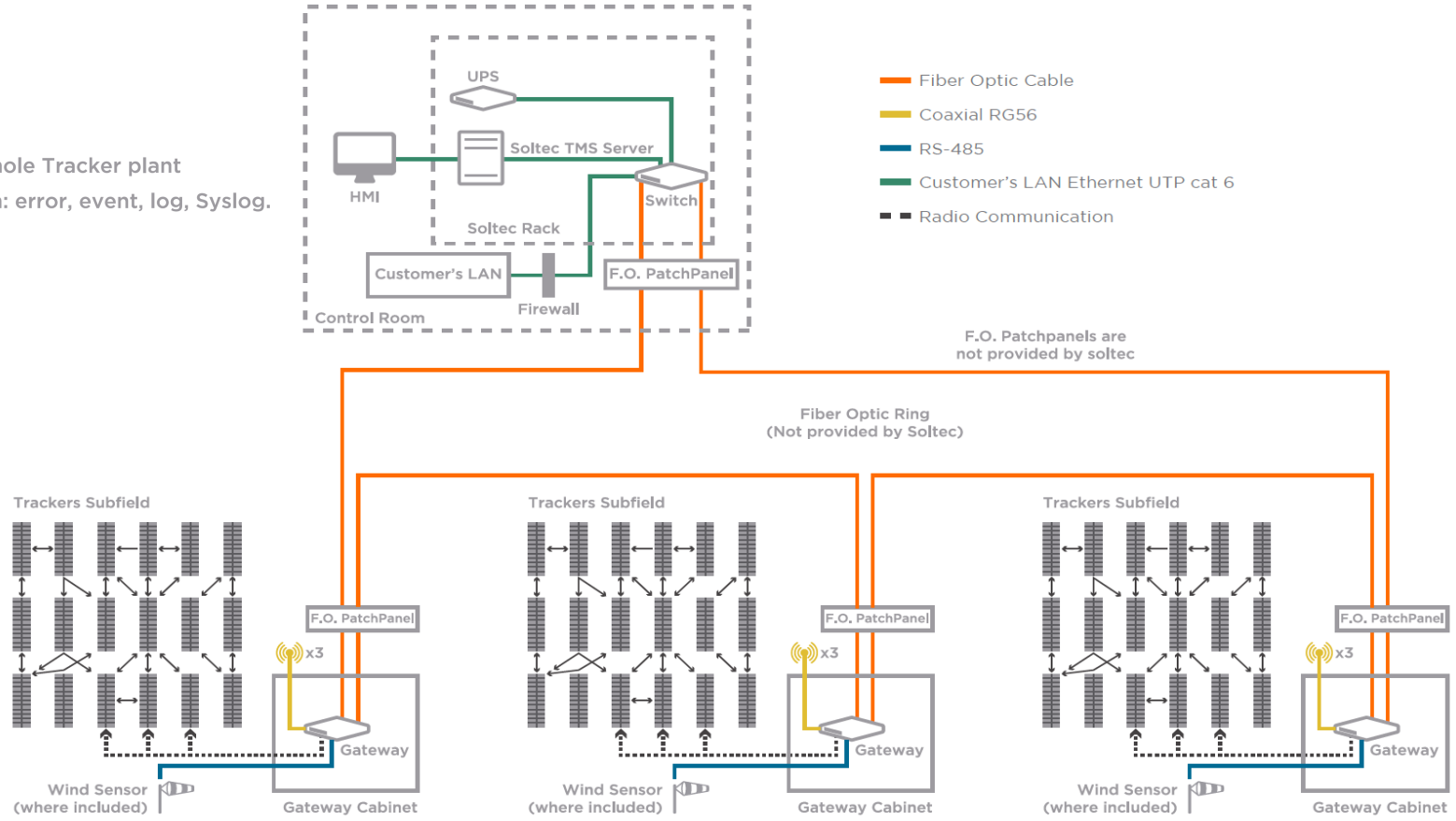
Full-Wireless Solar Tracker Control System

Plant Communications Architecture

TMS

Monitoring of whole Tracker plant
Save information: error, event, log, Syslog.
HMI



Full-Wireless Solar Tracker Control System

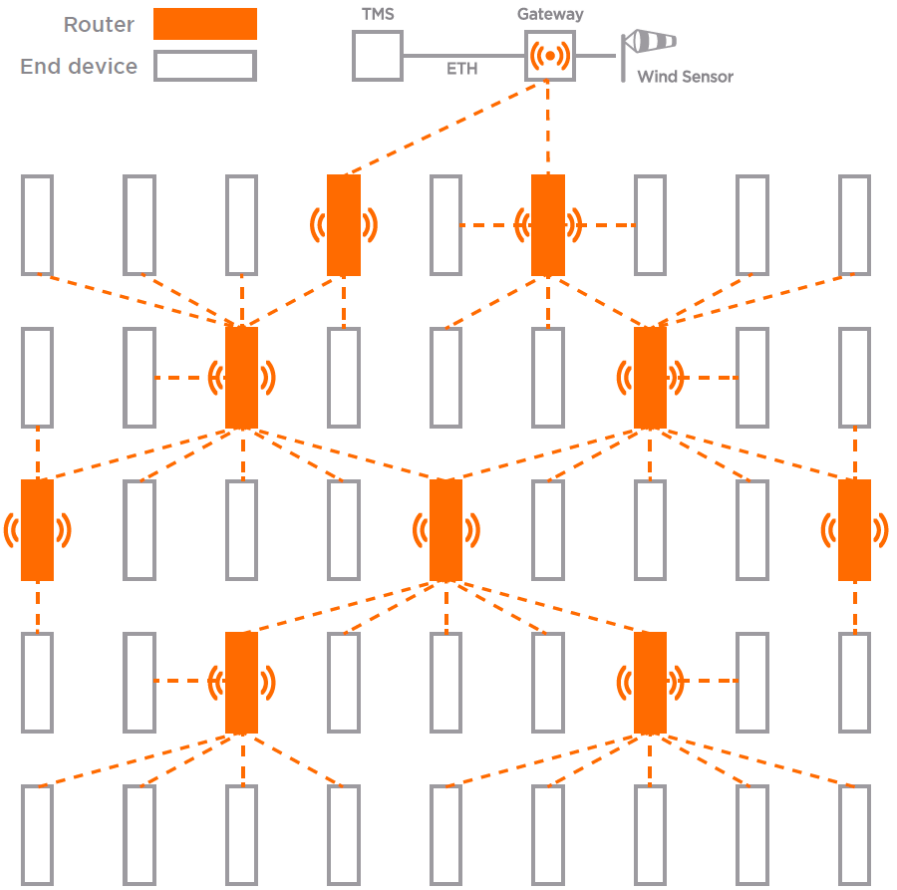
Sub-Field Architecture

Gateways

- Concentrate all information of associated trackers
- Connect with other Gateways to share information
- Creates a cluster of Gateways
- OPC-UA server accessible at each of the Gateways
- Distributed control in each Gateway

Tracker Controller

- Generate a Mesh Network IEEE 802.15.4
- Communicate with Gateways and other Trackers

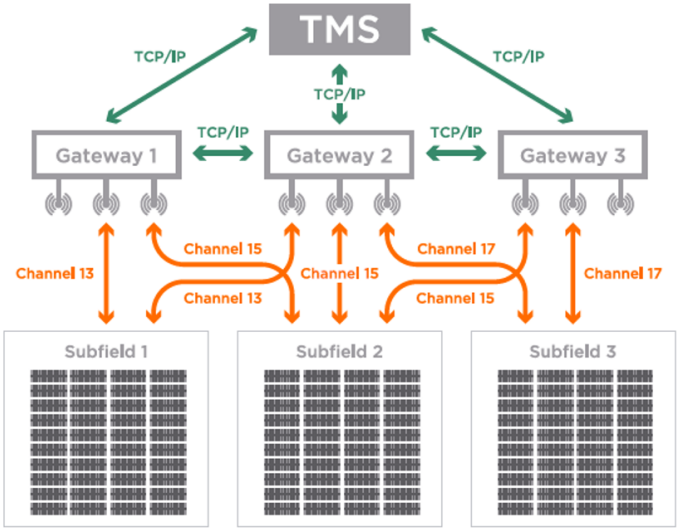


Soltec

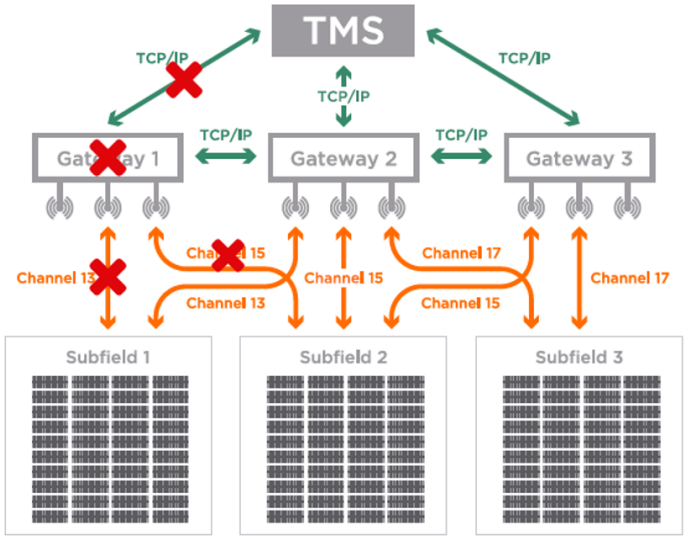
Full-Wireless Solar Tracker Control System

GCU Redundancy Feature

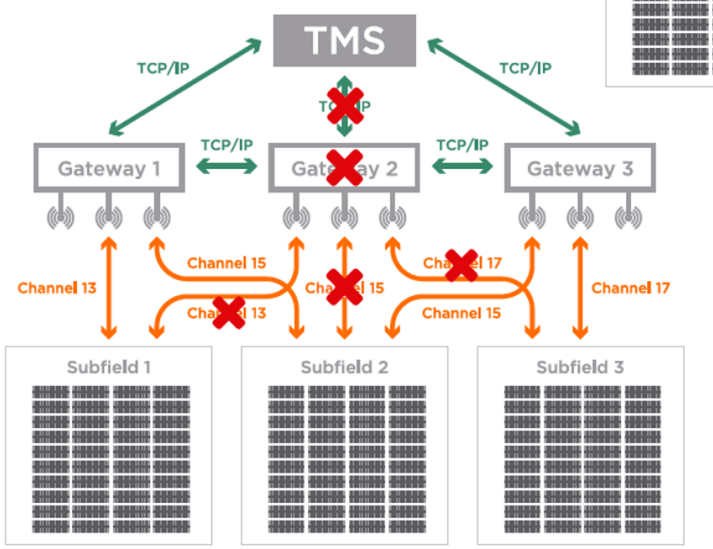
- The Gateway Control Units integrate 3 border routers OpenThread.
- All the GCUs together belong to a cluster of MQTT Brokers.
- All the GCUs share the information in a distributed database.



Normal situation



Gateway 1 failure



Gateway 2 failure

- In case of GCU failure, the closest GCUs take control of the Trackers.
- The assignment of secondary GCUs is configured at plant level and shared within the cluster.

Full-Wireless Solar Tracker Control System

Cybersecurity Features

Network Segmentation

- Independent plant network through dedicated fiber optics and switches.
- Connection to client's network through firewall.
- Logical separation between control system and monitoring system.

Wireless Connection

- Individual identification, authentication and authorization of all users (people, software and devices) with access by wireless connection.
- Wireless communications encrypted with AES-128.
- Authorization, monitorization and application of restrictions to wireless connections.

Redundancy and Resilience

- Redundancy of communication equipment.
- Fiber optics communications cables with reserve fibers dedicated alto to Tracking System.
- Control and communication systems solar powered with dedicated panels and battery backup. They can be also powered from AC power supplies.
- No single point of failure due to redundant mesh network, redundant wireless interfaces in Gateways and automatic assignment of Trackers to secondary Gateways.

Monitoring

- There are monitoring systems of the devices (host) and the traffic with access to the stations, controllers, switches and servers.
- The equipment and traffic monitoring allow to detect failures in the architecture and intrusion attempts.

How to keep your solar plant safe with Google's Full-Wireless OpenThread system

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1. Introduction and Track Record
2. Full Wireless Tracker
3. Advanced Control
4. **Conclusions**

Presenter:
Jose Alfonso Teruel, CTO at Soltec Innovations

Conclusions

1. Soltec consolidates the **3rd Global Solar Tracker Manufacturer** with focus on the **R&D** and inhouse mechanics, electronics and software developments.
2. **OpenThread** solves the problem of communicating safely tens of thousands of devices spread in large PV plants.
3. Soltec's **Self-Powered and Full Wireless Trackers** benefit from the latest **IIoT** technologies in the world. Compatible and open to integrate more devices to the **ecosystem**: sensors, cameras, inverters.
4. The **distributed control** enables the **highest availability** in the market.
5. **Cybersecurity** integrated at all levels.
6. **Redundancy** of communications and control with no single point of failure

   → Highest **safety** in case of events: wind, snow, hail, flood.

Javier Carpio, General Manager at Soltec Innovations
Jose Alfonso Teruel, CTO at Soltec Innovations
SPW Webinar| September 30rd 2020