

Which network can fulfill the petrochemical sector's desire to exploit Industry 4.0?

The global petrochemical industry has not been short of success. It has experienced more than 15 yr of strong volume growth, with no sign of stopping. Fueled by abundant raw materials and increasing demand, new petrochemical plants are being established around the world, and existing plants are quickly expanding to capitalize on this growth. *Hydrocarbon Processing's* Construction Boxscore Database is tracking more than 470 active petrochemical projects around the world. In total, these projects equate to nearly \$510 B in active petrochemical projects to boost production capacity to satisfy increasing global demand.

However, as the industry grows, so does competition. Petrochemical plants have no choice but to find innovative ways to rapidly optimize their production to get ahead, while maintaining and increasing safety in all aspects of the chemical production process.

Cue the Fourth Industrial Revolution. Also referred to as Industry 4.0, technologies such as augmented reality (AR), autonomous robots and real-time equipment analytics have emerged as next-generation solutions that can satisfy a plant's need for enhanced productivity, as well as mitigate the constant concern for personnel safety. Many already see their value. According to PWC, 60% of chemical companies state that Industry 4.0 data and analytics are of high importance, while 88% believe they will be of high importance within 5 yr.¹

However, these advanced applications need full Industrial Internet of Things (IIoT) connectivity to function—a requirement that Wi-Fi and two-way radio wide-area network (WAN) alone cannot fulfill.

Why? Because the information network is the backbone of complex petrochemical operations. It is the linchpin on which the productivity, safety and profit-

ability of the organization relies. Bandwidth and availability are precious, and downtime is unacceptable.

If plants are to truly take advantage of the IIoT, their mission-critical applications must run on a communications network that offers highly reliable, agile and adaptable connectivity in diverse, evolving, mobility-driven environments.

Networking challenges in petrochemical plants.

While it is clear that the IIoT is a critical part of establishing Industry 4.0 capabilities plant-wide, deploying a network to support connectivity demands in a dynamic and inherently hazardous environment can be difficult. In the petrochemical industry, balancing facility and production growth with employee safety is paramount.

This means that the network must keep up with several demands. For example, many petrochemical plants operate multiple networks to fulfill separate communications needs for their personnel. The burden of maintaining a Wi-Fi network for data and a two-way radio WAN for voice generates significant and unnecessary added costs and resource demands for daily operations.

Petrochemical plants also contain an abundance of explosive and flammable gases, such as ethylene, propylene, butadiene and other vapors, which means that maintaining safety in danger zones is a top priority for petrochemical plants. To keep equipment from sparking and starting a fire, networking infrastructure generally must be kept in an explosion-proof box as a precaution, further complicating installation.

Operations carried out in petrochemical plants are mission-critical (from the moment of deployment to ongoing plant operations), meaning they require constant connectivity. Dropping signals, even for a short span of time, not only

means productivity loss but also puts plant workers' safety at risk.

Simply put, plants cannot afford to risk downtime. With petrochemical plants undergoing a period of significant expansion, choosing the wrong industrial network solution could mean that a plant's investment will be unable to adequately connect its operations tomorrow.

A new kind of network.

To overcome these hurdles and enable the capabilities that Industry 4.0 brings, petrochemical plants require a different kind of network—an Internet of Things (IoT)-enabling network that is more flexible than Wi-Fi networks or two-way radio WAN. Only then can the petrochemical industry take advantage of the innovative technologies that maximize productivity, enhance safety and give organizations a leading edge over increasing petrochemical competition.

One viable solution is for petrochemical plants to deploy a mesh network topology—a resilient architecture, constructed of nodes, that enables a multitude of devices to wirelessly connect to each other. Each of these devices are capable of relaying data across the network until that data reaches its target destination. The technology is gaining increasing interest due to its ability to handle the inevitable surge of data that comes with an increased number of IoT-connected devices.

Like many other industries, petrochemical operations depend on a variety of vehicles, equipment, heavy machinery and personnel dispersed across vast, rugged terrain—all of which require reliable, high-bandwidth and mobile communications. Every aspect of exploration, extraction and production must always be carefully monitored and managed to ensure continuous operations and cost containment. A mesh network can provide

real-time, site-wide communications for employees, contractors, vehicles, drills, wellheads, video cameras, smart meters, sensors, laptops, smartphones and an abundance of other assets.

It sounds like a dream come true, but not all mesh networks are created equal. Plants require fully mobile wireless broadband connectivity that is simple, instantaneous and fail-proof in any application—a “living” mesh solution that moves and evolves with changing connectivity demands.

Delivering critical connectivity. This connectivity is achievable through a combination of wireless network nodes and networking software. This software utilizes any-node to any-node capabilities to continuously and instantaneously route data via the best available traffic path and frequency—for any number of nodes, all with extremely low overhead. Furthermore, superior mesh networks can communicate with any Wi-Fi or Ethernet-connected device to deliver low-latency, high-throughput data, voice and video applications.

A mesh network can provide a secure and converged solution, eliminating the need for petrochemical plants to maintain multiple networks by flexibly supporting data, voice and video. Not only does this solution reduce the total cost of ownership, but it also simplifies the work expected of personnel by allowing them to centralize their communications to a single device. Depending on the mesh network provider, certain nodes are also safe to deploy in any corner of a petrochemical plant without the need for mounting in explosion-proof boxes.

Wireless network nodes can be attached to both fixed and mobile assets, including equipment, vehicles and facility infrastructure. They can maintain multiple simultaneous connections between peers, as well as send and receive data on multiple frequency bands. Furthermore, they never break connections to form new ones, meaning connections are maintained until they are no longer needed. With high-bandwidth speeds across multiple mesh node hops, a mesh network offers extremely low latency for real-time, plant-wide connectivity, even at the network edge—making it the perfect solution for mission-critical operations that require ubiquitous connectivity.

Mesh networking software also autonomously directs traffic over all meshed connections. By dynamically load balancing and routing data around signal blockage from moving assets and potential interferences, it ensures that data packets get to their destination via the fastest path available. By eliminating the need for a controller node, the network will have no single point of failure.

As petrochemical plants are dispersed over widespread areas, they are regularly adding new bandwidth-intensive applications to support continued growth. A superior mesh network topology can rapidly evolve as a plant expands. In fact, as more nodes are added, more paths to direct mission-critical data are naturally formed. With more paths, the network becomes more resilient.

Petrochemical plants are also potential targets for high-risk network security attacks, meaning they require military-grade data security. A mesh network can protect a plant from security breaches due to multi-layered, military-grade security for network traffic, making it incredibly difficult to penetrate. It boasts multiple cryptographic options, configurable data and media access control (MAC) address encryption, and configurable per-hop, per-packet authentication between nodes.

Enabling IIoT through a mesh network. A mesh network is an effective alternative to existing limiting technologies like Wi-Fi and two-way radio WAN. Once a petrochemical plant has enabled IIoT connectivity, a multitude of Industry 4.0 applications can be implemented to drive optimized production and to increase employee safety. This means a plant can immediately exploit advantages, such as radio frequency identification (RFID) tracking of personnel and contractors, which is enabled through everywhere connectivity and provides real-time tracking of workers across a plant. This not only allows operators to monitor personnel’s ongoing safety status, but also aids in emergency extraction in case of an incident.

Mesh networks also support bandwidth-intensive applications, such as asset tracking and optimization, thereby enabling the monitoring of a plant’s assets in real time, as well as predict equipment maintenance needs and maxi-

mize efficient machine movements on the production line. Plants can lay the groundwork for innovative IIoT applications, such as 24/7, 365-d equipment autonomy, with plant-wide asset mobilization, which increases petrochemical output while keeping employees out of dangerous areas.

In addition, products and equipment can be protected from theft with real-time video surveillance. With round-the-clock views into operations, a plant can gain insights into plant performance and events on the production floor. With AR, productivity of employees can be enhanced, while also removing them from potentially hazardous petrochemical environments. This highlights the clear benefits of a wireless mesh network for the petrochemicals market that can deliver secure, reliable broadband coverage anywhere and at any time.

A new era of mesh networking.

Although this list is not exhaustive, it illustrates how an IIoT-enabling mesh networking solution can make operations smarter and employees safer. It also shows that this new kind of network is designed to deliver continuous wireless connectivity to support a myriad of applications.

What makes mesh networks even more appealing is that there are no cables to run, so the IIoT can be deployed cost effectively in a matter of days or weeks rather than months. It means petrochemical plants can maximize this exciting phase of industrialization sooner than imagined. The desire to create a truly connected plant facility need not be a distant pipe dream. Petrochemical plants cannot afford to ignore the IIoT, and when it comes to Industry 4.0, a “living” mesh network is their best alternative. **HP**

LITERATURE CITED

¹ “Industry 4.0: Building the digital enterprise,” Pricewaterhouse Cooper, 2016.



GEOFF SMITH began his career at AT&T Bell Labs developing high-speed modem technologies. He led Modem, DSL and Wireless R&D teams prior to joining Proxim Wireless in 2000, where he held senior executive positions managing

R&D, sales and marketing, enabling indoor and outdoor mobile internet. In 2015, Mr. Smith founded Wave Mobile Solutions, a DSRC V2X radio company focused on connected and autonomous vehicles.