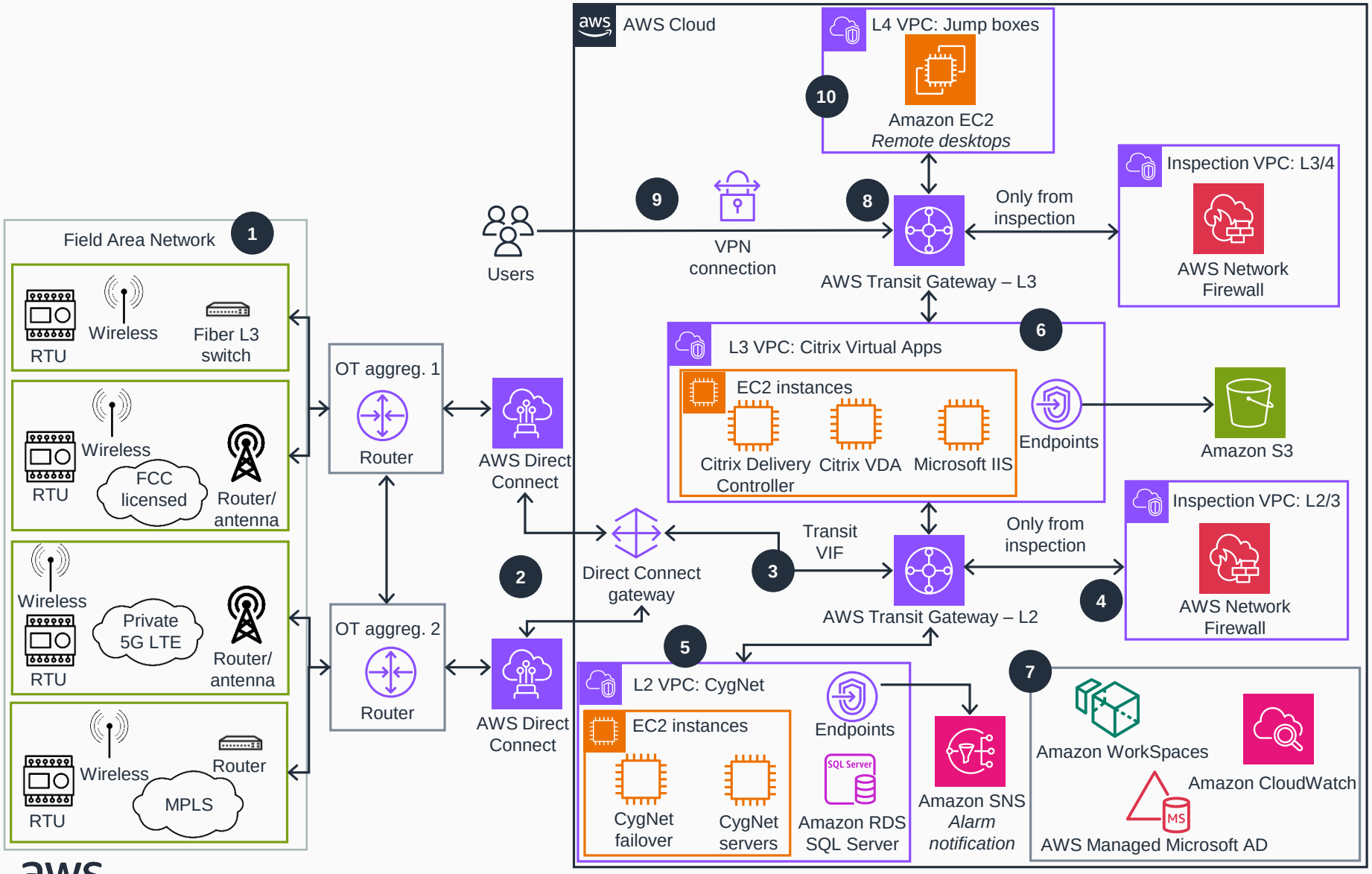
Guidance for Deploying CygNet SCADA on AWS

This architecture diagram shows a highly-available, private deployment of Weatherford's CygNet SCADA solution on AWS. The network is segmented to limit data flow between industrial and corporate environments—inserting firewalls and inspection appliances in between—in a design that mimics the Purdue security model. Although this architecture illustrates services at the Region level, all servers are deployed in at least two Availability Zones for high availability. This slide shows Steps 1-5.



AWS Reference Architecture

1. Private field networks of various types, including remote terminal unit (RTU), fiber, wireless, router/antenna, Federal Communications Commission (FCC) licensed radio links, private 5G long term evolution (LTE), or multiprotocol label switching (MPLS) networks, aggregate to centralized locations using OT aggregation (OT aggreg.) routers.

2. **AWS Direct Connect** is installed at these aggregation locations, providing consistent, private fiber connectivity to AWS. These links carry any IP-based protocols as a dedicated wide area network (WAN) circuit in a hosted connection that supports redundancy in paths, Regions, and devices. Connections are available from 50Mbps to 10 Gbps.

3. A **Direct Connect** gateway will be the logical demarcation for these physical connections in AWS. A private autonomous system number (ASN) connects to an **AWS Transit Gateway**, using transit virtual interface (VIF). Transit VIF is a fully redundant border gateway protocol (BGP)-enabled cloud router. Unlike typical hardware routers, it can have multiple conditional routing tables based on any given network flow direction. This will force traffic through the Inspection virtual private cloud (VPC).

4. The Inspection VPC contains an **AWS Network Firewall** to separate Level-2 from Level-3. This is a fully managed appliance that supports deep packet inspection using AWS threat signature managed rules. No updating or patching is needed to stay up to date. Stateful and stateless rules are supported. East/West routing within Level-2 can be inspected through the firewall.

5. Purdue Level-2 VPC (for OT) CygNet servers, failover, and database (**Amazon Relational Database Service [Amazon RDS] for SQL Server**) are deployed in a VPC. These are CygNet backend servers for processing. Scale and redundancy options are available for the database and compute nodes. The CygNet deployment will be broken into multiple **Amazon Elastic Compute Cloud (Amazon EC2)** instances based on disk, I/O, CPU, and memory consumption. **Amazon Simple Notification Service (Amazon SNS)** uses endpoints to send alarm notifications.

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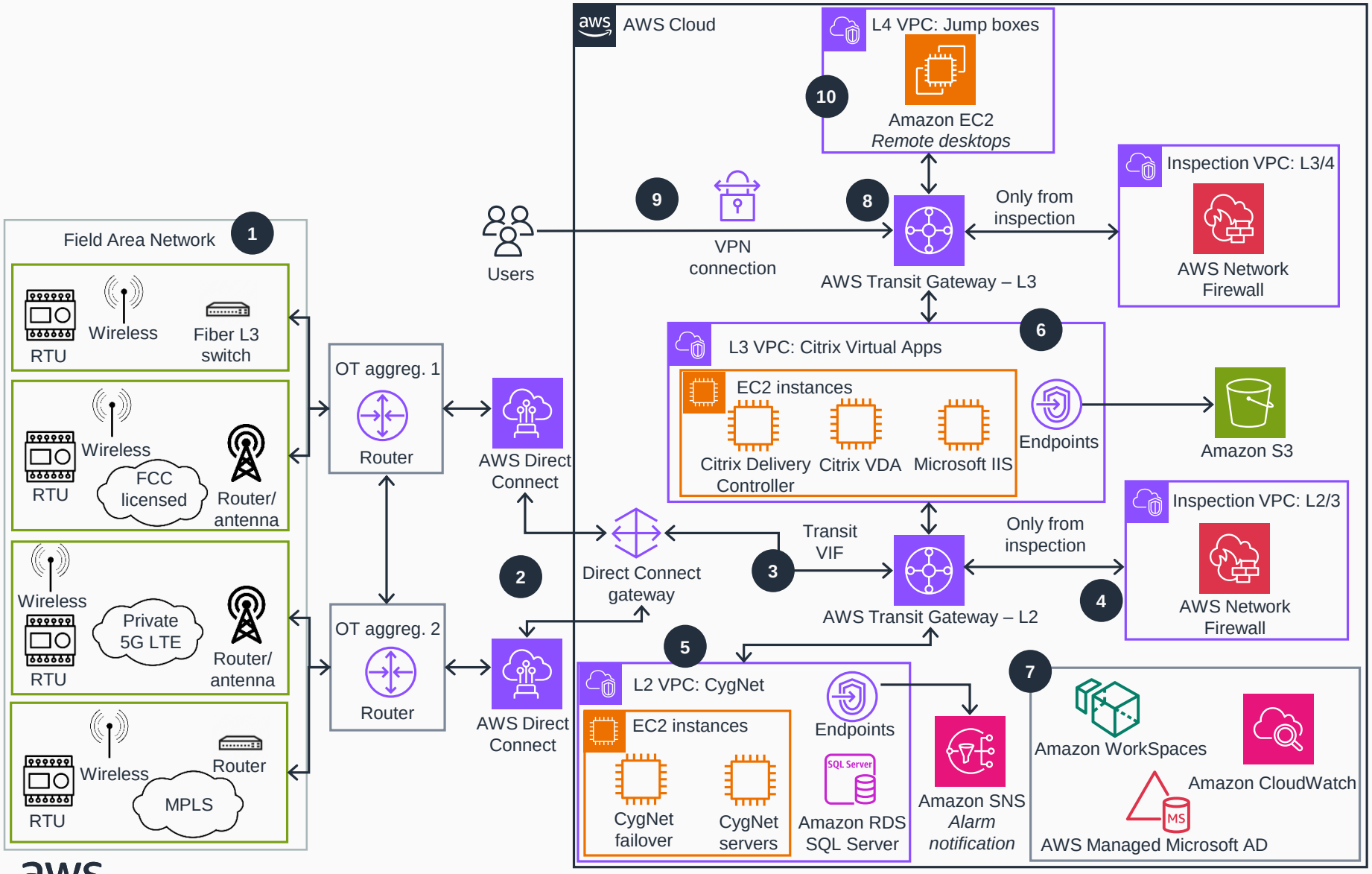

6 A separate VPC exists at Purdue Level-3, serving as an intermediate network, also known as an OT-IT Demilitarized Zone (DMZ). This VPC contains multiple components: a Citrix Delivery Controller (which delivers the CygNet application), a Citrix Virtual Delivery Agent (VDA) for connection management, Microsoft Internet Information Services (IIS) for hosting CygNet's Thin Web Client, and additional Level-3 functions, including a data lake that uses **Amazon Simple Storage Service (Amazon S3)** through endpoints. This traffic is strictly separated by the Level 2/3 Inspection VPC. Scale and redundancy options are available for the database and compute nodes.

7 Supporting services include **AWS Managed Microsoft AD**, a fully managed cloud Active Directory Service. This service does not expose authentication traffic to VPCs. Additionally, **Amazon CloudWatch** gives you visibility into your infrastructure. **Amazon Workspaces** is a fully managed virtual desktop infrastructure (VDI) option that connects to servers and virtual apps.

8 Purdue Level-3 Transit Gateway is a second **AWS Transit Gateway** that forces separation between Level-3 and Level-4 VPCs. Inspection VPC contains an **AWS Network Firewall** to separate Level-3 from Level-4.

9 VPNs can be used to extend the network to users outside of AWS while still enforcing the use of firewalls.

10 The L4 VPC can host remote desktops for administrators and IT teams to access the private networks.

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