

ORACLE

Oracle Energy and Water
Customer Edge
Conference

Grid Roadmap

Now, New, and Next

Sameer Kalra, Brad Williams, and Russell Taylor

Oracle Energy and Water

March 13, 2023



Speakers



Sameer Kalra

Director of Operational
Technology Products



Brad Williams

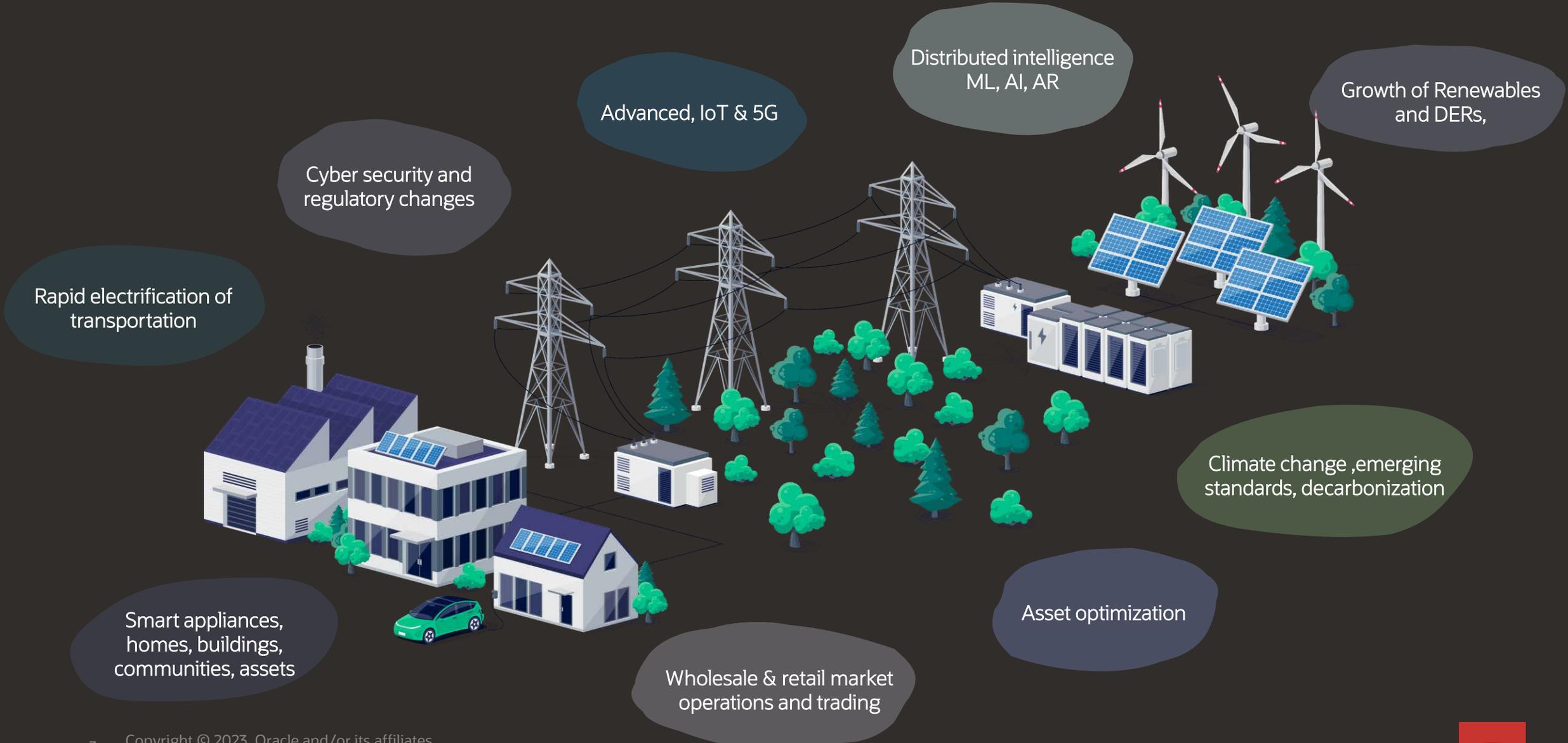
Vice President, Industry
Strategy



Russell Taylor

NMS/UX Product Manager

The Energy Landscape is Rapidly Changing...



Cyber security and regulatory changes

Advanced, IoT & 5G

Distributed intelligence
ML, AI, AR

Growth of Renewables and DERs,

Rapid electrification of transportation

Climate change ,emerging standards, decarbonization

Smart appliances, homes, buildings, communities, assets

Asset optimization

Wholesale & retail market operations and trading

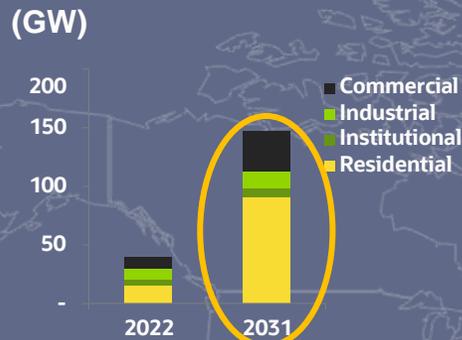


DER capacity growth Forecasts across the world

Do you have a solution that can address this growth?

DER forecast 2022-2031 shows ~80% of DER capacity will grow at residential and commercial customer premise

North America



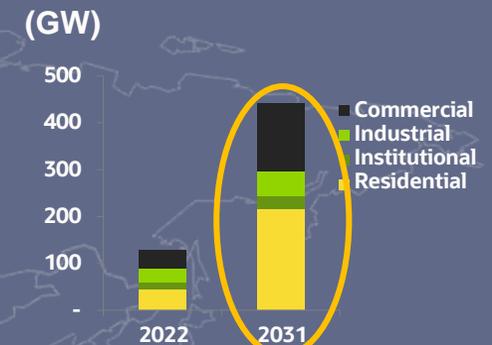
North America is forecast to install 40 GW of new DER capacity in 2022, increasing to 146 GW in 2031.

Europe



CE Delft estimates that 83% of EU households could become prosumers by 2050. The trend is similar

Asia Pacific



Asia Pacific will see similar DER capacity growth)

Oracle Energy & Water Portfolio Solves the Most Challenging Energy and Water Problems



| Customer Experience and Engagement | Monetization and Revenue Management | Meter Management | ERP | Asset Management | Network Management | Data, Analytics and Platform |
|------------------------------------|-------------------------------------|------------------|------------|------------------|--------------------|------------------------------|
| ORACLE | | | | | | |
| SAP | | Itron | SAP | | Schneider Electric | AWS |
| Salesforce | Itineris | Landis + Gyr | Salesforce | | GE | Google |
| Adobe/Marketo | Harris Utilities | Siemens | Microsoft | IBM | Siemens | IBM |
| Microsoft | Junifer/Gentrack | | Infor | | ABB | Google |
| Uplight | Octopus Energy | | Workday | | OSII (Aspen) | OSIsoft (Aveva) |
| Bigely | PowerCloud | | | | | Microsoft |



Once-in-a-Generation Market Opportunity

Evolution of Grid as a Platform

- 1** Digitalization and automation of grid management is helping utilities manage a surge of DERs and is an opportunity to reduce overall costs
- 2** Utilities experimenting with digital tools for data access, sharing, integration and analytics to create value
- 3** Growing EV adoption and mandates globally is driving new electricity demand and integration with grid (V2G)

Sustainable energy visions

Flexibility management for all services, customer classes, and assets



OT Value Chain Vision and Strategy

Reconciliation

- Measurement & Verification
- Settlements

Customer and Regulatory Requirements

- Customer Choice
- State Mandates RPS EV Adoption
- Federal Environmental Regulation

Grid and Market Operations

- Schedules
- Dispatch
- Optimization
- Planned Outage
- Congestion
- Capacity
- Contingency
- Market Portal

Grid Interconnections

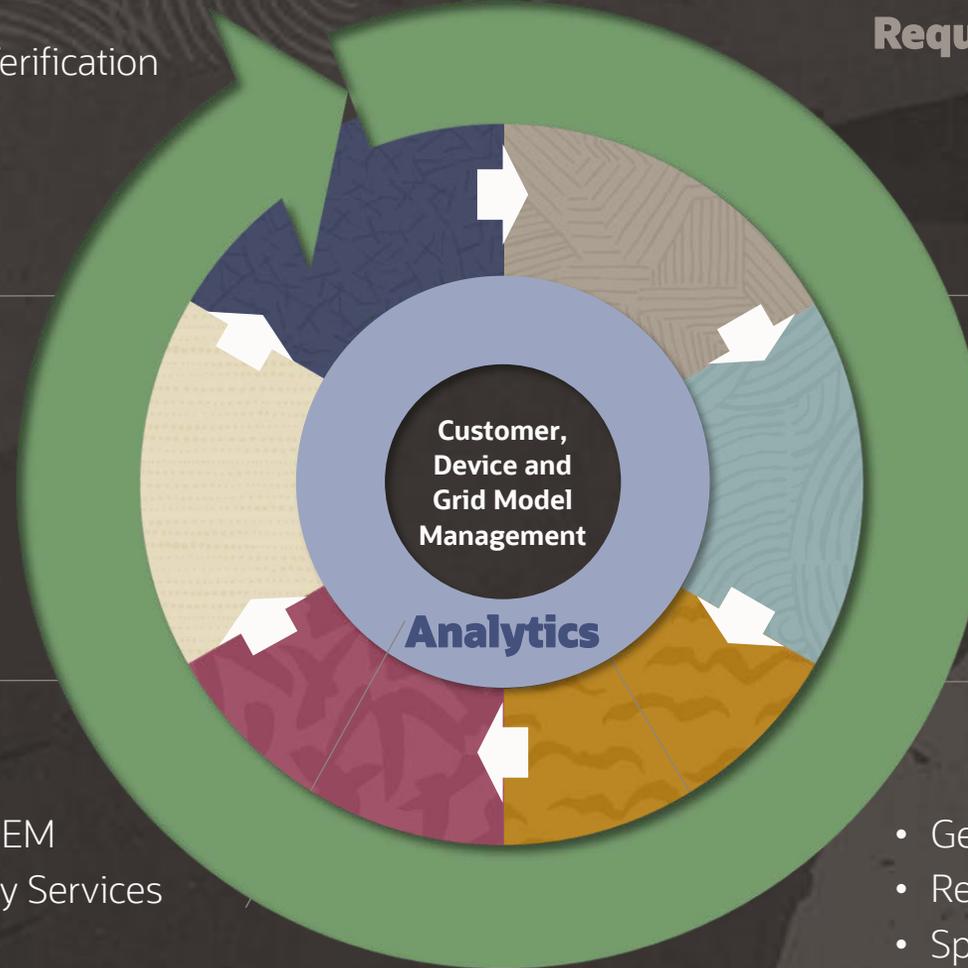
- New Load Connections
- DER Solar/Wind/EV
- Energy Storage

Customer Programs

- EE/DR
- EV Charging/V2G
- Energy Arbitrage
- Microgrid
- BEM/HEM
- Ancillary Services

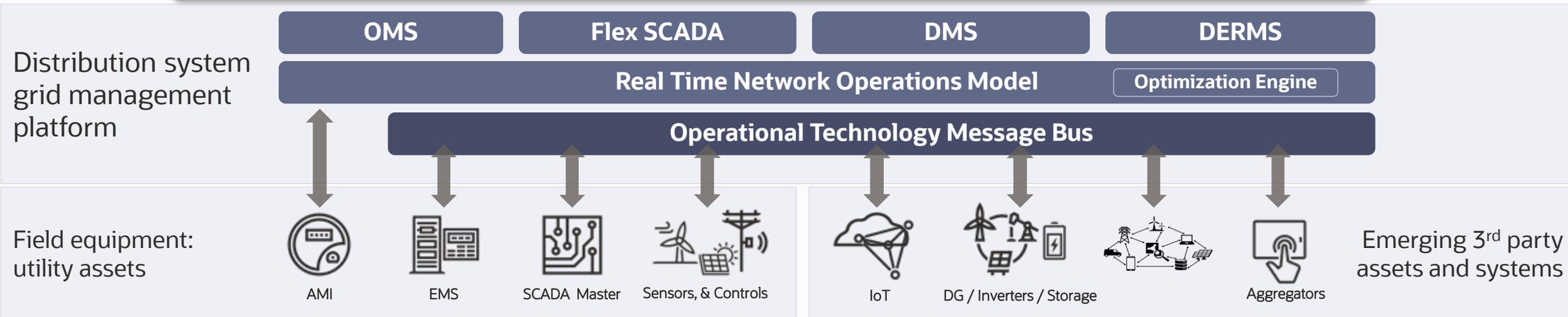
Planning

- Generation and Grid Capacity Planning
- Reliability/Resiliency Planning
- Spatial Load and DER Forecast and Adoption Rates
- Non-Wires Alternatives

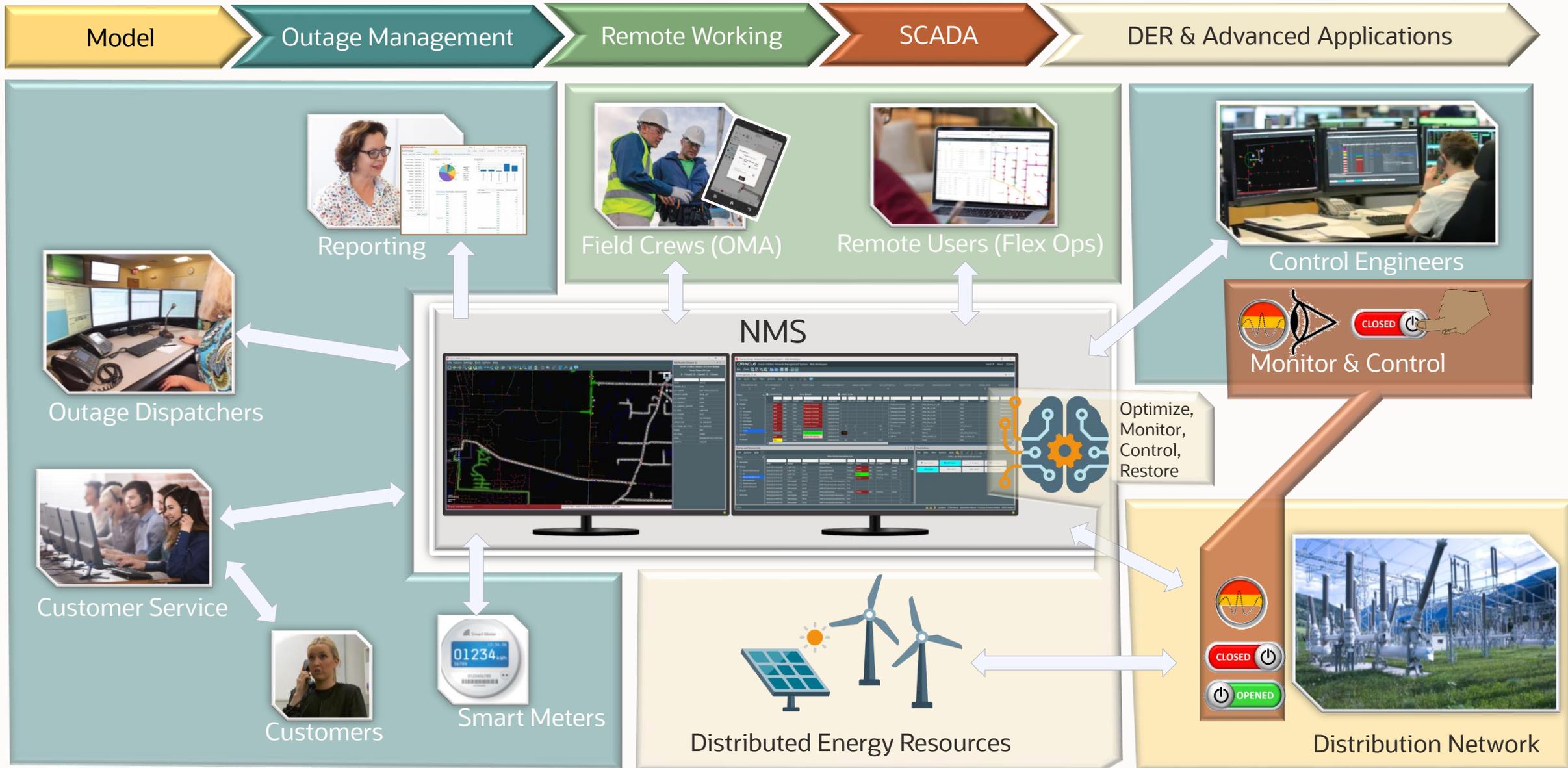


Oracle Integrated NMS platform – ADMS & DERMS

Transforming field data → information → actionable insights → optimized network performance



Your Journey to a Full ADMS



Investment Themes



Reliable and Safe Operations

Fully integrated ADMS & SCADA provide single pane of glass reducing TCO and enhance cybersecurity



Enable Remote working & Optimize UX

Improved user experience, Better situational awareness, higher productivity, easier access to information



Customer to Grid DER Management

Industry's most comprehensive solution for end-end distributed resource management



Data, Analytics and Insights

Leverage data science to enable more accurate insights and proactively provide solutions to future network issues

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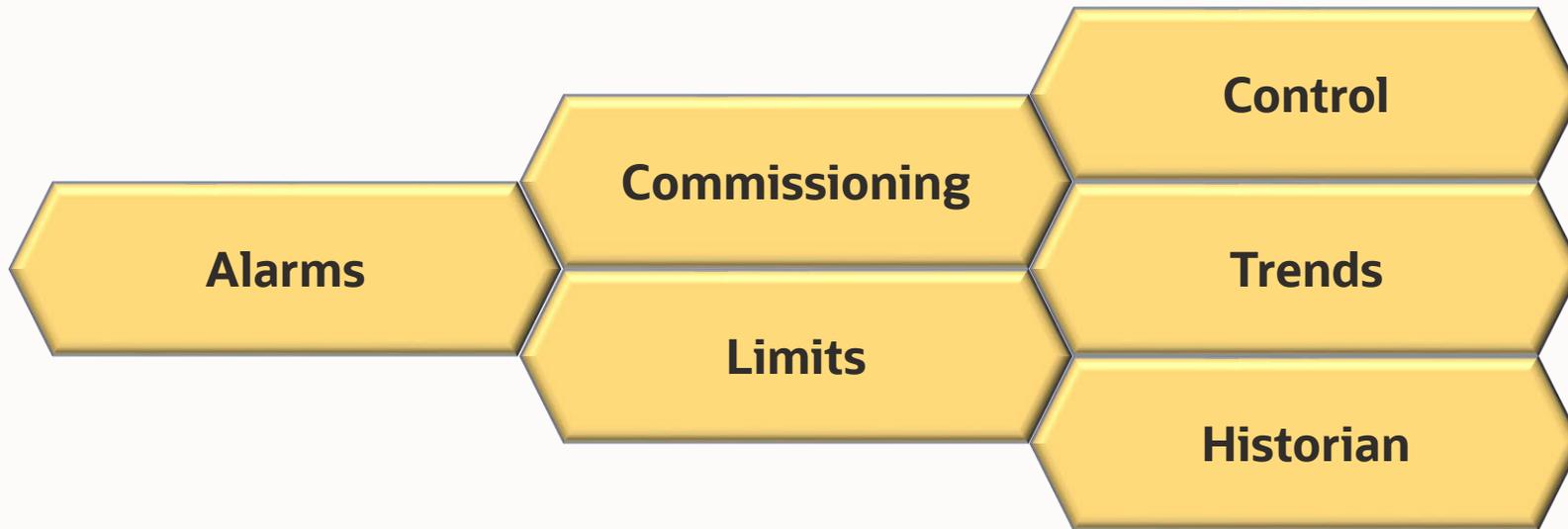
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Flex SCADA

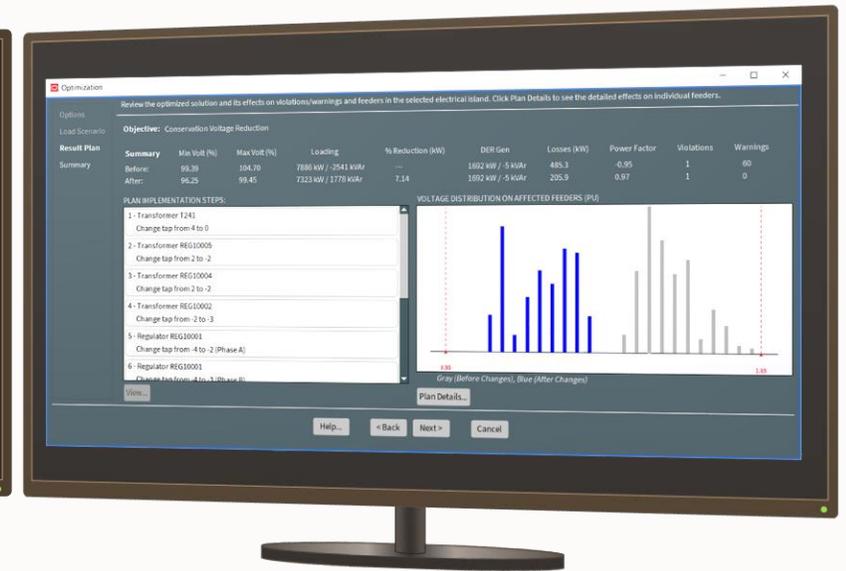
Single, powerful platform to provide full control, monitoring, and analysis capabilities



VVO and FLISR

FLISR and VVO now Live at FirstEnergy!

FLISR continues to deliver results at United Energy...



Investment Themes



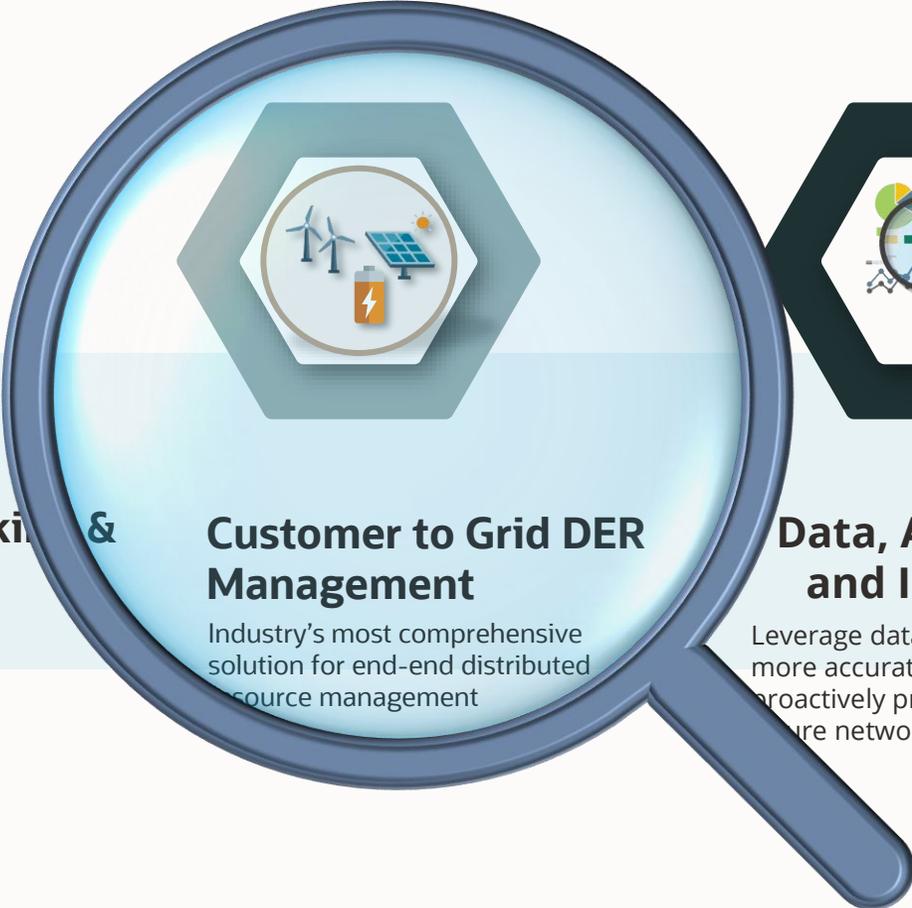
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Customer to Grid DER Management

Industry's most comprehensive solution for end-end distributed source management



Data, Analytics and Insights

Leverage data science to enable more accurate insights and proactively provide solutions to future network issues



Decarbonization requires effective coordination across the energy value chain



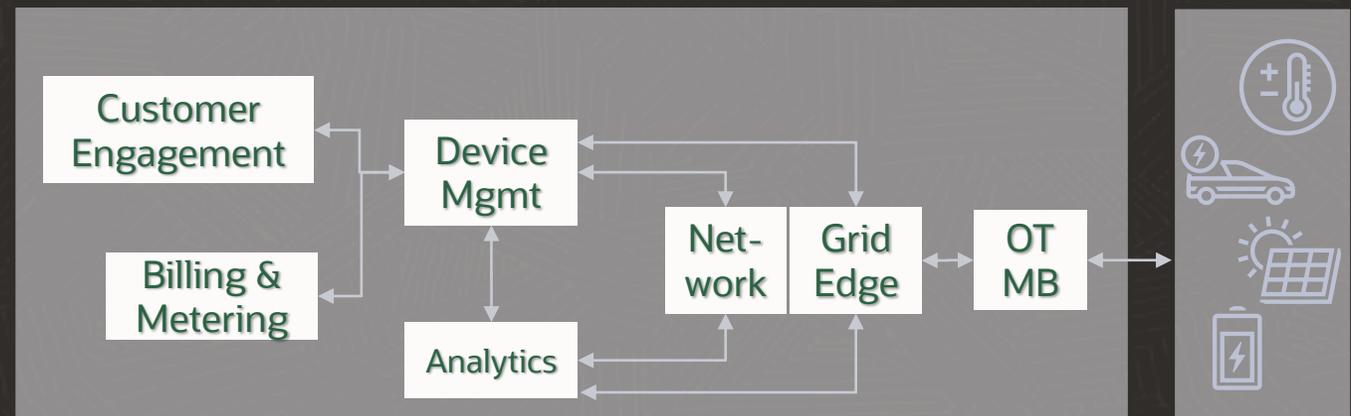
What is a utility enterprise DERMS solution?

A utility enterprise DERMS encompasses customer, programs management and network operations systems that enable optimized regulation of the grid and connected DER

Utility enterprise DERMS core functions:

- **DERMS Network Operations**
- **DER Market Operations**
- **DER Device Management**
- **DER Customer and Programs Management**
- **DERMS Analytics**
- **Field Service**

Simplified DERMS Architecture



Investment Themes



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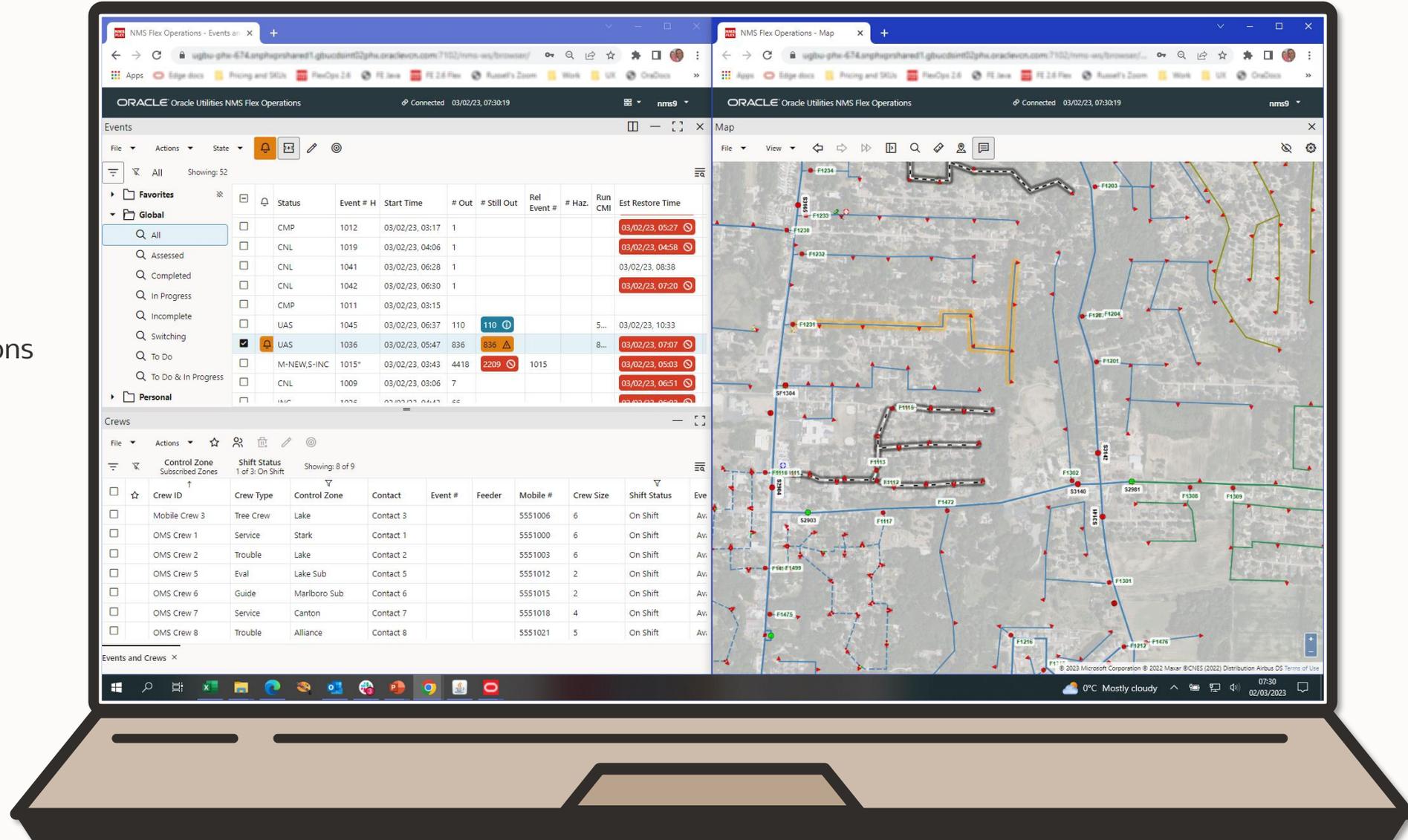
Flex Operations is now live at FirstEnergy

Benefits

- Share restoration work among more Users
- Restore Customers faster
- Submit switching requests
- More users in dispersed locations

Positive feedback from Users

Already incorporating ideas from battle-hardened **Users** into next release

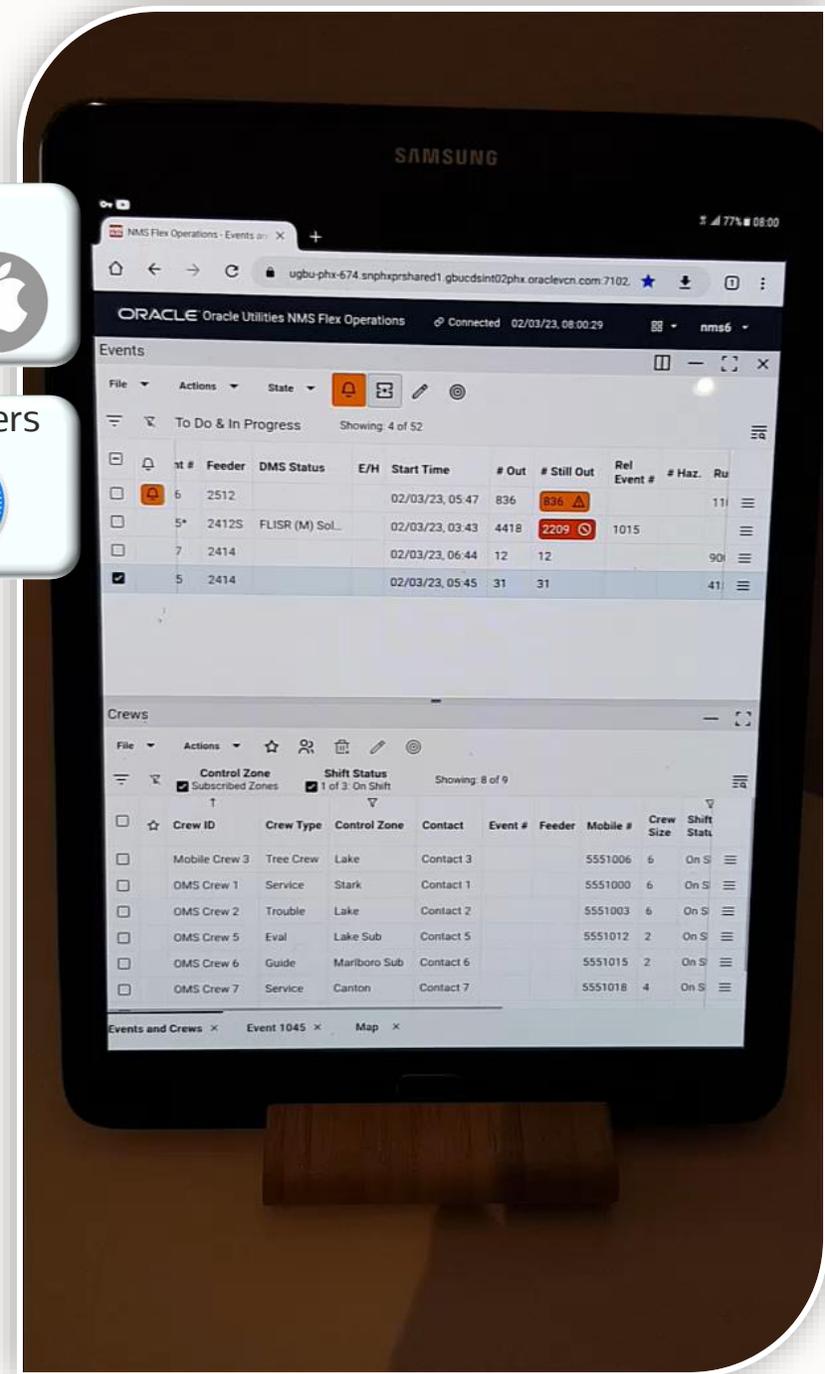


Flex Operations – Recent Enhancements

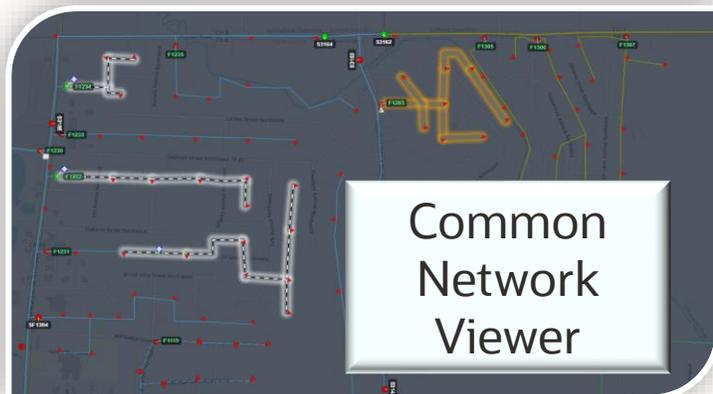
Now supported on **tablet-sized devices** – touch enabled & device responsive

Benefits

Even greater flexibility, supporting a wider range of utility-owned device types, and User types



Flex Ops (and OMA) now using the **Common Network Viewer...**



Common Network Viewer

Flex Operations



A new map renderer, which can be used across products



OMA



Control Room Client



Common Network Viewer Benefits

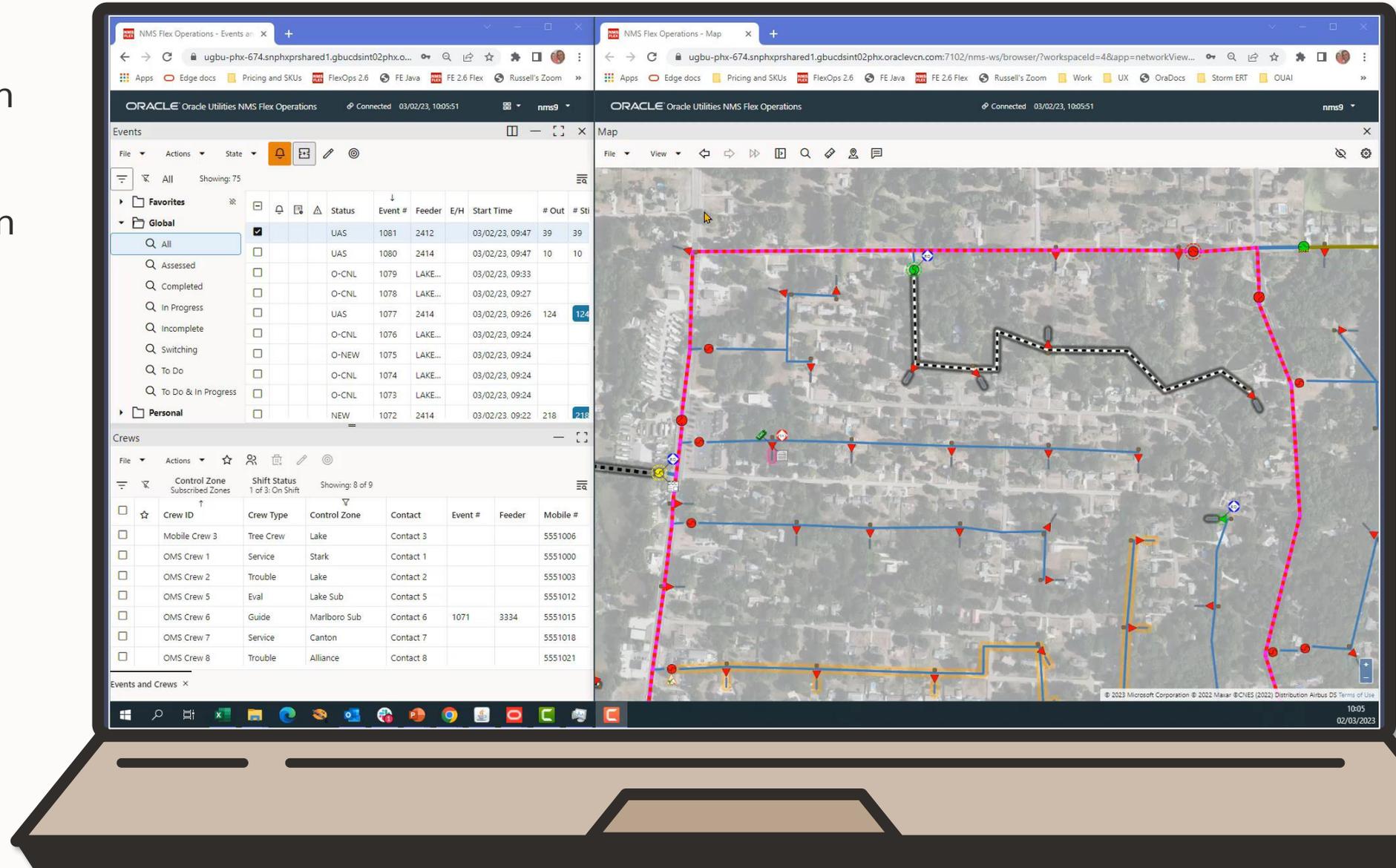
Develop new features in one place

Simplified configuration

Easier to configure

Easy to share configuration

Improved User Experience...



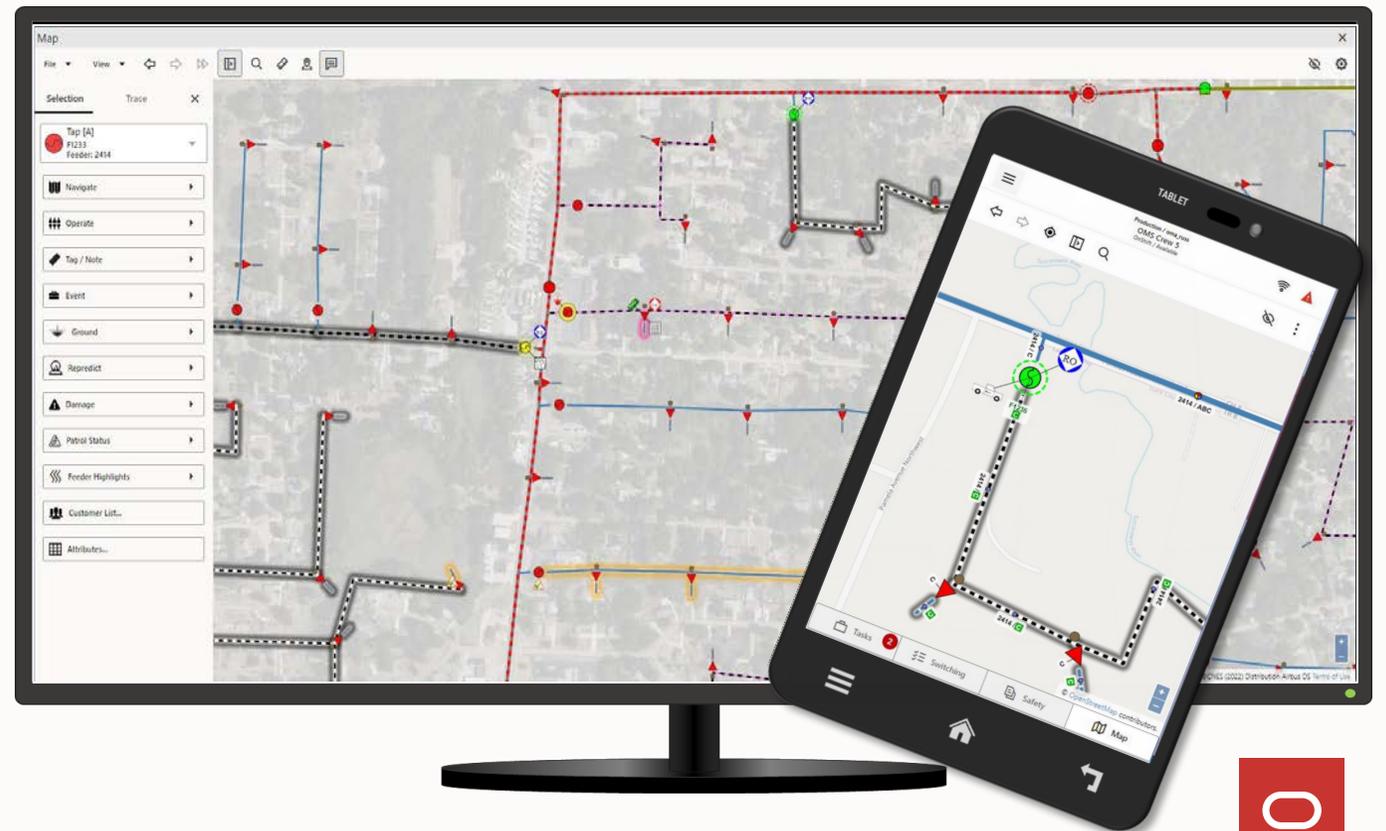
Common Network Viewer Benefits

Users spend **a lot** of time interacting with the Map repeating many interactions...
We are making those interactions much easier:

- **Panning** much quicker – no delay loading adjacent network
- **Zooming Out** much quicker
 - No delay loading network
 - No performance issues with text when zoomed out
- “Clever” **Back/Forward** buttons
- Easier to **Select** objects
- Easier to “**surface**” information
- Better **feeder highlighting**
- Improved **tracing**
- Improved **situational awareness**

Still in the backlog...

- Easier **Searching**
- Adding and organizing **Saved Views**
- Viewing images in event and other **symbol tooltips**



| Field Management Integration

Network Management

- Outage Management
- Storm Management
- Call Center Management
- Review Outage Reports

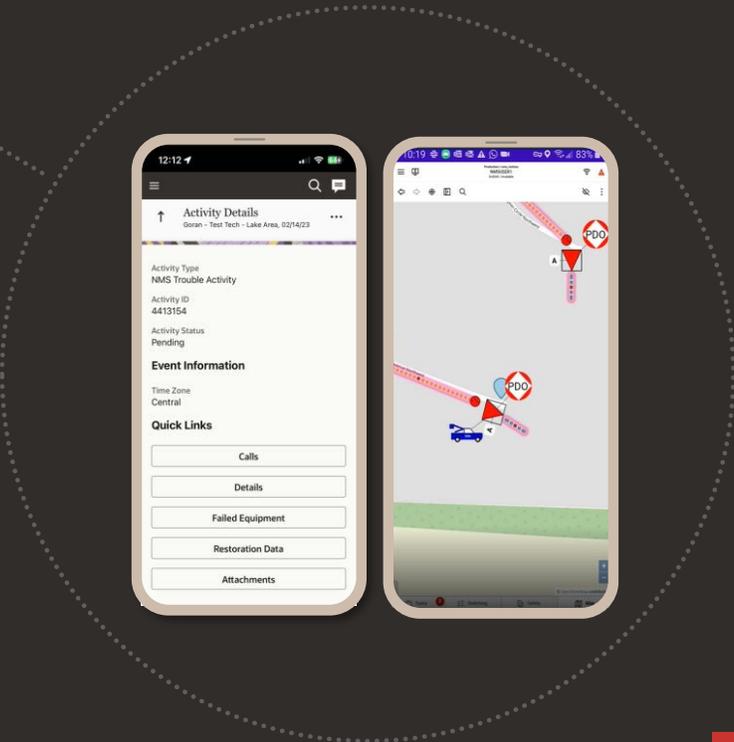


Field Service

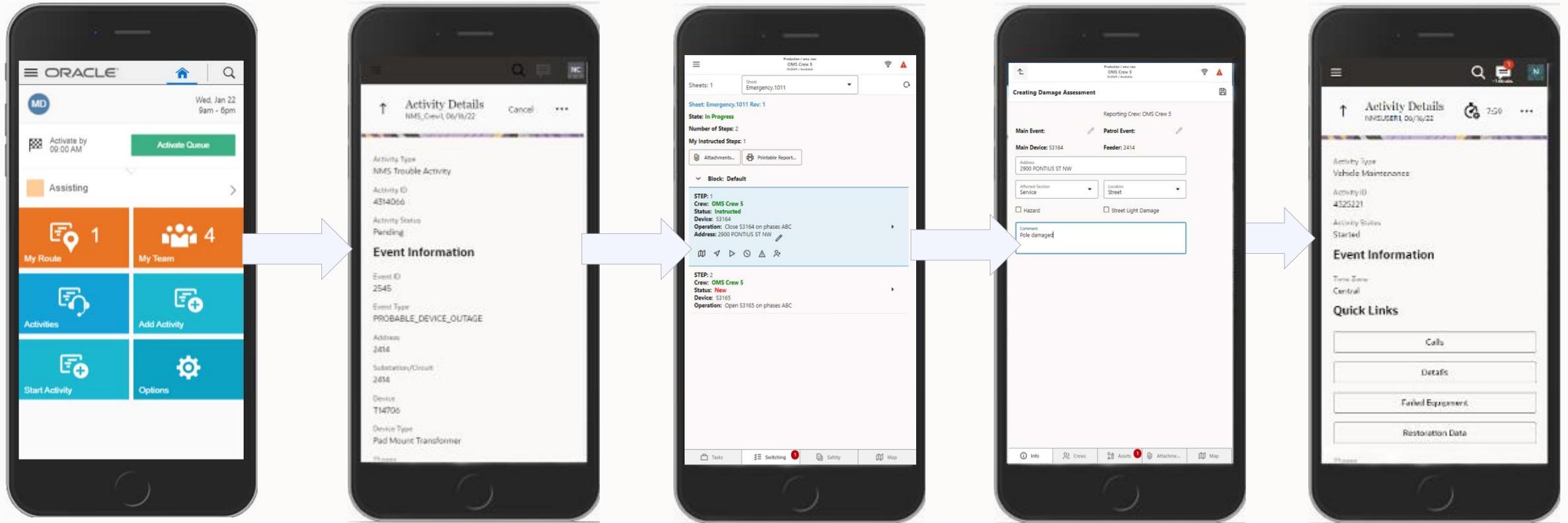
- Scheduling & Routing
- Forecasting
- Booking & Capacity Management
- Field Service Management
- Central Field Management Hub

Operations Mobile App

- Switching Plans
- Damage Assessments
- Advanced GIS
- ERTs



NMS – OMA – OFS Integration | Field Work Workflow



View related activities in OFS Mobile queue

Begin work on activity on OFS Mobile

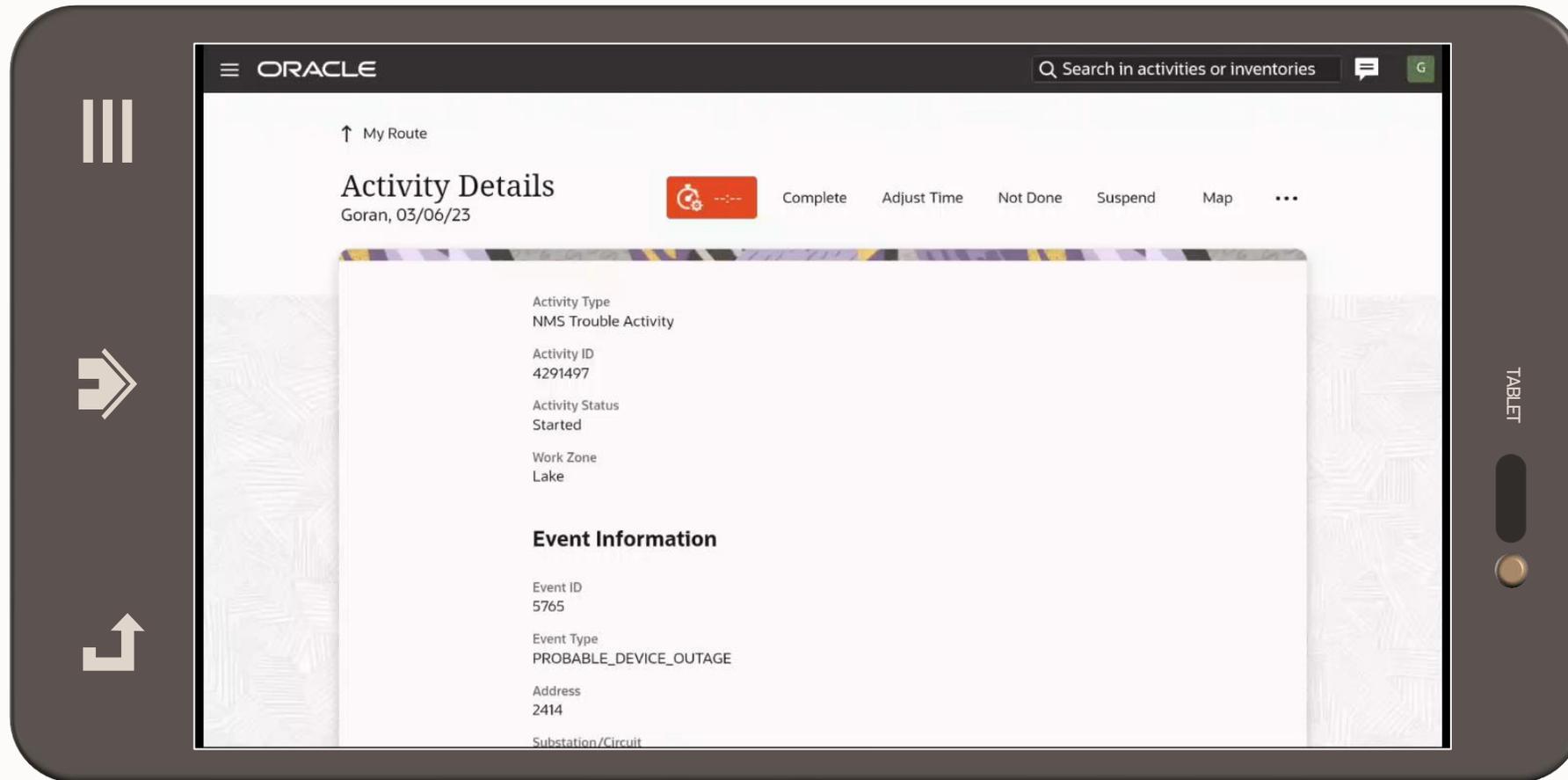
Launch OMA to work on switching plan activity

Create Damage Report in OMA

Return to OFS to complete Activity



NMS – OMA – OFS Integration | Field Work Workflow



Investment Themes



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Enable Remote working & Optimize UX

Improved user experience, Better situational awareness, higher productivity, easier access to information



Customer to Grid Management

Industry's most comprehensive solution for end-end distribution resource management

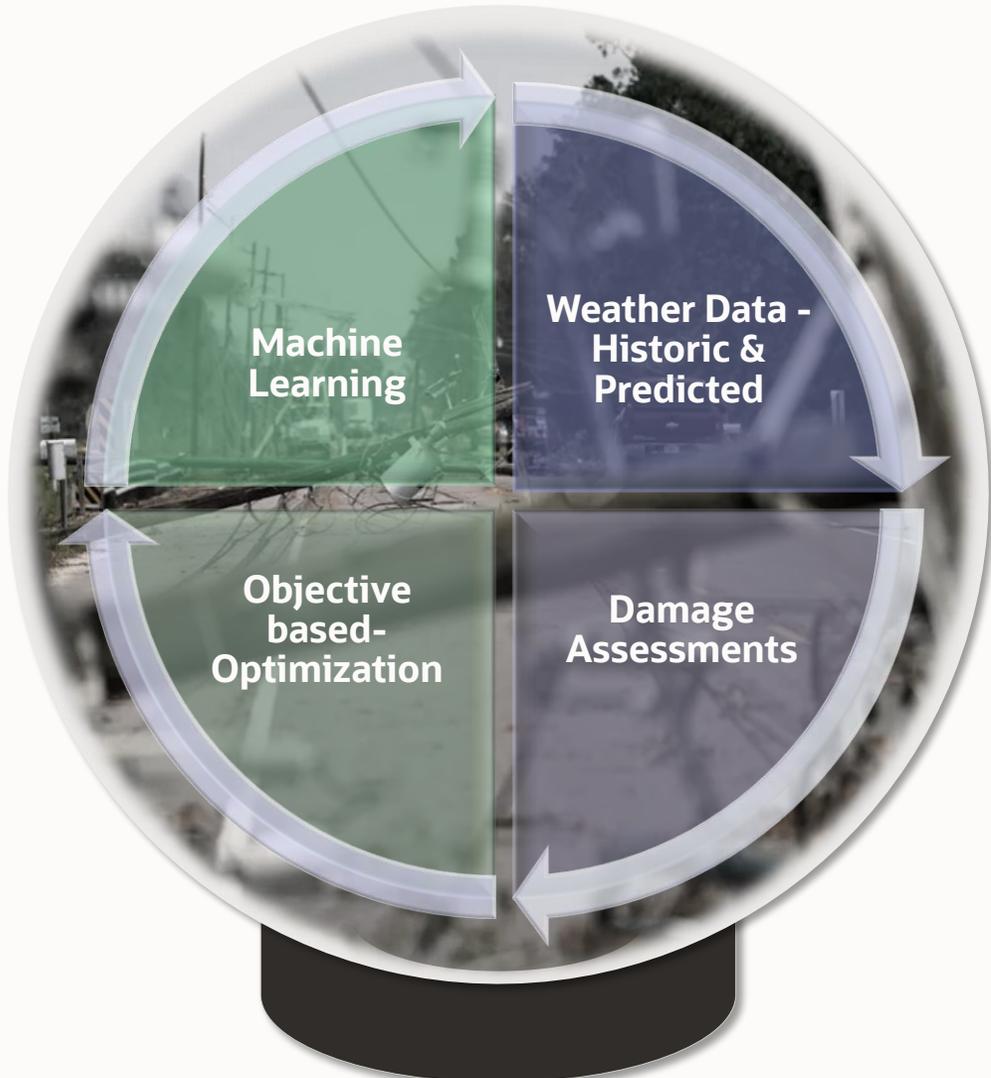


DER Data, Analytics and Insights

Leverage data science to enable more accurate insights and proactively provide solutions to future network issues



Data and Analytics



Key DER Analytics Insights

- Phase connections validation and continuous improvement
- Customer-to-transformer connections validation and continuous improvement
- Load, DER, and controllable/flexible resource disaggregation
- Disaggregated load and DER weather adjusted forecasts
- Measurement and Verification



Storm Estimated Restoration Timeline

Create a *Storm Model* for approaching storm

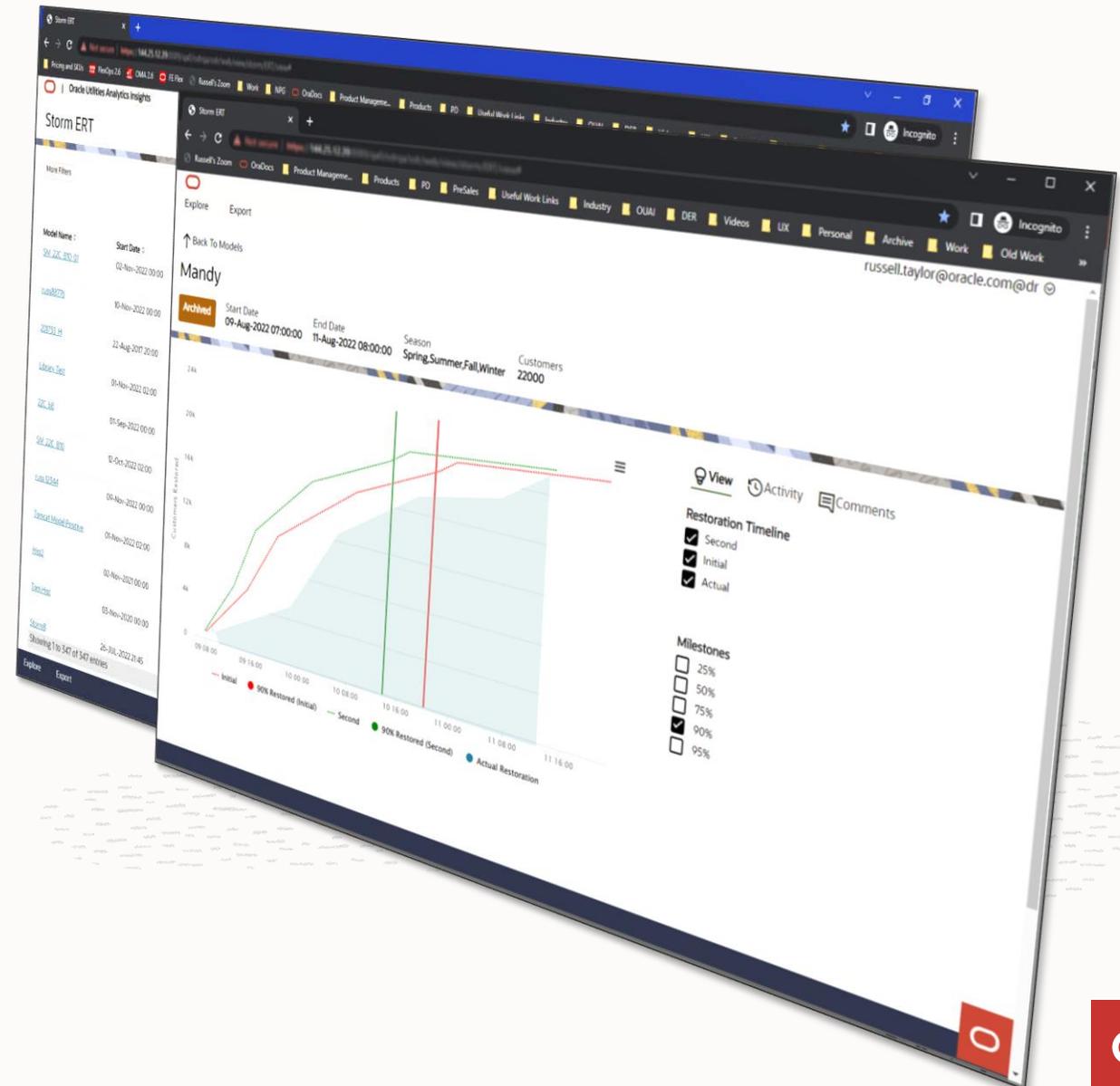
Generate an *Estimated Restoration Timeline* based on similar historic storms.

Associate the *Actual Restoration Timeline* with the model as restoration gets underway.

Uses *Historic* and *Archived* storm models to help predict more accurate future storm ERTs

Benefits of Storm ERT:

- Enables you to provide accurate ERTs to customers
- Improves Customer satisfaction
- Helps avoid potential financial penalties
- Removes dependence on tribal knowledge for ERT calculation



Strategic Innovation

Oracle NMS in Oracle Cloud Infrastructure (OCI)

Scalability

Leverage mature OCI infrastructure:

- DBaaS for RDBMS
- WebLogic Server for OCI for WebLogic
- IaaS for compute as needed

Security

Leverage built in Oracle security monitoring

- Reduce exposure to potential security breaches on in-house non-production infrastructure

Reliability

High Availability and Disaster Recovery

- Multiple Fault Domains
- Multiple Regions

Oracle's ADMS - OCI Compliant Architecture

Transition with Hybrid Approach

- Cloud hosted for Production
 - ✓ On-Premise for Disaster Recovery (or vice versa)
- Cloud hosted Non-Production
 - ✓ Dev, Test, Integration, and Training Environments

Vendor Support Services

Oracle Consulting Services

- To help allocate, secure and configure OCI infrastructure

Issues of moving OT to the Cloud

ORACLE

**Regulatory IOU Investments
Revenue/Earnings Mechanism**

SaaS Model for Capital Investment Earnings
vs O&M Costs pass-through

**Understanding or applying physical
NERC CIP rules to cloud systems**

- Contingency for major events
- Access to basic public networks providing network access to cloud OT systems
- May require a hybrid approach

SCADA in the Cloud?

- Device connectivity and security still a challenge
- Latency
- Growth of devices at grid edge and customer premise: DERs, sensors, controllers

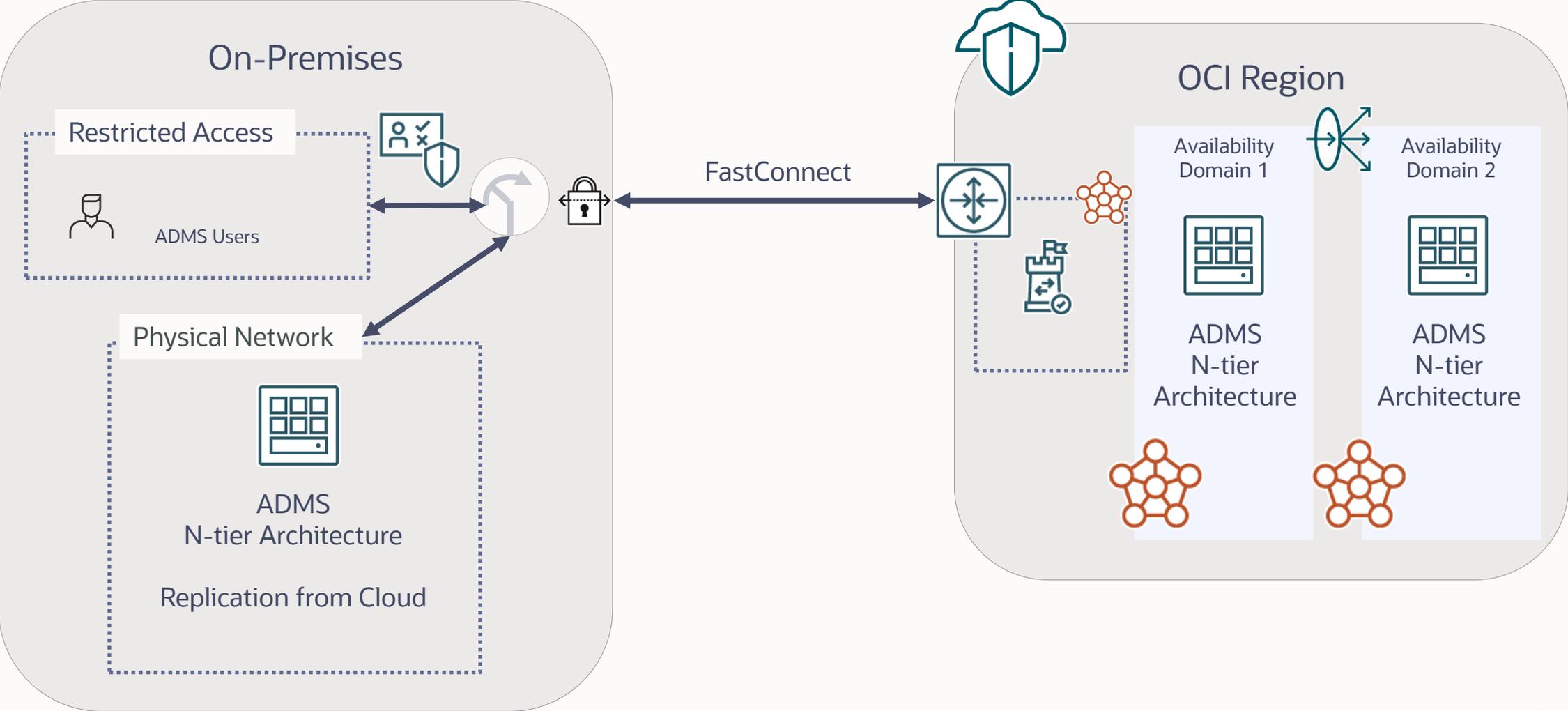


Oracle has the **systems, software, controls, and experts** required to support the utility industry's requirements for Critical Utility OT Systems in the Cloud.

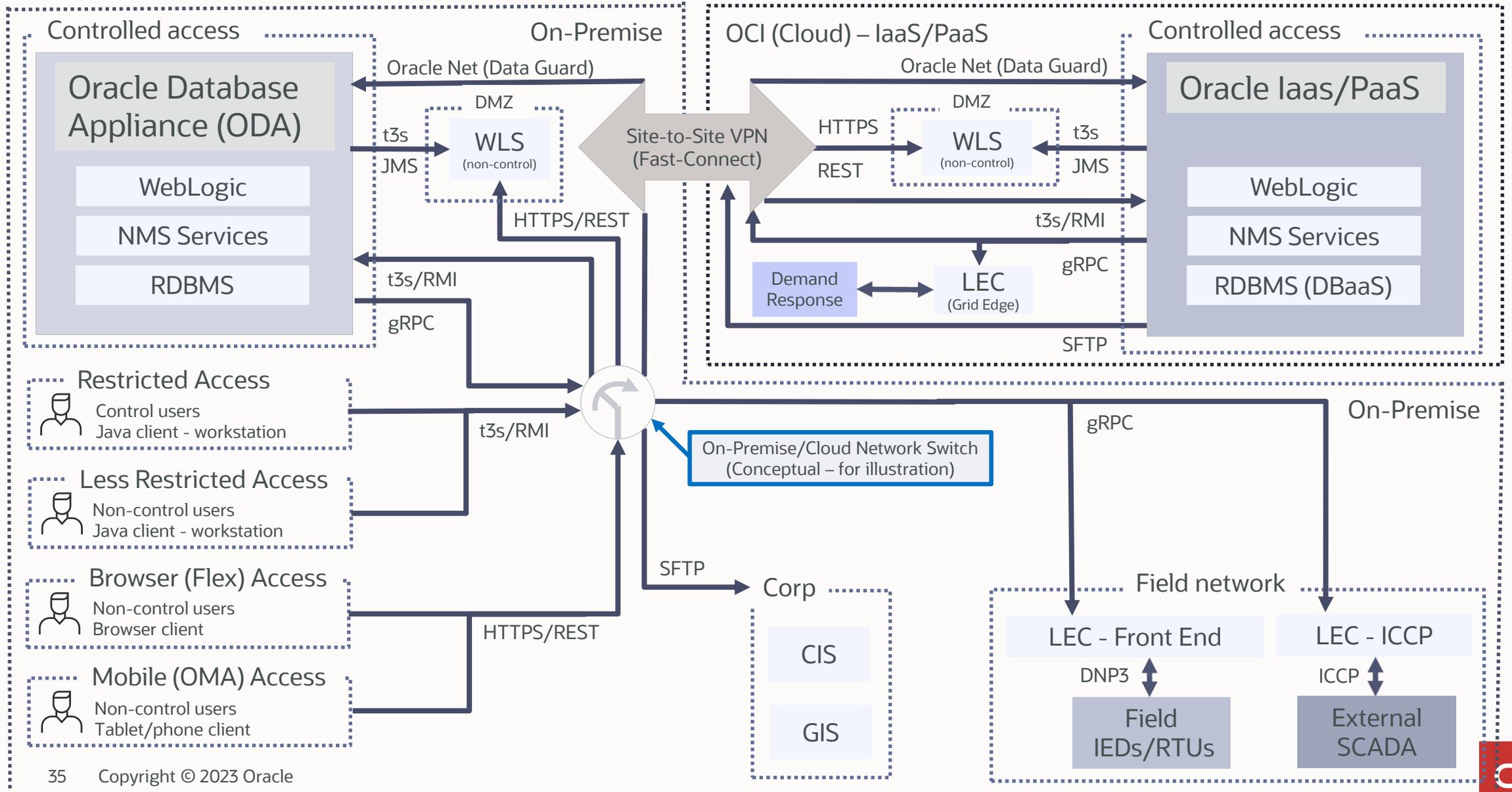
- Secure Configuration, Implementation, Operations and Maintenance



Hybrid Cloud Architecture Example



Example NMS OCI/On-Premise Hybrid DR Architecture

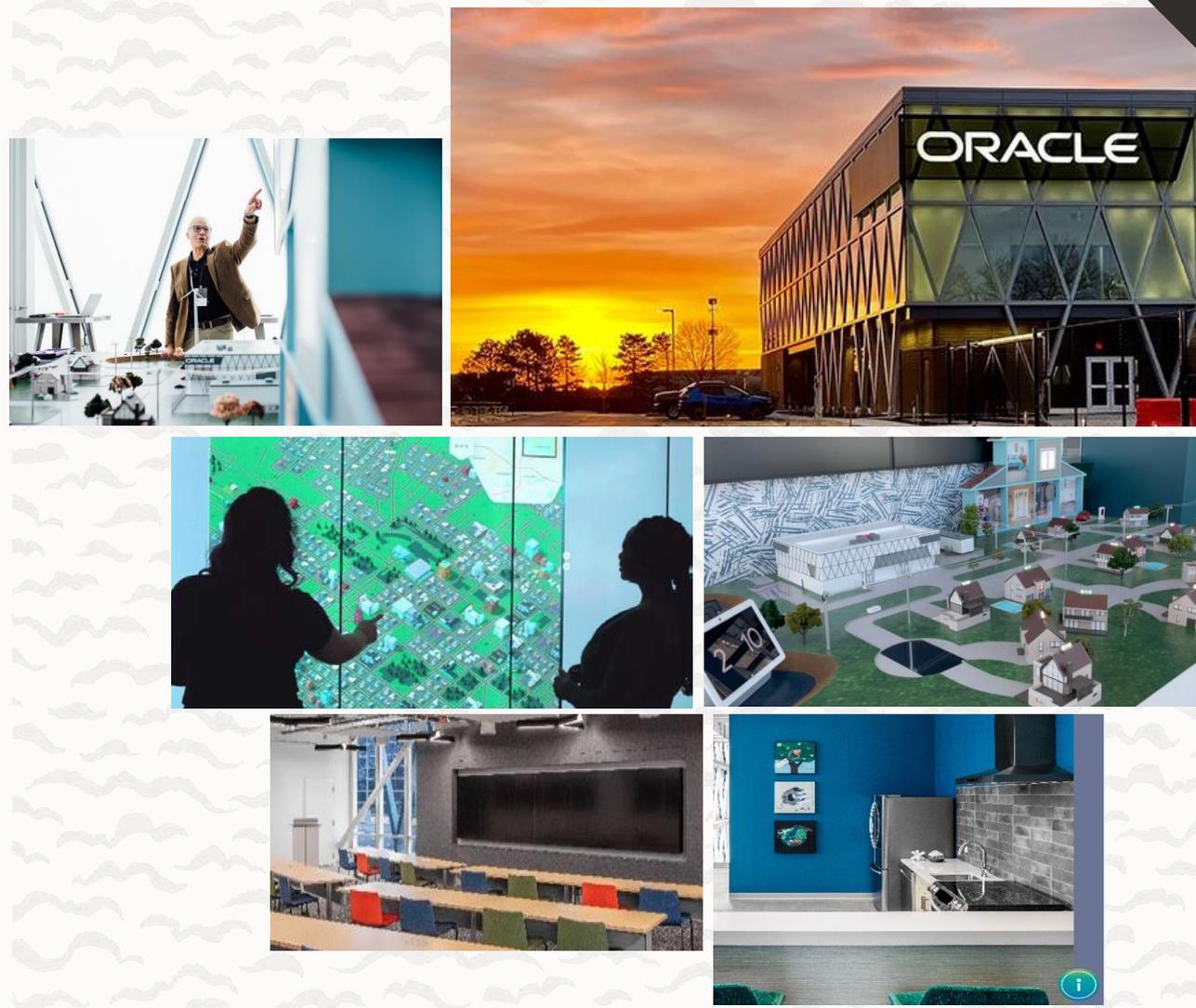


Oracle Industries Innovation Lab

Grid Edge Innovations

- Resiliency with Autonomous Grid Edge Devices
 - Autonomous Microgrid Islanding
 - Wildfire Risk Mitigation
 - Synthetic Inertia Resiliency with 100% Renewable DER
- Enterprise DERMS Customer DER Market Portal

Visit the Innovation Hub to see more!



Resiliency with Grid-Forming Inverters to Support Autonomous Microgrids



Like a synchronous generator, **Grid-Forming (GFM) Inverters** can be used to inject active and reactive power to establish voltage and frequency in islanded mode.

GFM Inverters can be used to form autonomous microgrid islands for improved grid-edge resiliency and reliability with high penetrations of renewable DER.

Resiliency Use Case: FLISR Islanding of Feeder Sections into Autonomous Microgrids and return to normal with disturbance is cleared.

Leverage Oracle Live Energy Connect OTMB Smart Inverter integration via IEEE 2030.5 & 1547 (SEP2.0 & SAE J3072)

- RESTful interface to actively manage DERs, and other grid devices
- **State of California mandates:** SunSpec's Common Smart Inverter Profile (CSIP) – 2030.5 Inverters
- REST interface on top of Modbus for smart inverters
- Designed to communicate to DER devices and aggregators
- Grid Forming Inverters



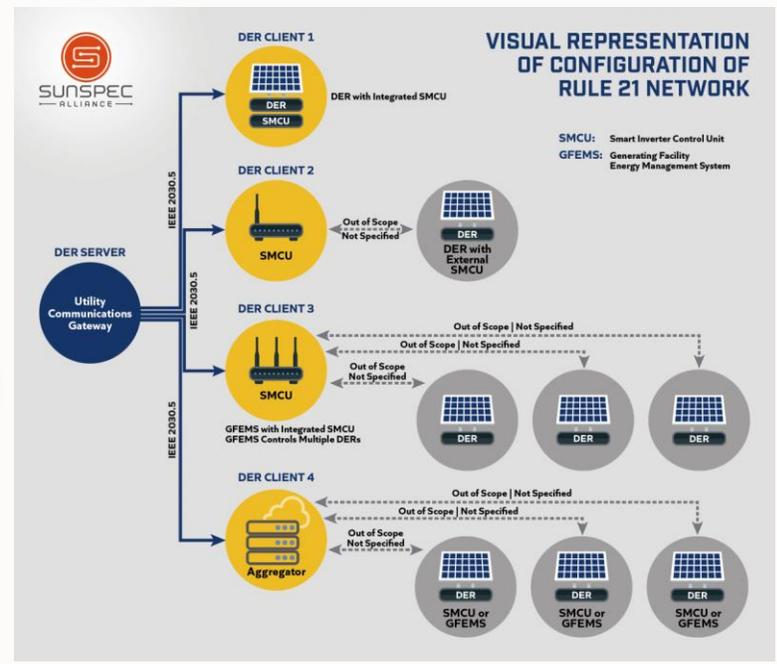
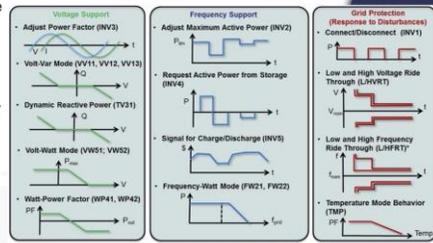
Defining Advanced Inverters

- **The context**
 - Total installed capacity of PV and ESS is growing fast
 - Large growth expected in distribution systems
- **The problem**
 - Because the grid is slow to evolve, we encounter technical challenges with voltage/frequency regulation, protection, etc.
 - Unless mitigated, these challenges will make it increasingly difficult and costly to continue integrating renewable energy
- **Advanced inverters are a big part of the solution**
 - Actively support voltage and frequency by modulating output
 - Have high tolerance to grid disturbances
 - Interact with the system via communications



...Faster than a tap changer
 ...More powerful than a rotating machine
 ...Able to leap deep voltage sags in a single bound

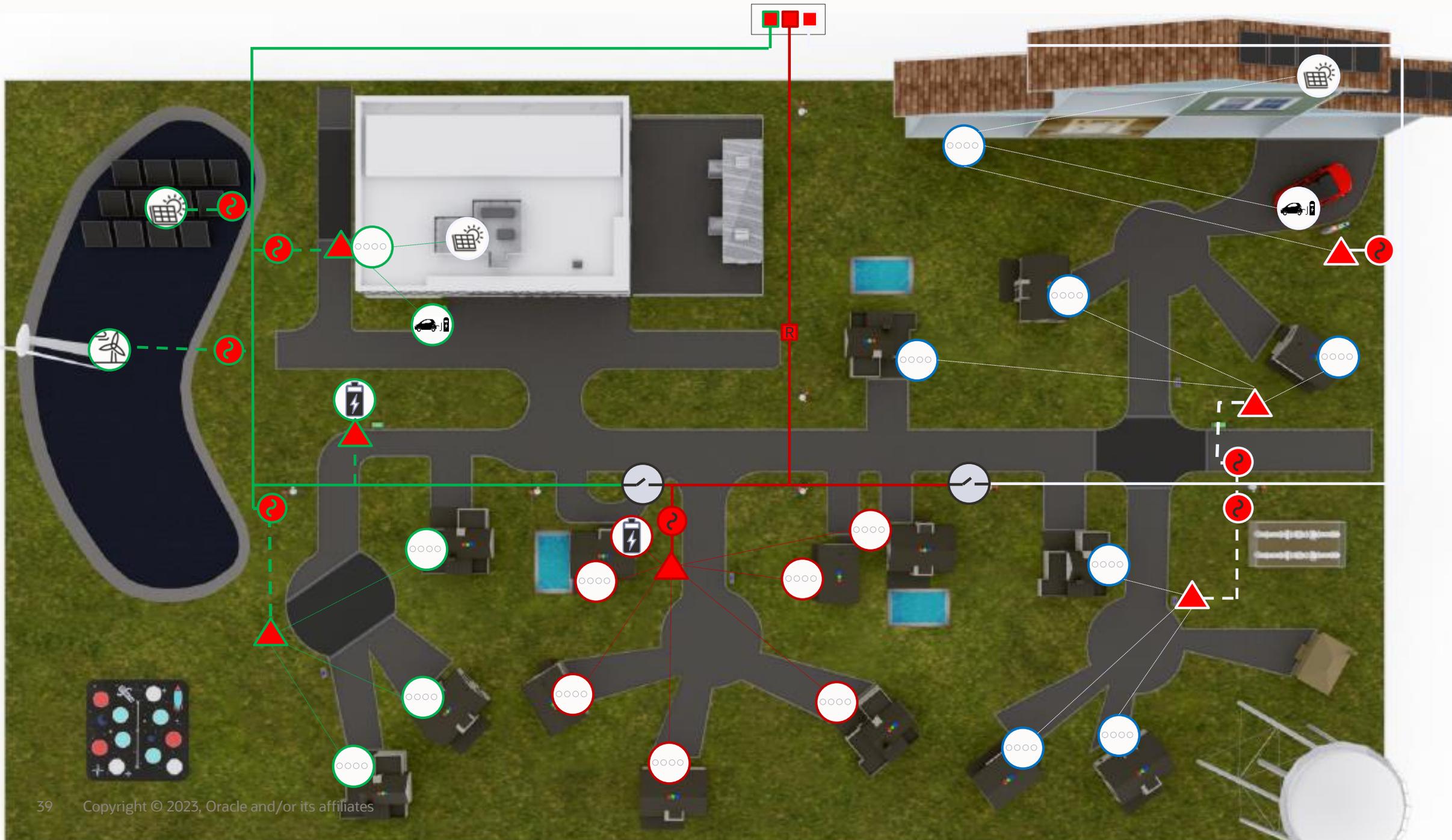
Courtesy of Fronius



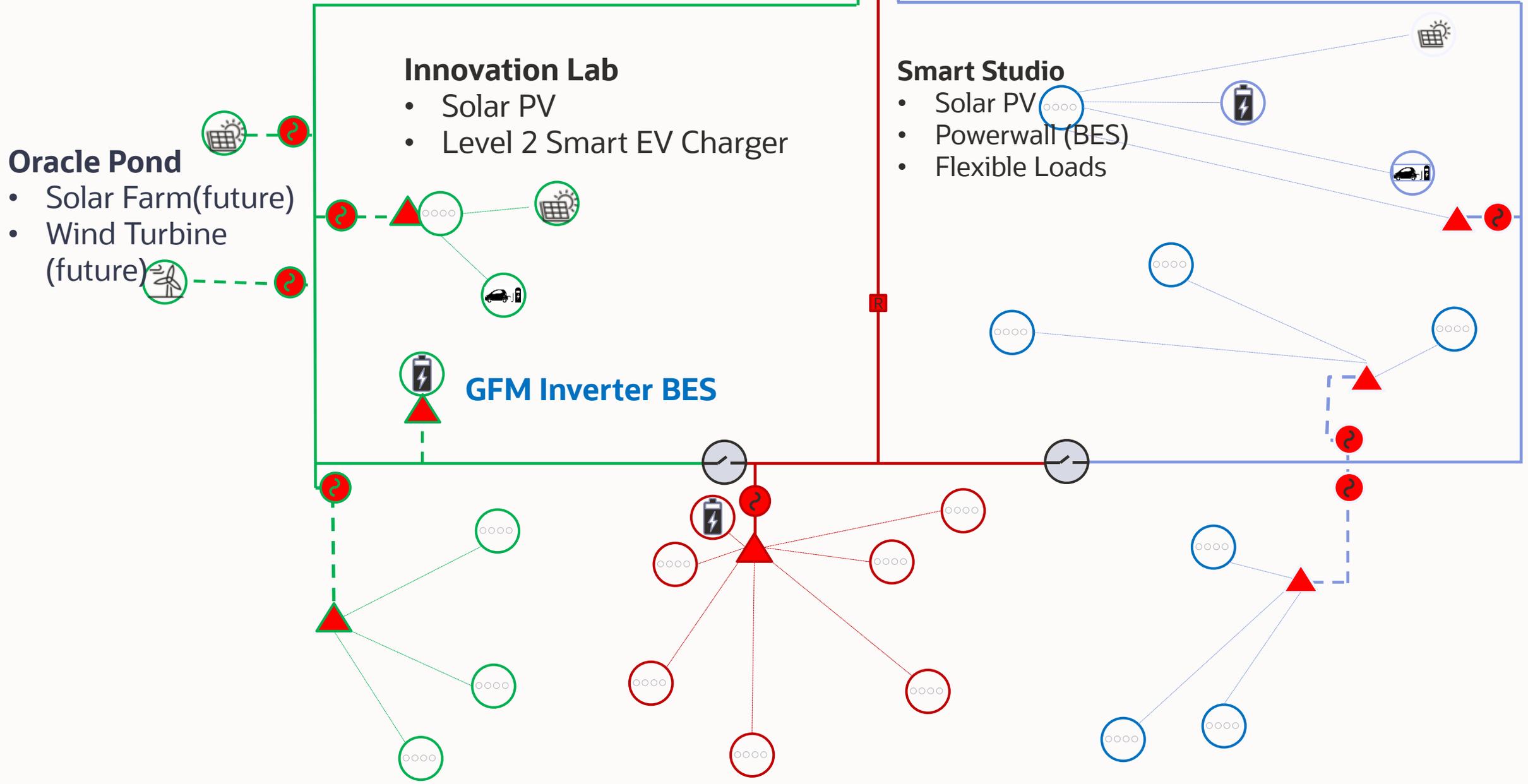
DER Optimization Use Cases

- DER dispatch, monitoring & control
- Smart EV Charging schedules
- DER volt/var control
- Grid stability: fast frequency/voltage response synthetic inertia / load balancing



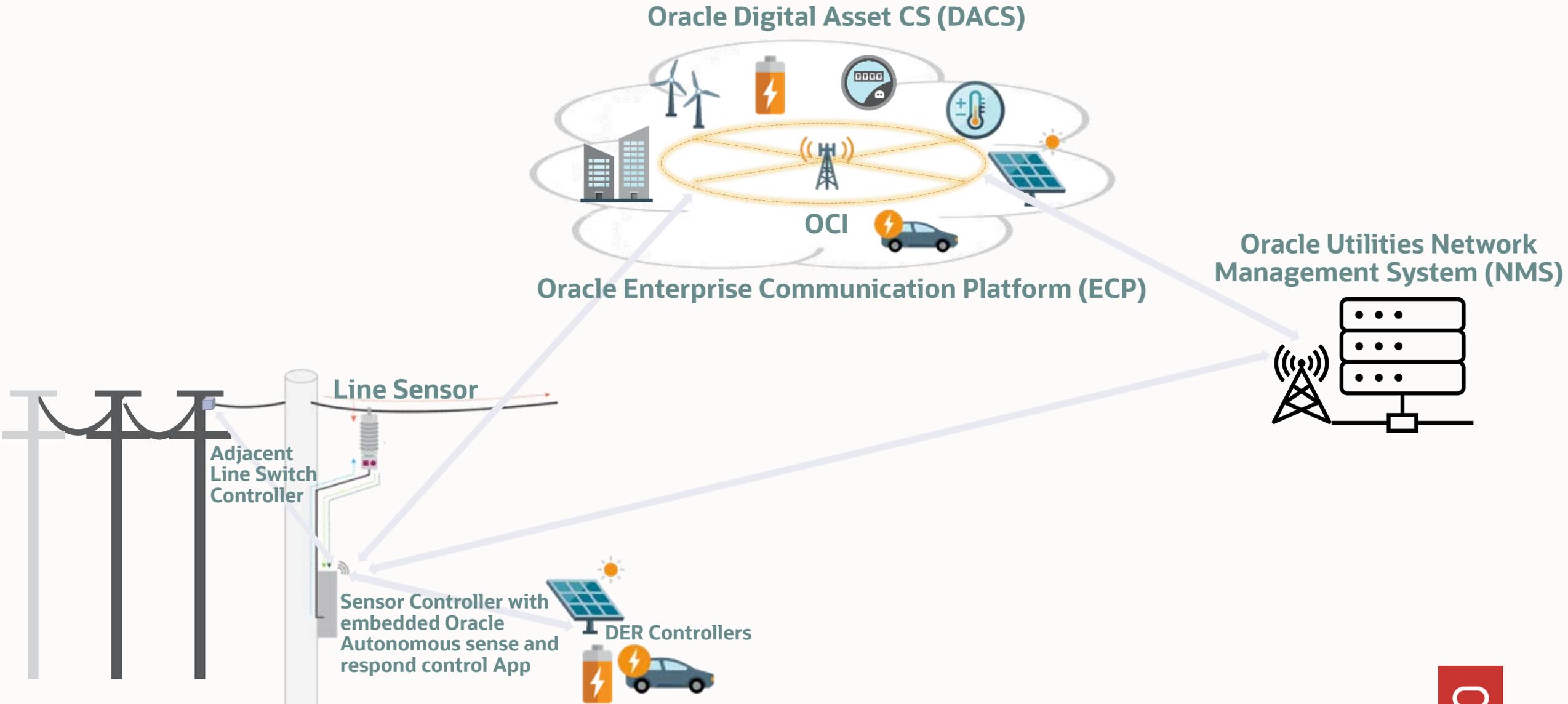


Chicago Innovation Center Substation



Autonomous Grid Edge Resiliency through Fast Risk Detection and Mitigation Response

with Centralized Control Room Situational Awareness and Overarching Authority



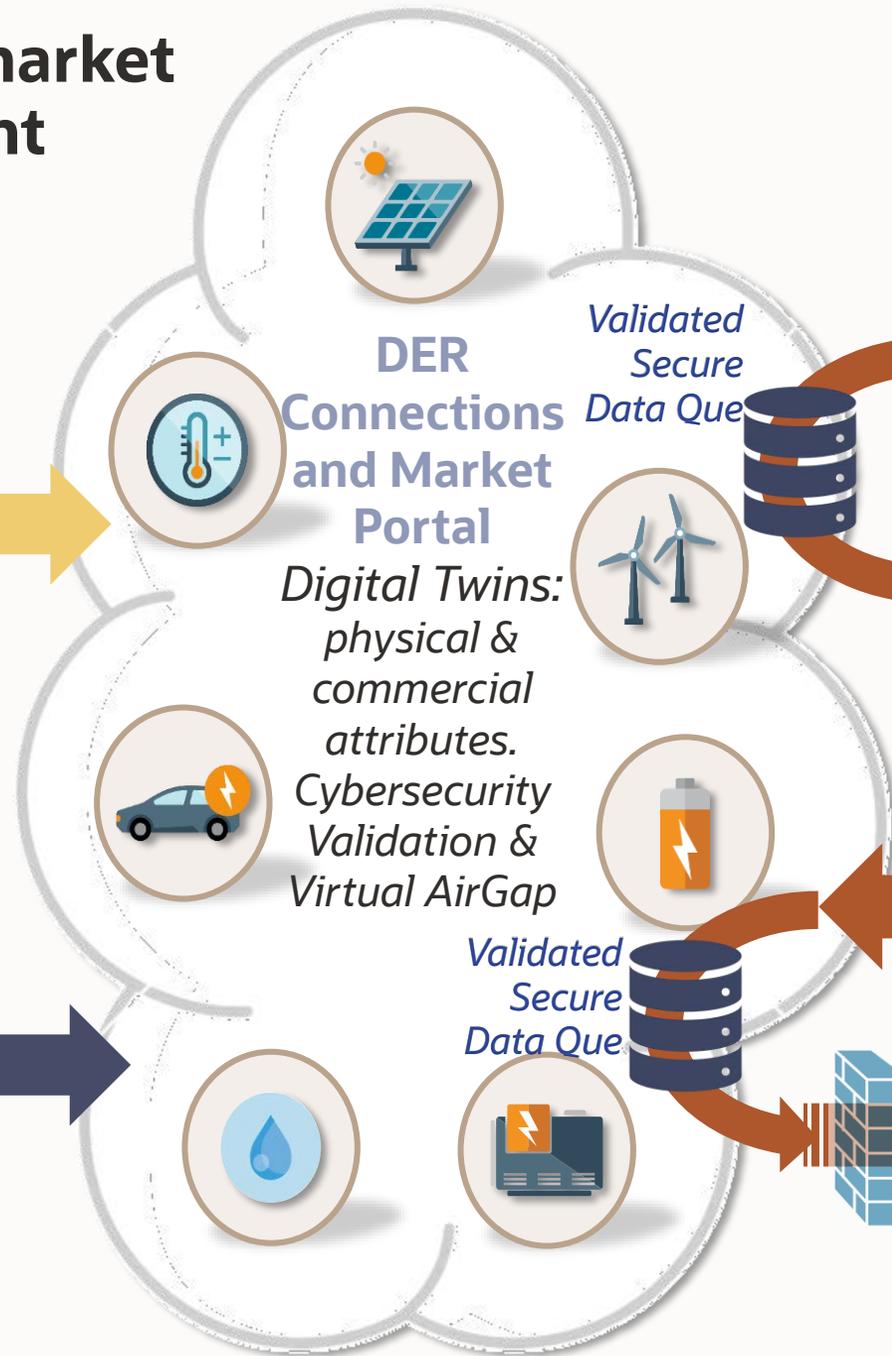
DER connections and market operations management Cloud Service

Future

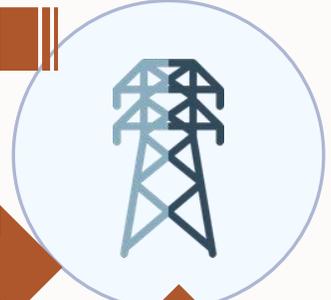
DER Devices



DER Aggregators



ISO Markets



DSO Operations

Energy & Grid Planning & Operations

- DER Connections Process & Planning
- ADMS/DERMS day-ahead market clearing & real-time optimization

Secure OT Network



Summary

—

Why Oracle?



Industry-leading OMS/ADMS platform by a leading enterprise software company

Proven Leadership

Most prudent investment



Storm-proven ADMS reliability and performance that even the largest utilities can count on

Scalable & Reliable

100% reliable when it counts most



Flexibility for mobile and remote workers, and the ability to quickly scale up as the situation arises

Flexible Workforce

Maximize worker efficiency



History of innovation resulting in robust DER-aware OMS, ADMS and SCADA capabilities

Innovation & Collaboration

Future ready



Transparent pricing and lowest total cost of ownership
Cloud-ready

Value & Transparency

Lower cost of ownership



Consistent track record of full scope project delivery on schedule and on budget

Service & Delivery

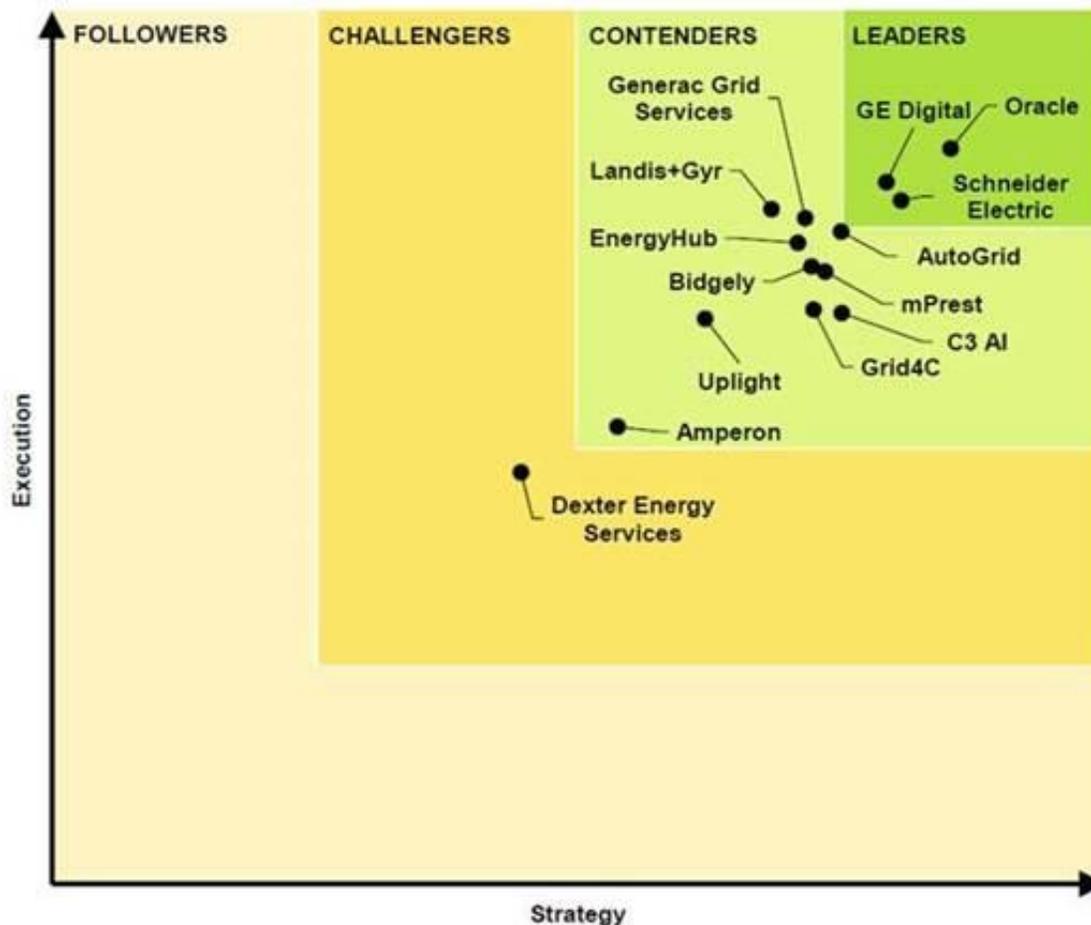
Fastest time to value



Oracle #1 in new Guidehouse Insights Leaderboard

AI Vendors for DER Integration Report

Chart 1-1. The Guidehouse Insights Leaderboard Grid



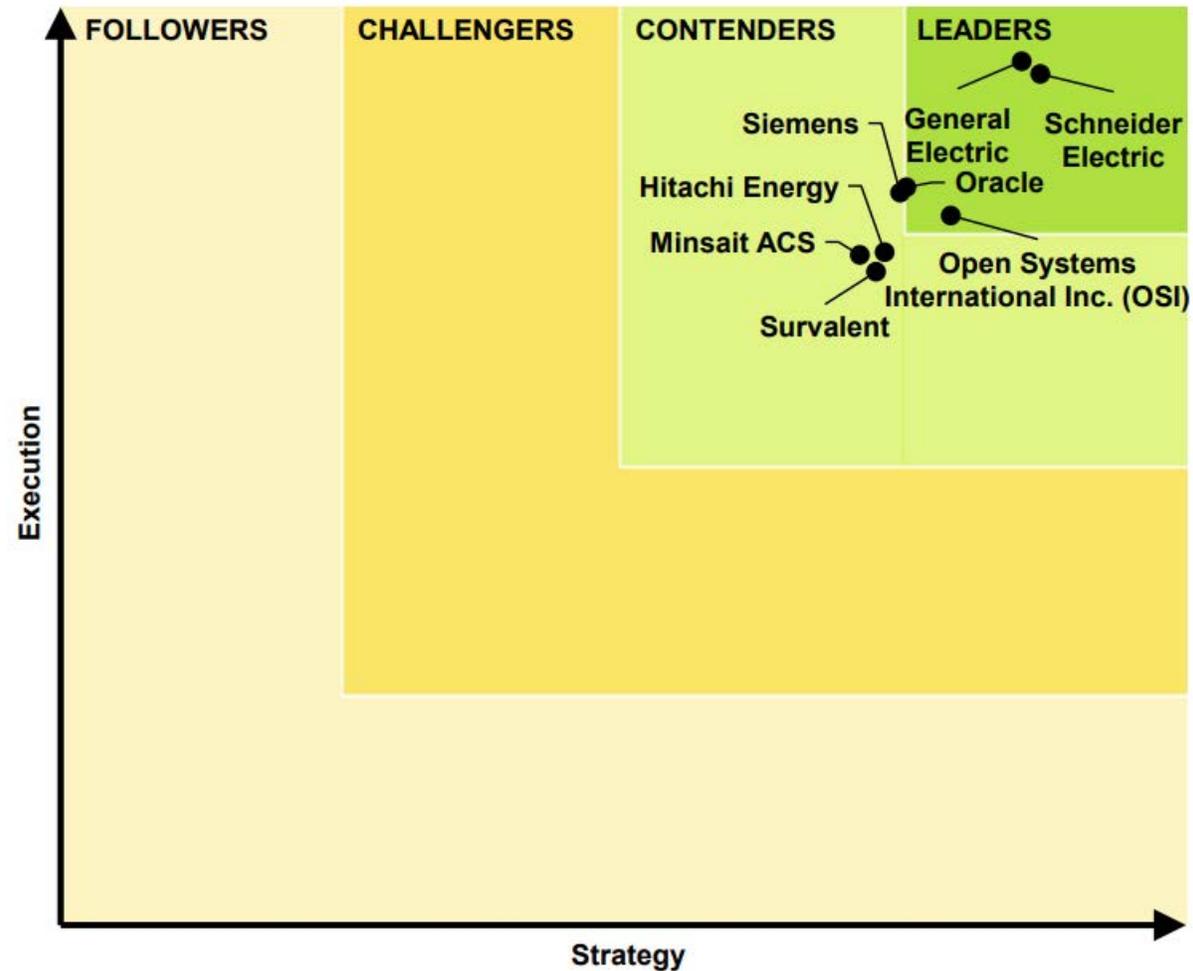
Oracle outranked GE Digital and Schneider Electric. According to Guidehouse...

“Leaders stand out from the competition because of their advanced technology and holistic application portfolios, flexible system architectures, sustainable business model, and significant market traction. Leaders in this analysis have taken a holistic approach, offering a wide portfolio of AI solutions for DER integration.”



Oracle as ADMS leader in Guidehouse Insights Leaderboard

Chart 1-1. The Guidehouse Insights Leaderboard Grid



(Source: Guidehouse Insights)

Oracle ADMS by Numbers

61M+

meters served

17 Million

service interruption
minutes avoided at a
single utility

6 of top 10

US utilities using
Oracle NMS

1.8 GW

DER modeled at one
utility

Customer Success



August 9, 16, 23
6M meters across
3 instances
On time, on budget



\$6.28M savings in first
3.5 years from using
FLISR



50% reduction in
switching errors 33,000
switch sheets annually