

Guided Procedures Through Extended Reality (IEC)

Empower Facility Teams and Reduce the Risk of Human Error With Extended Reality Guidance

EcoStruxure Power Digital Application

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EcoStruxure™ Power



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Overview

Context of Application

In the past, as electrical distribution systems and associated operation and maintenance (O&M) procedures evolved slowly, and as employees benefitted from decades of experience, O&M challenges were substantial, but manageable.

Nowadays, facility personnel encounter a rapidly changing technical environment, whose underlying structure is becoming increasingly automated and uses increasingly complex digital technology. It is significantly more challenging for them to master all operational, maintenance, and safety practices specified in manufacturers' technical manuals and procedures.

Consequently, they must regularly perform stressful O&M tasks they are not intimately familiar with, where human error could have serious adverse safety or uptime consequences.

Problem to Solve

The facility manager, maintenance manager, and technician need to:

- Operate and maintain the electrical distribution installation while mitigating downtime and reducing risks resulting from human error.
- Quickly resolve technical issues with complicated procedures they are not intimately familiar with.
- Easily access and comply with asset maintenance schedules, safety information, and associated documentation.
- Participate in training without impacting the live equipment.



EcoStruxure XR Operator Advisor Client App

Purpose of the Application

Provide supporting information to help analyze the status of equipment:

- Virtual single line diagrams overlaid on top of equipment
- "Points of interest" which can display electrical data (V, A, kW, etc.) or equipment/environmental conditions (temperatures, humidity, etc.)
- Easy access to related documentation

Provide extended reality step-by-step "Guided Procedures" for operations and maintenance, available on:

- Smartphones
- Tablets
- Mixed reality glasses

Enable remote collaboration with experts in other locations



Mixed Reality Glasses

Application Outcomes

Contextual Asset and Site Information

Points of interest can be configured and virtually displayed in front of equipment and devices to communicate site-specific safety and maintenance information and to access drawings, user guides, and multimedia.



Contextual Asset or Site Information overlaid on top of equipment

Overlaid Live Data

Device and equipment data can be virtually overlaid on equipment and viewed in the EcoStruxure XR Operator Advisor Client Mobile App and/or Desktop App, or through mixed reality glasses.

Overlaid Events and Alarms

Abnormal conditions are virtually overlaid on top of equipment and are highlighted to alert and guide users.

"X-Ray" Vision

Users can virtually look inside enclosures without the risks involved with opening doors or removing panels.



"X-Ray" Vision

Step-by-Step Guidance

Users have access to generic or site-specific procedures with step-by-step instructions.

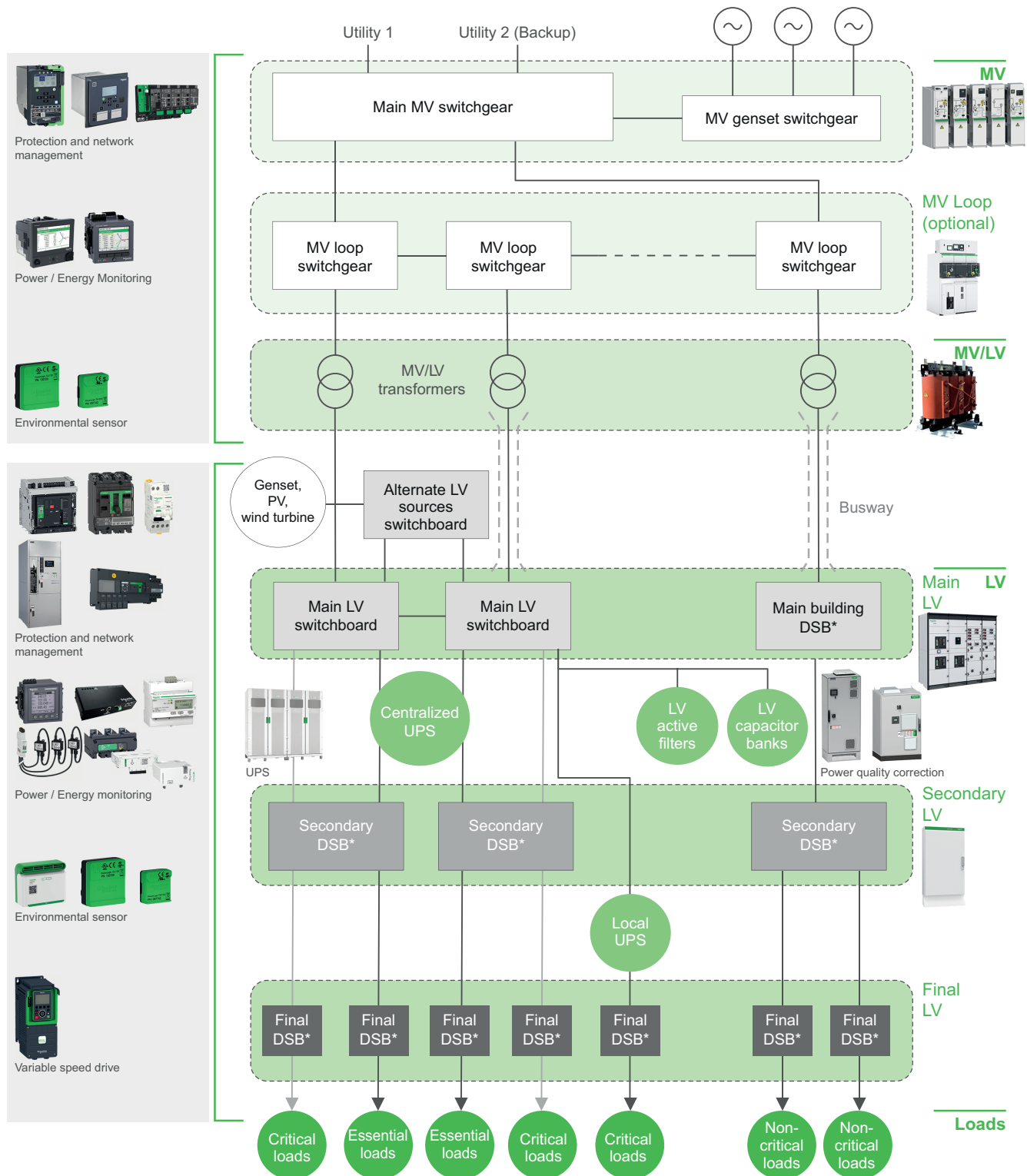
Data-driven step prerequisites can be configured to help ensure conditions are met before the next step can be started. Prerequisites can be status feedback from connected devices and/or pictures taken to document that actions were taken.

Remote Collaboration

A remote expert can support on-site personnel using the extended reality environment.

Electrical Architecture

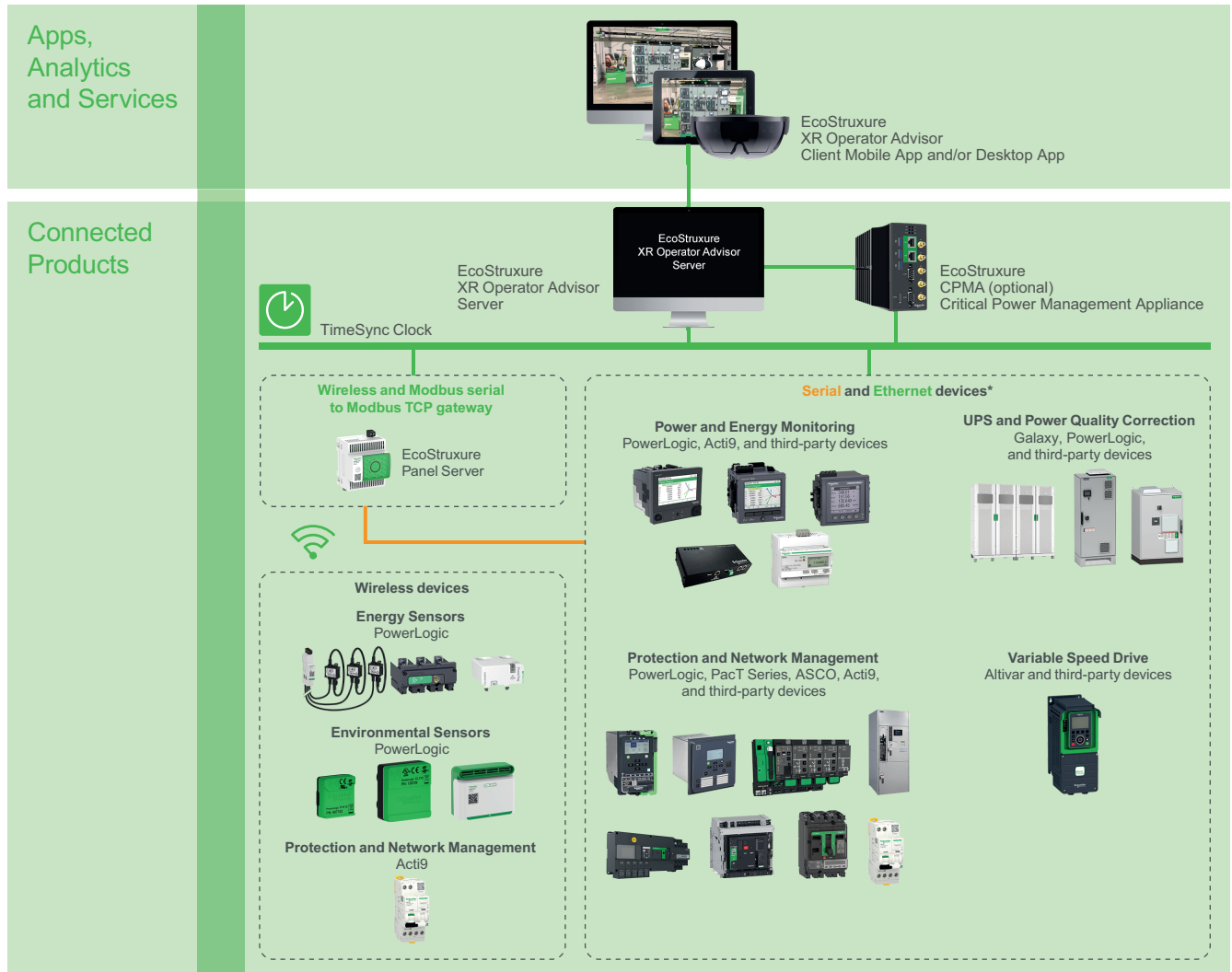
The following diagram illustrates the types of products that can be connected to enable the Guided Procedures Through Extended Reality application:



Digital Architecture

The digital architecture of the Guided Procedures Through Extended Reality application involves collecting the input data from the different products (including third-party), either directly over Ethernet, via gateways (such as EcoStruxure Panel Server), or through the EcoStruxure CPMA (Critical Power Management Appliance). This data is then passed to the EcoStruxure XR Operator Advisor Server for data processing. Data can then be viewed on different EcoStruxure XR Operator Advisor Client Apps.

The recommended digital architecture for the application is shown below:

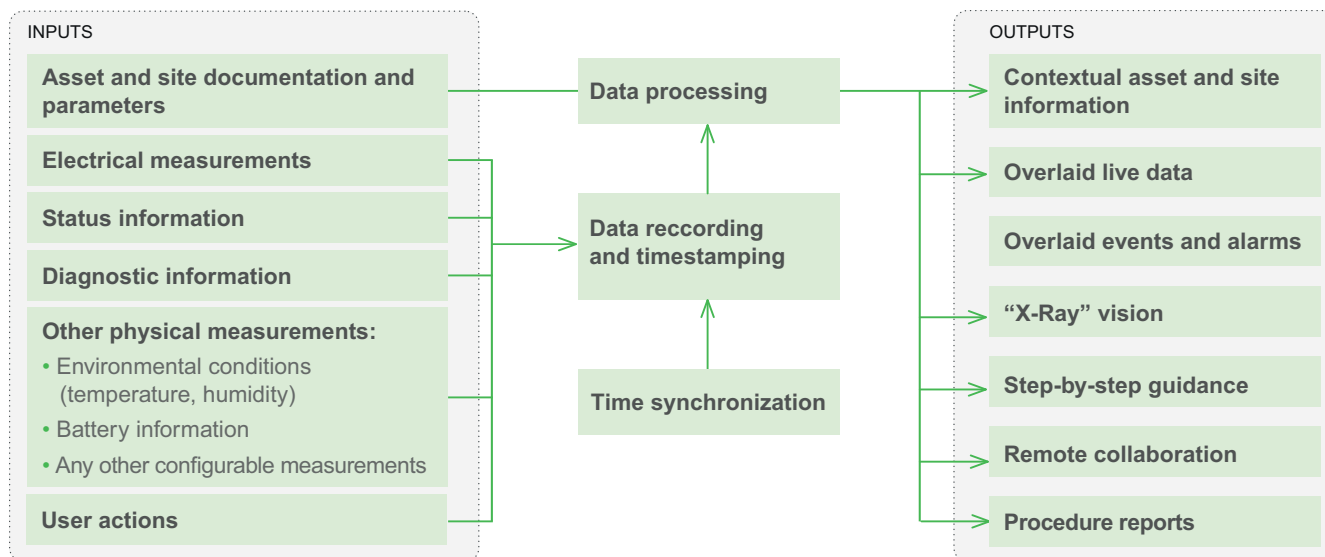


* Depending on the connected product chosen, communication protocols can be Ethernet or Serial.

System Description

Data Flow

The Guided Procedures Through Extended Reality application can be broken down as follows:



Inputs

The following data is required to enable the Guided Procedures Through Extended Reality application:

Asset and Site Documentation and Parameters

These data are configured during the commissioning of the Extended Reality environment. They may include:

- Site map
- Size and relative spatial position of assets
- Standard manufacturer-recommended maintenance procedures
- User-requested procedures for a given electrical asset
- User guides
- Drawings
- Maintenance schedules
- Procedures for operation and maintenance that involve more than one related electrical asset in a given system

Electrical Measurements

Real-time values can be read from connected devices such as power and energy monitoring devices, energy sensors, protection and network management devices. Typical values include:

- Current and voltage
- Power (Active, Reactive, Apparent)
- Frequency

- Power factor
- Energy



Power and Energy Monitoring

PowerLogic, Acti9, and third-party devices



Energy Sensors

PowerLogic and third-party devices

Status Information

Status information can be retrieved from connected products:

- Circuit breaker position (open, closed, racked-in, racked-out, etc.)
- Circuit breaker trip status and protection status
- ATS/PTS status, UPS status, and motor status
- Other statuses, operating modes, or conditions

The above information can come from circuit breakers, protection relays, UPSs, ATs/PTs, power quality correction equipment, variable speed drives, and other electrical distribution equipment, including third-party devices.



Protection and Network Management

PowerLogic, PacT Series, ASCO, Acti9, and third-party devices



UPS and Power Quality Correction

Galaxy, PowerLogic, and third-party devices



Variable Speed Drive

Altivar and third-party devices

Diagnostic Information

Connected products can also provide diagnostic data. This can include:

- Operating mode (normal/degraded/fault)
- Self-diagnostic data of electronic devices
- Specific data depending on equipment (opening time of a circuit-breaker, transfer time of a transfer switch, etc.)

Other Physical Measurements

Non-electrical measurements like environmental conditions (temperature, humidity, etc.) can also be integrated into the system.



Environmental Sensors

PowerLogic and third-party devices

User Actions

User actions are captured during all operational or maintenance activities.

Data Recording and Timestamping

For the Guided Procedures Through Extended Reality application, a timestamp accuracy of ± 1 second is sufficient to provide updated data to the user and monitor his actions.

Data recording and timestamping can occur at various levels for event data (status change, alarms, user actions, etc.) as well as for measurement data. Connected products, depending on the level of sophistication, can record and timestamp data as follows:

- **Event and measurement data recorded and timestamped on board:** power meters such as PowerLogic ION9000, PM8000, HDPM6000, and some PowerLogic PM5000 models (PM53xx and PM55xx)



PowerLogic
ION9000



PowerLogic
PM8000



PowerLogic
HDPM6000



PowerLogic
PM5000

- **Event data recorded and timestamped on board, measurement data not recorded onboard:** protection devices (PowerLogic P5/P3, MasterPacT MTZ, ComPacT NSX), ATS/PTS (ASCO 7000 Series PTS, TransferPacT Active Automatic), ATS controller (PowerLogic T300), UPS (Galaxy VX/VL/VM/VS), power correction devices (PowerLogic PFC and AccuSine PCS +/PCSn/EVC+/PFV+), VSD (Altivar)

PowerLogic
P5PowerLogic
P3PowerLogic
T300MasterPacT
MTZComPacT
NSXASCO
7000 Series
PTSTransferPacT
Active
AutomaticGalaxy
VX/VL/VM/VSPowerLogic
PFCPowerLogic
AccuSine PCS
+/PCSn/EVC
+/PFV+

Altivar VSD

- **No onboard recording at all:** some energy/power meters (entry-level PowerLogic PM5000 models, Acti9 iEM3000, Acti9 Active, PowerLogic PowerTag), environmental sensors (PowerLogic TH110, CL110, HeatTag)

PowerLogic
PM5000Acti9
iEM3000Acti9
ActivePowerLogic
PowerTagPowerLogic
TH110PowerLogic
CL110PowerLogic
HeatTag

When EcoStruxure CPMA (Critical Power Management Appliance) is part of the architecture:

- All data recorded and time-stamped onboard connected products are retrieved with their original timestamp and recorded by EcoStruxure CPMA.
- Data which are not recorded onboard connected products are also retrieved but as real-time data. Recording and timestamping is carried out by EcoStruxure CPMA. The EcoStruxure XR Operator Advisor Server then connects to the EcoStruxure CPMA as a single data source to overlay status, alarms, and measurements in the EcoStruxure XR Operator Advisor Client Apps.

When EcoStruxure CPMA is not part of the architecture: EcoStruxure XR Operator Advisor Server must connect directly to all connected products to retrieve status, alarms, and measurements as real-time data and overlay them in the EcoStruxure XR Operator Advisor Client Apps.

During the execution of procedures, the EcoStruxure XR Operator Advisor Server records and timestamps all user steps with their duration.



EcoStruxure
XR Operator Advisor
Server



EcoStruxure
XR Operator Advisor
Client



EcoStruxure
CPMA

For a comprehensive overview of device recording and timestamping capabilities, refer to Time Synchronization Capabilities of EcoStruxure Power Connected Products.

Time Synchronization

For consistent timestamping of all the data, the date and time should be accurately distributed to connected products and data loggers.

Time synchronization can be performed through various technologies (PTP, NTP, SNTP, etc.). An external master clock may be required and can be connected to a GPS antenna to reach the expected time precision.



TimeSync Clock

Data Processing

Data processing is performed by the EcoStruxure XR Operator Advisor Server. Data collected can be compared between communicating devices and/or to configured thresholds.

Trigger conditions calculated by the server use these data comparisons to determine if an operator can move to the next step of a procedure.

Additionally, the relative location of operators is calculated and can enable spatial trigger conditions that help prevent an operator from proceeding unless he or she is in the correct position.



EcoStruxure
XR Operator Advisor
Server

Outputs

Outputs are displayed in EcoStruxure XR Operator Advisor Client which can be accessed both locally, with a smart device or mixed reality glasses, and remotely using the PC based application.



EcoStruxure
XR Operator Advisor
Client Mobile App and/or Desktop App

Contextual Asset and Site Information

The following information can be embedded in points of interest and virtually displayed in front of equipment and connected products:

- Safety information
- Maintenance information
- Drawings
- User guides
- Multimedia, etc.



Contextual Asset and Site Information

Overlaid Live Data

The following equipment and device data collected by the server can be displayed in EcoStruxure XR Operator Advisor Client :

- Electrical measurements
- Equipment status information
- Diagnostic information
- Other physical measurements

When viewed through a smart device or mixed reality glasses, the data is virtually overlaid on top of equipment and connected products.



Overlaid Live Data

Overlaid Events and Alarms

Alarms can be configured to alert energy managers or operations staff in case of events that require attention, such as:

- Exceeded threshold
- Electrical tripping
- Risk of arc flash
- Change in relative user position

Pop-up messages or visual changes can be configured to communicate the alarm or event conditions described above.



Overlaid Events and Alarms

"X-Ray" Vision

Operations staff can virtually look inside equipment without the risks associated with opening doors and removing panels. This is done by toggling the visibility of interior images overlaid on top of the equipment.



"X-Ray" Vision

Step-by-Step Guidance

- Operations staff can access generic or site-specific procedures configured using a decision tree interface that provides step-by-step instructions to complete relevant tasks.
- Procedures can be specific to a single equipment or span a sub-system of equipment in a user's installation.
- Step prerequisites, based on connected product data or relative user position, can be configured to help ensure conditions are met before the next step can be started.



Step-by-Step Guided Procedures

Remote Collaboration

- Users in multiple locations can access the extended reality environment to collaborate and coach others in real time with on-site situational awareness.
- The spatial position of collaborators is made viewable using virtual avatars.

Procedure Reports

- After a procedure is performed by an operator, a report can be viewed to attest to its completion or if the procedure was not completed.
- In case a procedure is interrupted, the report can help initiate the review and improvement of either of the procedure, tooling, or operator training.

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