GE Power
Real-time Insight
TRANSLATING DATA TO ACTIONABLE INTELLIGENCE
FOR EMPOWERED DECISION MAKING
imagination at work

Today's Environment

To give a sense of the scale of the volume of data in a power system, a North American distribution utility with about 5 million customers translates to a network model size of about 22GB.

Smart grid advances are expected to increase the quantity of data that utilities have to manage by a factor of 10,000.

98% of the most effective companies working with Big Data are presenting results of the analysis via visualization.

As smart grids and meters become more common across the industry, the amount of data available to be gathered and analyzed will skyrocket – reaching 100s of terabytes every year.

The number one challenge utilities experience in terms of data management is identifying what data is relevant.

The amount of data being generated by utilities is astronomical and growing every day. Utilities have new sources of data but do not know how to utilize this data or gain the intelligence from it to make operational decisions.

50 Bytes

Amount of data generated **per hourly read per meter**

5 Million

Number of meters in a large distribution system

494 Megabytes

Amount of data from synchrophasors **every minute**

20 Terabytes

Amount of data from power flow results calculated **every 15 minutes for 1 year** for a distribution system with **5 million customers**

15 Seconds

Average amount of time a utility manager can afford to spend trying to get value from all of this data

INDUSTRY CHALLENGES

AN OVERWHELMING AMOUNT OF NEW AND DISPARATE DATA

New automation technologies, smart sensors and improvements in the communication capabilities of devices have enabled real-time access to information from automatic switches, line sensors and smart meters. Control room systems, such as AMI, SCADA, ADMS, OMS, GIS, EMS and many other systems external to the enterprise, including load, resource schedules and forecasts, are also contributors to increasing information. By conservative estimates, the amount of digital information increases tenfold every five years.

These advancements have allowed for the collection of critical operational data from multiple locations, devices and systems, translating to a wealth of data that the organization now has access to. But for data, quantity does not equal quality, and for most organizations data is neither integrated, readily available nor shared across organizational silos. Organizations are coming to the realization that collecting data is only the first step in the process of managing data.

CUSTOMER CHALLENGES

TRANSLATING DATA INTO REAL-TIME KPIs AND ACTIONABLE INSIGHTS

This new and ever-increasing abundance of data being collected is often overwhelming for most organizations, and as a result, usually underutilized.

Utilities have invested in equipment and software solutions that facilitates the gathering of an ever-increasing amount of data. They are now faced with the challenge of how to meet business objectives and effectively generate a return on their investments utilizing that new data.

Companies often find it challenging to translate the large volume of data being gathered into useful information, especially for various key stakeholders who often have different Key Performance Indicators (KPIs). These KPIs will also continue to change and evolve over time with future user requirements, presenting further hurdles to the enterprise.

The utility's IT departments are often asked to make sense of this wealth of data and deliver value from it. Developing in-house solutions to support these requirements for their internal customers generates prohibitive costs and requires significant resource allocations for the enterprise.

DEALING WITH DATA IS COMPLEX, TIME-CONSUMING AND PRESENTS AN OBSTACLE IN EFFECTIVELY, AND PROACTIVELY, MANAGING THE GRID.

Translating Data to Actionable Intelligence for Empowered Decision Making

GE's Real-time Insight software solution provides a platform that aggregates, integrates, correlates and visualizes power system data, in real-time, from multiple internal and external sources or systems into one dashboard view. This new visualization of data can then be utilized to drive critical and actionable business and operational decisions to meet KPIs and power system performance metrics.

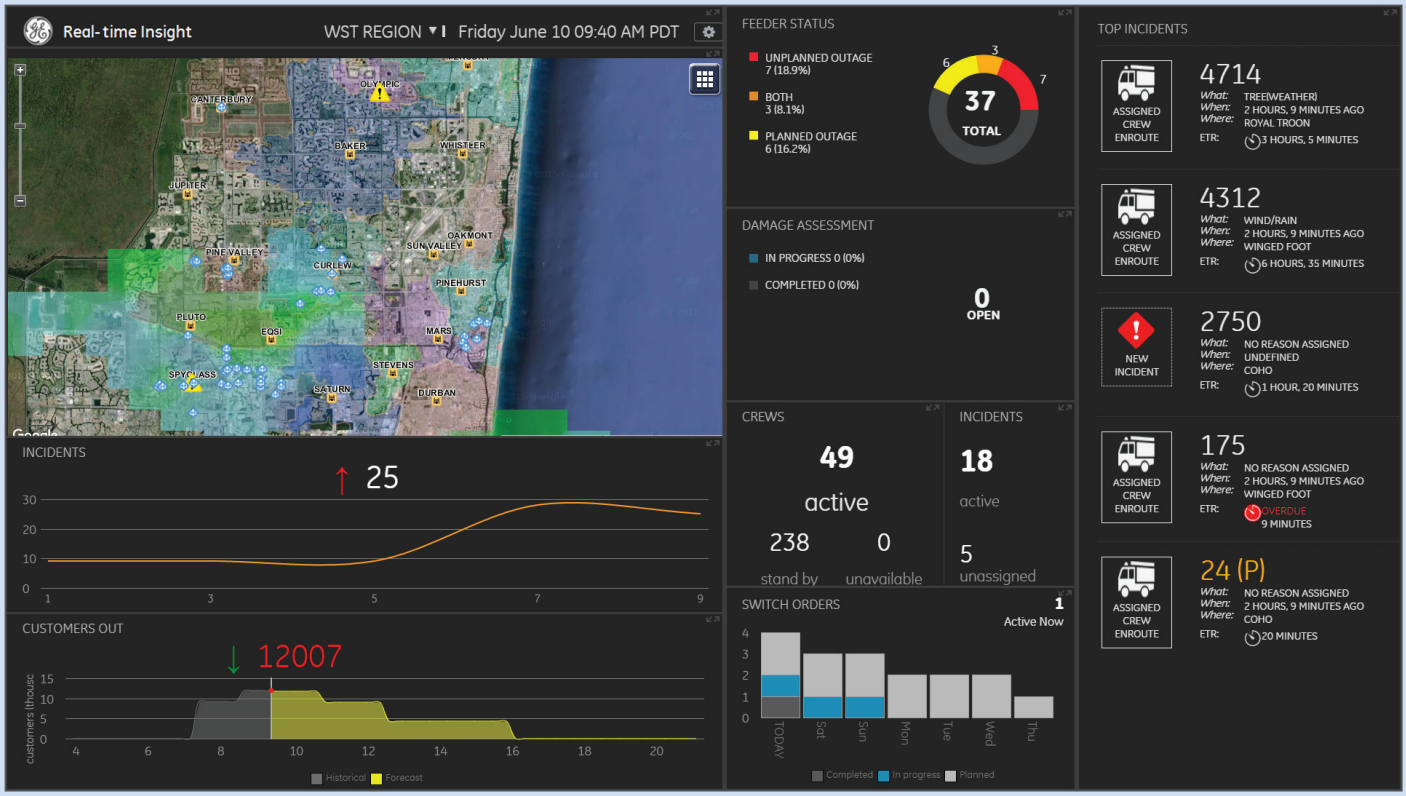
Utilizing an extensive library of both pre-designed and customizable widgets, Real-time Insight allows each end-user to customize the output of their data to create and visualize the intelligence needed to support their unique requirements. Deployment is flexible and can be delivered as a desktop (which may be interactive and provide additional application functionality), as a true dashboard (wall-mounted display) or as a mobile client.

Real-time Insight has been built as a scalable and diverse solution and can be utilized as an application development platform to develop future applications such as distributed energy resource management (DERM), forecasting or call center tools.

GE has over a 100+ years in the design, development and manufacturing of power system devices and components. Leveraging this knowledge to build software solutions for the key industries it serves — energy, oil and gas, and industry and infrastructure — GE's objective is to maximize operational reliability and efficiency for its customers.

Maximizing on the manufacturing experience, industry domain knowledge and extensive software capabilities, GE has designed Real-time Insight to address the industry-wide challenges customers face today to assist and prepare their organizations for the future.

Real-time Insight - Bridging the Gap Between Data and Intelligence



GE ADVANTAGE

Integrates Operational Data from Multiple Systems into a Single Consolidated View providing Real-time Visualization

- Correlates and visually displays data in one dashboard view, allowing individual stakeholders the ability to view key information associated with their role or use case and delivers valuable operational insights
- Aggregates data from all available business systems and functions providing organizations a single infrastructure and view of critical business information
- Enables utilities to expand the volume, variety, variability and velocity of existing data used providing insight into previously unused or unavailable information
- Incorporates an unlimited number of data sources from internal and external systems consolidating multiple sources, breaking down information silos within and external to the enterprise
- Administers real-time 24x7 data, via an Internet browser, through dashboard views or the platform's mobile capabilities, providing flexibility for stakeholders

Versatile, Scalable IT Platform providing a User-friendly, Customizable Solution Defined by User or Use Case

- Extensive, expanding and easily modifiable widget library with the ability to quickly develop new ones as user requirements change and evolve
- Customizable screens by role or use case with drag-and-drop widgets provides each user with access to the data they need associated with their KPIs
- Delivers a flexible and future-proof solution that can easily port to new technology and is not dependent on the "tool of the day"
- Security and authorization built into the product ensuring controlled access
- Flexible architecture with decoupling of servers - client (UI) decoupled from server/ server decoupled from client – allowing for easy replacement of either without impact
- Scalable and diverse solution designed to be utilized as a development platform to build applications such as DERM, forecasting or call center tools, extending the functionality of Real-time Insight to meet expanding IT development needs

Rapidly Deployed Solution offering a Lower Cost of Ownership

- Installation can be done in a week or less, dependent upon configuration, versus six months for other operational systems, allowing organizations to quickly realize the benefits of correlated and visualized data
- Pre-integrated with other GE solutions, such as SCADA, ADMS, OMS, EMS and GIS systems providing the lowest cost of integration and deployment
- Pre-integrated data sources lower total cost of ownership by avoiding expensive and difficult interface development and support by end-users

Integrates Operational Data from Multiple Systems into a Single Consolidated View providing Real-time Visualization

Correlated Data Visualized in One Dashboard View

Real-time Insight provides a platform that integrates data from multiple sources or systems into one dashboard view. Data is analyzed and processed in order to present important information to users with a wide variety of interests and priorities.

Superimposing data from multiple sources, and unrelated systems not designed to communicate or work together, enables more meaningful views of a stakeholder's KPIs in real-time, allowing for valuable visualization of critical information. Combinations of data from varied sources delivers greater opportunities to improve reliability and customer service as well as reduce cost.

Stakeholders - in the control room, board room and the field - are able to draw valuable insights on key information important to their role or use case. The dashboard environment delivers operational insights, facilitating data-driven decision-making, extracting value from the various streams of available operational and external data.

Incorporates an Unlimited Number of Data Sources from Multiple Internal and External Systems

The Real-time Insight platform was designed to interface with multiple data sources to create a "bigger picture" analysis. Information from both inside and outside the control room can be combined for further analysis and viewed in Real-time Insight.

Internal sources of data that can be incorporated include both GE and non-GE systems, such as ADMS, OMS, GIS, EMS and SCADA. External sources of data can include weather, forecast and schedules (e.g., energy storage charge and discharge schedules), news and information feeds.

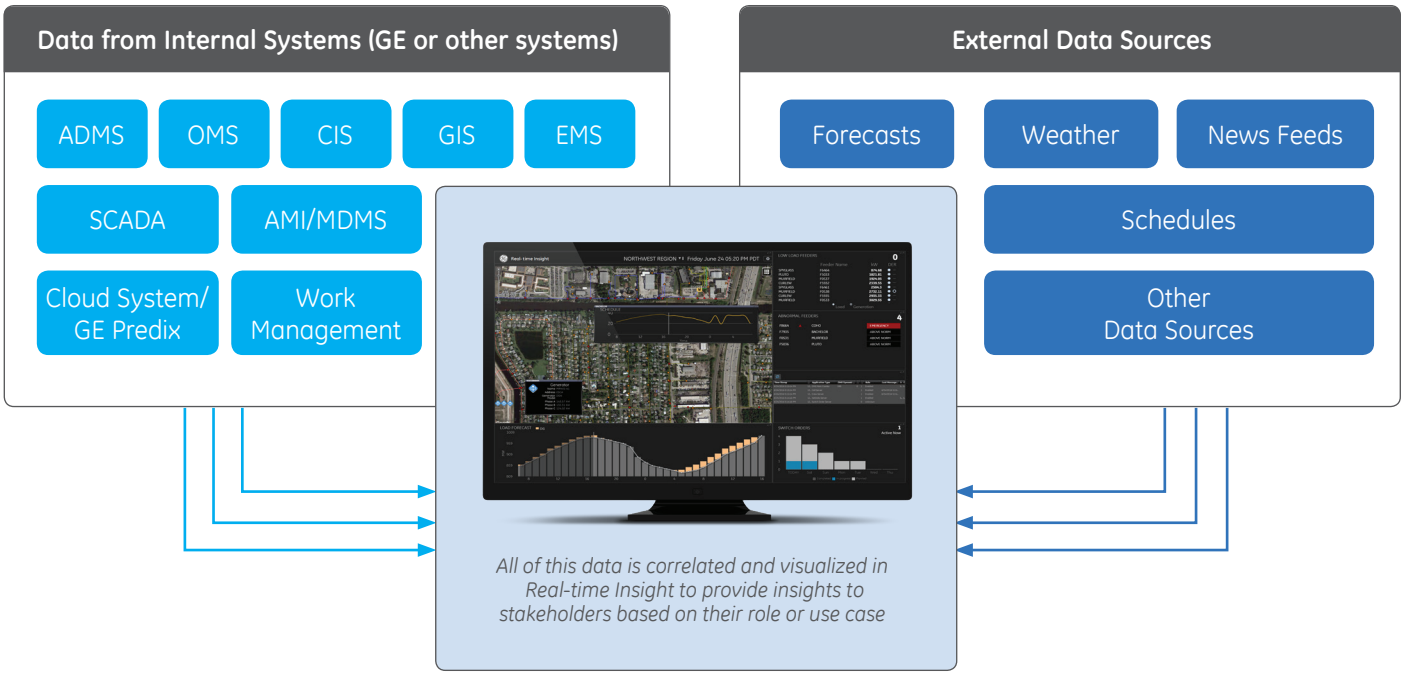
Mobile Capabilities for 24x7 Access

Real-time Insight applies a browser-based approach for flexible and secure mobile access outside of the office. Task-specific data and portals can be provided with secure access to any enterprise user of Real-time Insight. This enables 24x7 access to real-time information on important KPIs for those roles where availability is paramount, for example the corporate and public relations teams.

Effectively Collecting, Integrating and Displaying Data

GE's Real-time Insight extends the benefits of automated systems by providing a server/client platform for collecting, integrating and displaying information.

Information from internal systems, such as large data sets of a distribution utility, can be integrated with data from third-party systems, such as weather, traffic or news. Views can be constructed using real-time data, historical records and a multitude of other sources.



Versatile, Scalable IT Platform providing a User-friendly, Customizable Solution Defined by User or Use Case

Flexible and Future-proof Solution

Real-time Insight is built to be flexible and not dependent on the "tool of the day." On the client side, Google Web Toolkit (GWT) is utilized and coupled with Java on the server side. The platform can easily be ported to new technology in the future. For example, on the client side, C# or Java™ can be utilized. Security authorization has been built into the product ensuring controlled access.

Decoupling Client and Server

Decoupling the client from the server, and vice versa, allows Real-time Insight to deliver significant IT user flexibility. The client, the server, or both, can be replaced or altered without impact to the other. This reduces the risks associated with future system modifications and ensures testing is contained.

This structure was designed to deliver resiliency for IT departments. For example, if the system loses a client they are simply able to start another client, and the same applies to servers. The Real-time Insight platform was designed to run as many server applications on as many machines required by the user.

Built as a Scalable and Diverse Solution

IT departments are increasingly challenged with managing a broad range of requests for company-specific applications to support various stakeholder needs.

Designed to meet this challenge, Real-time Insight goes well beyond the dashboard. The Real-time Insight platform was designed to scale and can be utilized by IT departments as a development platform to build future applications such as DERM, forecasting or a call center tool.

Real-time Insight allows IT departments to work within GE's platform to develop targeted tools for their control centers as well as applications beyond the utility.

Rapidly Deployed Solution offering a Lower Cost of Ownership

Quick Installation

Installation can be done in a week or less, dependent upon configuration, versus the long and extensive process required for other critical operational systems.

This allows organizations to quickly realize the benefits of correlated and visualized data.

The Value of Pre-integration

Real-time Insight is pre-integrated with other GE solutions, such as SCADA, ADMS, OMS, EMS and GIS systems, significantly decreasing integration and deployment costs.

Pre-integrated data sources lower total cost of ownership by avoiding expensive and difficult interface development and support by end-users.

The Real-time Insight Dashboard – Designed to be Customized for the Role, User and/or Use Case

Real-time Insight empowers stakeholders in the control room, board room and the field, to access the right information at the right time in order to make faster and more accurate decisions with dashboards that adapt to a user's role and their KPIs. The dashboards translate data into personal, timely and relevant insights that increase grid flexibility and optimize operations.

Energy Management Use Case

Real-time Insight delivers increased situational awareness about the transmission system. Dashboards provide "information at a glance" and allow operators to quickly assess the level of risk, drill down to details or specific data on individual assets as needed, and make more informed operational decisions-all to sustain a secure and stable Energy Management System (EMS). Information available from EMS applications such as State Estimation, Power Flow and others can be combined with data from sources such as schedules, maps, and weather to provide additional real-time, visualized information to stakeholders inside and outside of the control room as required.

Distribution Management Use Case Example and Resulting Dashboard

Real-time Insight enables the collection and display of key information across the entire distribution system. Even during normal operations, KPIs provide the ability to quickly see the status of the system across multiple service territories with dozens or hundreds of operators and field crews.

Displays selected region

Feeder Name widget displays distributed generation resources (DER) contribution by feeder

Abnormal Feeders widget identifies feeders in abnormal state and status

Schedule widget identifies trends of historical and forecast data and can be accessed on demand

DMS/OMS System Performance and Statistics Log

Users can customize main geographic display to have a focus on major alerts, real-time topology, weather, etc.

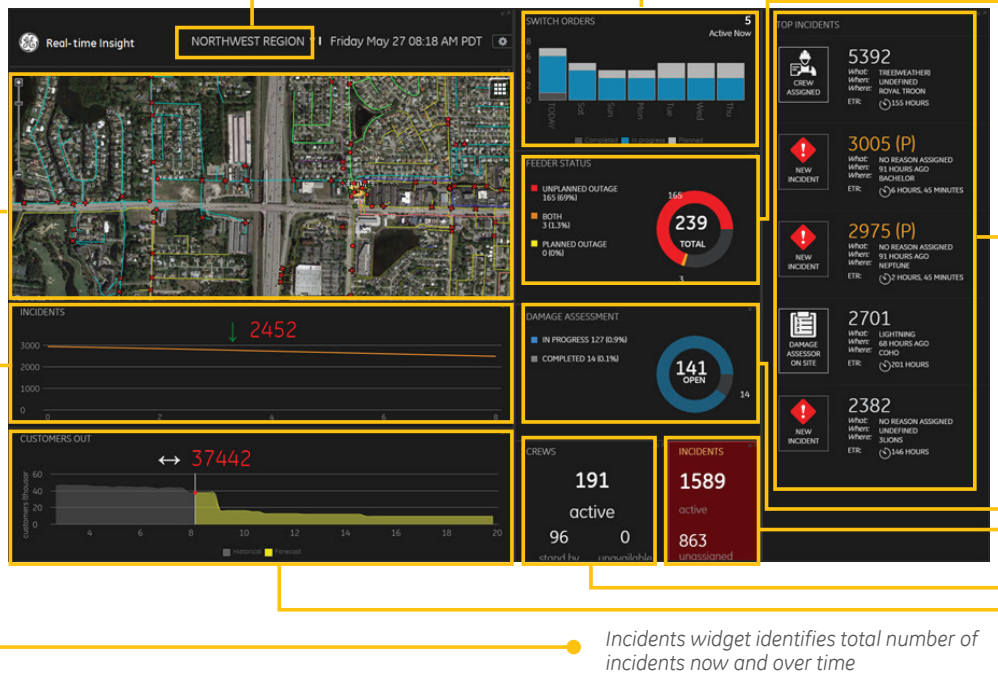
Switch Orders widget displays switch order activity

Load Forecast widget identifies historical native/DER supplied load and forecast

Detailed real-time information can be queried directly in the display

Outage Management Use Case Example and Resulting Dashboard

Large storms create high-levels of activity managed by many different people across the organization. Real-time Insight enables utilities to gather important information about the existing conditions and status of the restoration process to ensure the fastest-possible recovery time.



Displays selected region

Switch Orders widget identifies activity today and activity scheduled for future

Feeder Status widget identifies total number of feeders as well as feeders with problems

Top Incidents widget lists top 'n' incidents ranked by size, with status

Damage Assessment widget identifies incidents that require damage assessment (DA) as well as status of DA

Incident Summary widget identifies total number of active as well as unassigned incidents

Crews widget identifies crews that are active, on standby and unavailable

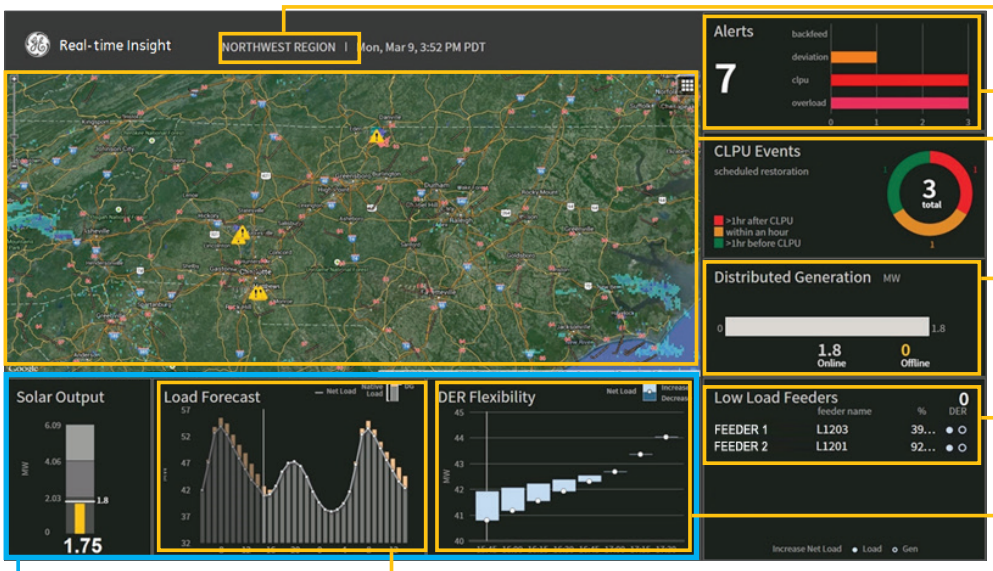
Customers Out widget identifies total number of customers de-energized up until now and the expected restoration time

Incidents widget identifies total number of incidents now and over time

Users can customize main geographic display to have a focus on major alerts, real-time topology, weather, etc.

Distributed Energy Resource Management (DERM) Use Case Example and Resulting Dashboard

Real-time Insight is a true applications development platform that enables the development of new functionality such as a DERM system. Using ADMS model data and load flow results, weather and load forecasts, a complete set of new visualization and management of DER are available.



Displays selected region

Alerts widget identifies potential problems

Users can customize main geographic display to have a focus on major alerts, real-time topology, weather, etc.

Distributed Generation widget identifies how much distributed generation (DG) has been disconnected

Low Load Feeders widget identifies where back-feed risks are located

DER Flexibility widget answers user questions, such as:

- *How much flexible DER do we have?*
- *How can this change my load?*

These three widgets collectively provide information on distributed connected DG

Load Forecast widget answers user questions, such as:

- *What is the DG forecast?*
- *What is our net load forecast?*
- *How much is our native load?*

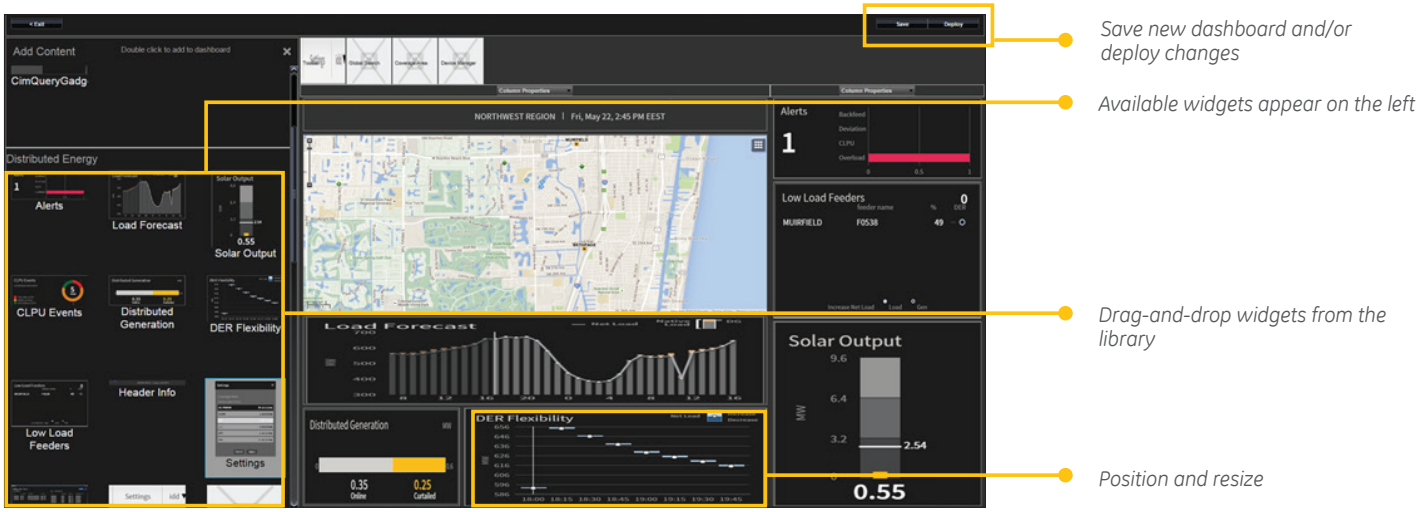
Real-time Insight enables a utility with low visibility into their network to use irradiance data and their distribution connectivity model to understand real-time DG contribution versus its native load. Real-time Insight delivers an understanding of both the utility's DG flexibility and their resource adequacy for restoration following system disturbances.

Building a New Dashboard is Simple

The Flexible Dashboard Environment

Dashboards can be created that provide views of the overall health of the system as well as detailed views of important components.

Multiple dashboards can be configured to provide customized data that is tailored for specific groups, for example corporate users, system operators, managers or customers.



Save new dashboard and/or deploy changes

Available widgets appear on the left

Drag-and-drop widgets from the library

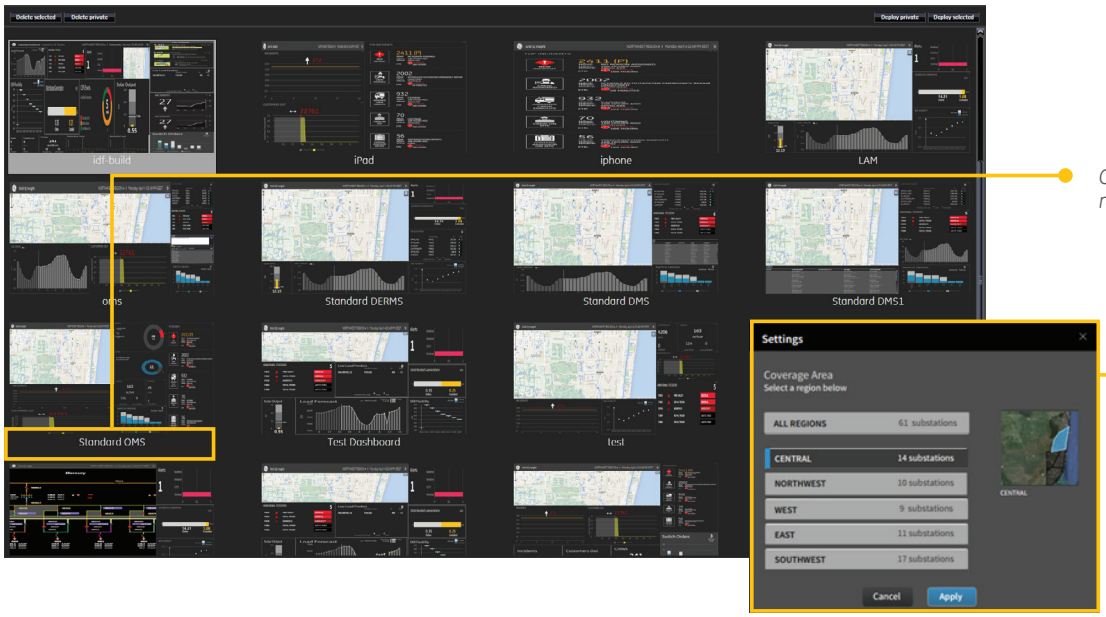
Position and resize

Accessing Saved Dashboards

Easy Selection and Configuration

Once created, dashboards are saved to the platform and can be accessed and utilized by other users in the system, dependent on role permissions. Each dashboard can display data for a pre-defined region:

- A region is an area of responsibility (AOR) or collection of substations
- Created based on ADMS regions
- Created during Real-time Insight deployment



Once built, each dashboard is represented by a name and image

Select region of focus

THE REAL-TIME INSIGHT WIDGET LIBRARY

Designed to be Customized for the Role, User and/or Use Case

Utilizing an extensive and continuously expanding library of both pre-designed and customizable widgets, Real-time Insight allows each user to customize the output of their data to create and visualize the intelligence needed to support their unique requirements. The data can be used to drive critical and actionable business and operational decisions to meet KPIs and system performance metrics.

The Intelligence Behind the Widget

Widgets are applications that incorporate interfaces, displays and business logic into a self-contained unit to provide specific information. A collection of widgets can provide a comprehensive collection of important data and information that serves a particular purpose. Widgets are even capable of providing data to other widgets to generate additional data for further analysis.

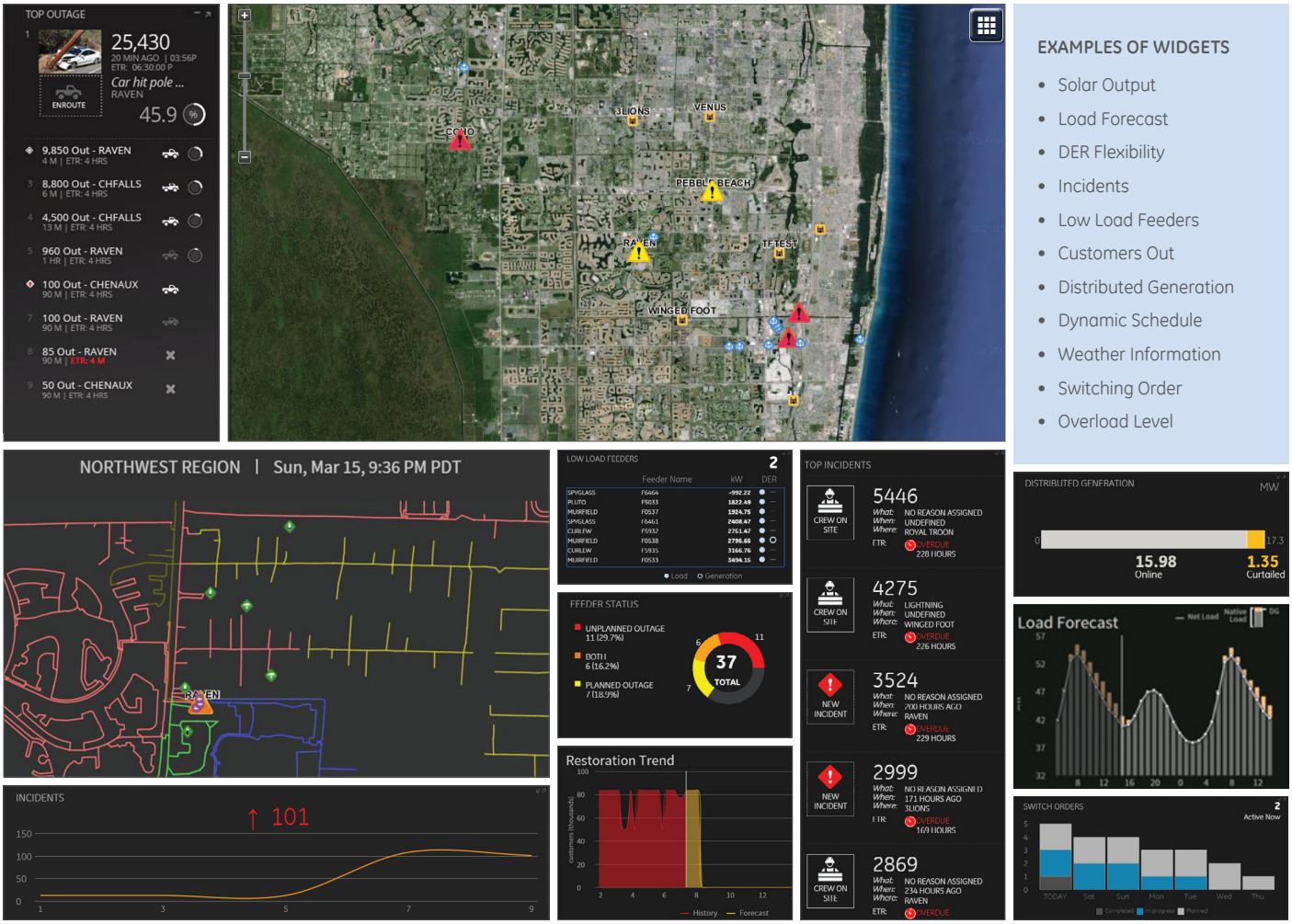
Perhaps most importantly, widgets enable the creation of information that no single system or data source can provide on its own.

The Widget Library

A library of widgets can be imported into a dashboard using "drag-and-drop" techniques to modify existing dashboards or create new dashboards. GE Real-time Insight customers have full access to a library of pre-configured widgets. Users are able to quickly develop new widgets as requirements change and evolve.

There are three basic types of widgets:

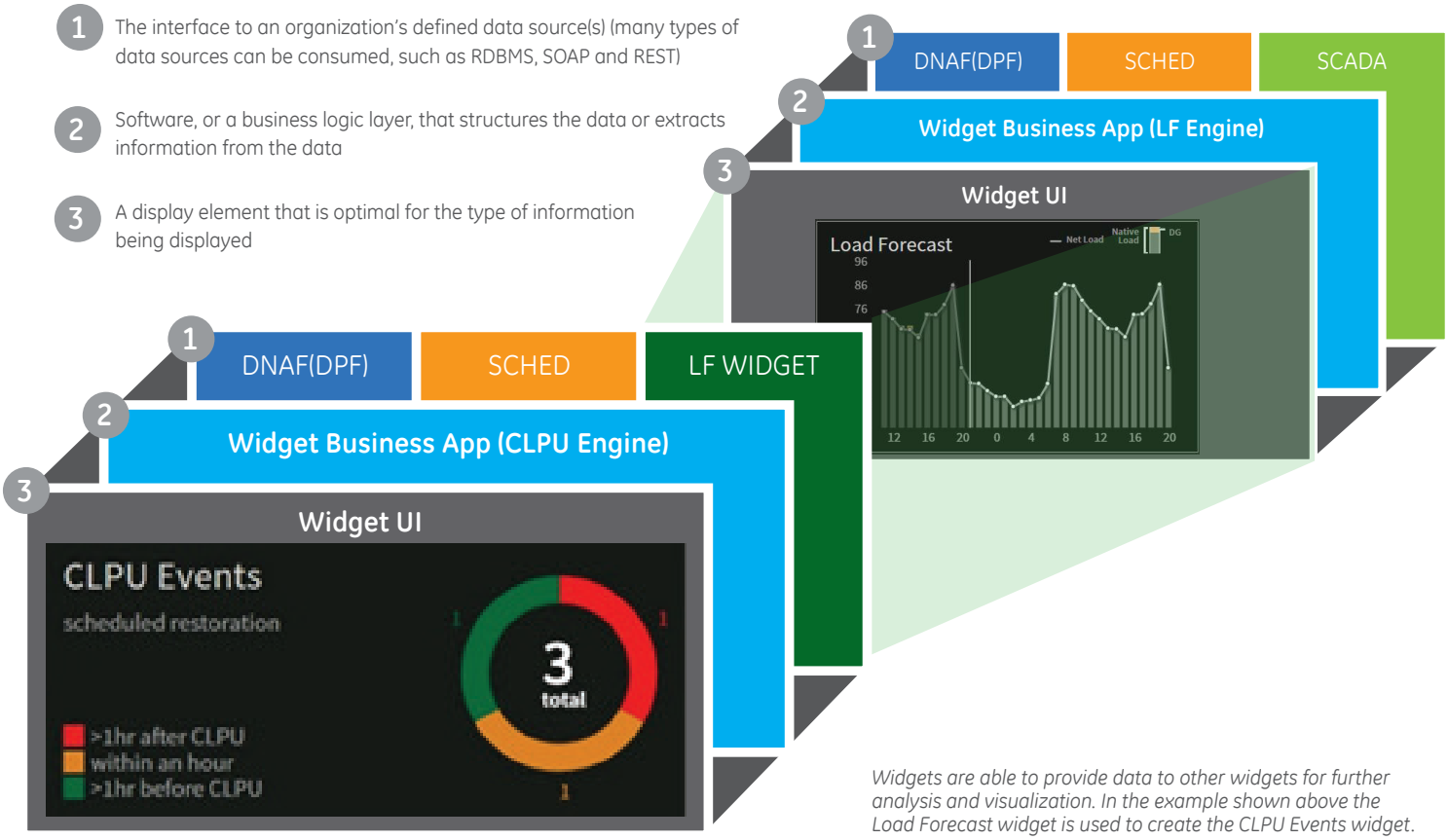
- **Map Widgets** show geospatial rendering of data from external sources including ADMS system displays, outage footprints and weather.
- **Information Widgets** display real-time or historical information from external sources such as the number of de-energized customers, time to restore service and the number of incidents.
- **Application Widgets** provide new functions to the user such as forecasts for wind and solar, market participation information, or other applications that can be derived from available data from interfaces or other widgets.



Widget Architecture

Dashboards are built using pre-configured widgets comprised of three parts:

1. The interface to an organization's defined data source(s) (many types of data sources can be consumed, such as RDBMS, SOAP and REST)
2. Software, or a business logic layer, that structures the data or extracts information from the data
3. A display element that is optimal for the type of information being displayed



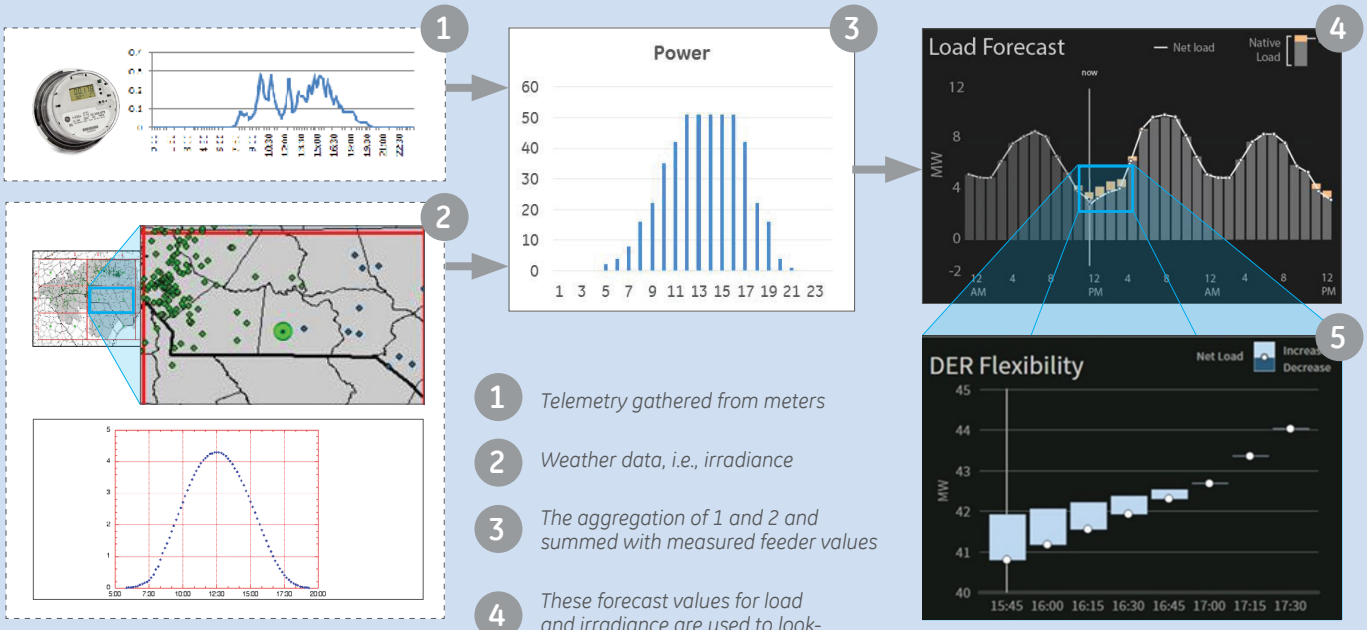
Widgets are able to provide data to other widgets for further analysis and visualization. In the example shown above the Load Forecast widget is used to create the CLPU Events widget.

Building a Widget

EXAMPLE ONE: Rolling Forecast of Load and Distributed Generation

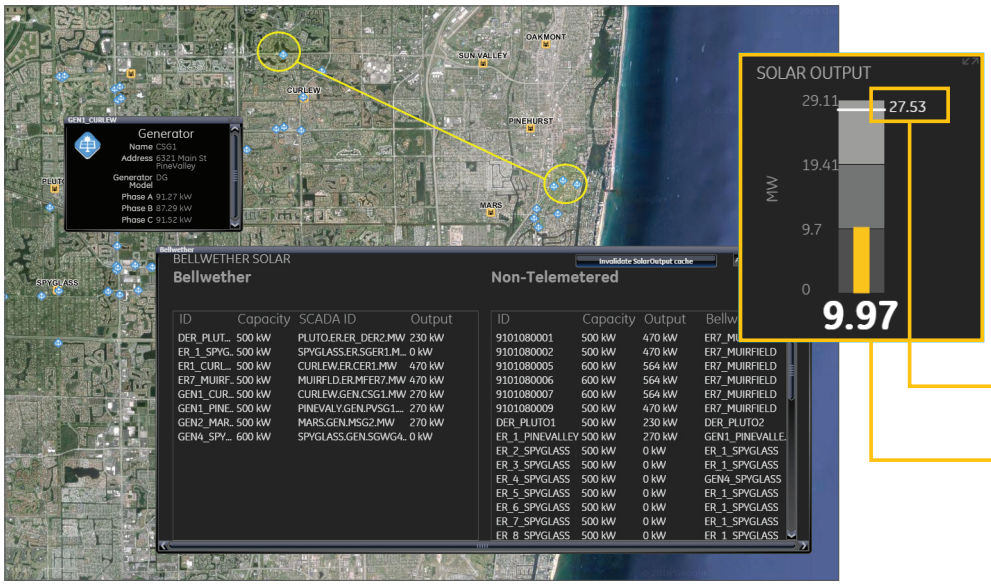
Load Forecast and DER Flexibility Widgets

ADMS systems are aware of DER/DG in the system model as well as their connectivity and operational status. Irradiance data, map/geo-spatial data and load profiles can be combined with ADMS data to calculate the load served by centralized resources versus load served by distributed resources. Understanding the native load, as opposed to the distribution-connected generation, is critical in managing restoration following an outage.



1. *Telemetry gathered from meters*
2. *Weather data, i.e., irradiance*
3. *The aggregation of 1 and 2 and summed with measured feeder values*
4. *These forecast values for load and irradiance are used to look-ahead, generating a 24–hour load and generation profile in the Load Forecast widget*
5. *The data from the Load Forecast widget is then used to generate the PV generation profile shown in the DER Flexibility widget*

EXAMPLE TWO: Solar Output – Photovoltaic Generation per Region



Solar Output Widget

Utilities are currently challenged to quantify the output from non-telemetered photovoltaic (PV) generation.

Utilizing external irradiance data from weather systems and locational and nameplate data from the utility's internal ADMS model, the output of non-telemetered PV generators can be estimated for power flow calculation and switching analysis.

Forecast at current time

Bellwether method:

- *Cycle sites over time*
- *Locate nearest online metered PV*
- *Assume actual vs. forecast at same ratio*
- *Aggregate all metered and unmetered PV based on dynamic topology*

GE's Real-time Insight Bridges the Gap Between Data and Intelligence

The Situation

New automation technologies, smart sensors and improvements in the communication capabilities of devices have led to an overwhelming amount of new and disparate data.

The Challenge

Organizations are coming to the realization that collecting data is only the first step in the process of managing data. Dealing with data is complex, time consuming and presents an obstacle in effectively and proactively managing the grid. The challenge for utilities is converting this data into something valuable and useful.

The Solution

Real-time Insight bridges the gap for utilities by translating data into actionable intelligence for empowered decision making. The Real -time Insight software solution provides a platform that aggregates, integrates, correlates and visualizes power system data, in real-time, from multiple internal and external sources or systems, into one dashboard view. This new visualization of data can then be utilized to drive critical and actionable business and operational decisions to meet KPIs and power system performance metrics.

Why GE?

GE Grid Software Solutions is a market leader in utilities operation and information technology solutions. Grid Software Solutions offers a complete energy platform for Distribution, Transmission, WAMS, Markets and Oil and Gas Management. Our solutions enable utilities to:

- Maintain grid stability to supply reliable power
- Improve energy efficiency to provide affordable power
- Integrate CO_2-free energy to deliver renewable power

GEGridSolutions.com

imagination at work

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