GS2205 – Data Glut: Big Data Visualization in Utilities

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Class summary

You have accumulated asset data in your enterprise—now what? This class shows how utilities can use Autodesk® visualization tools to integrate with their smart meter systems to effectively manage smart meters in their network. The integrated solution demonstrates how you can use the power of Autodesk® Infrastructure Map Server technology to visualize various meter events and empower operations personnel to resolve issues.

Key learning objectives

At the end of this class, you will be able to:

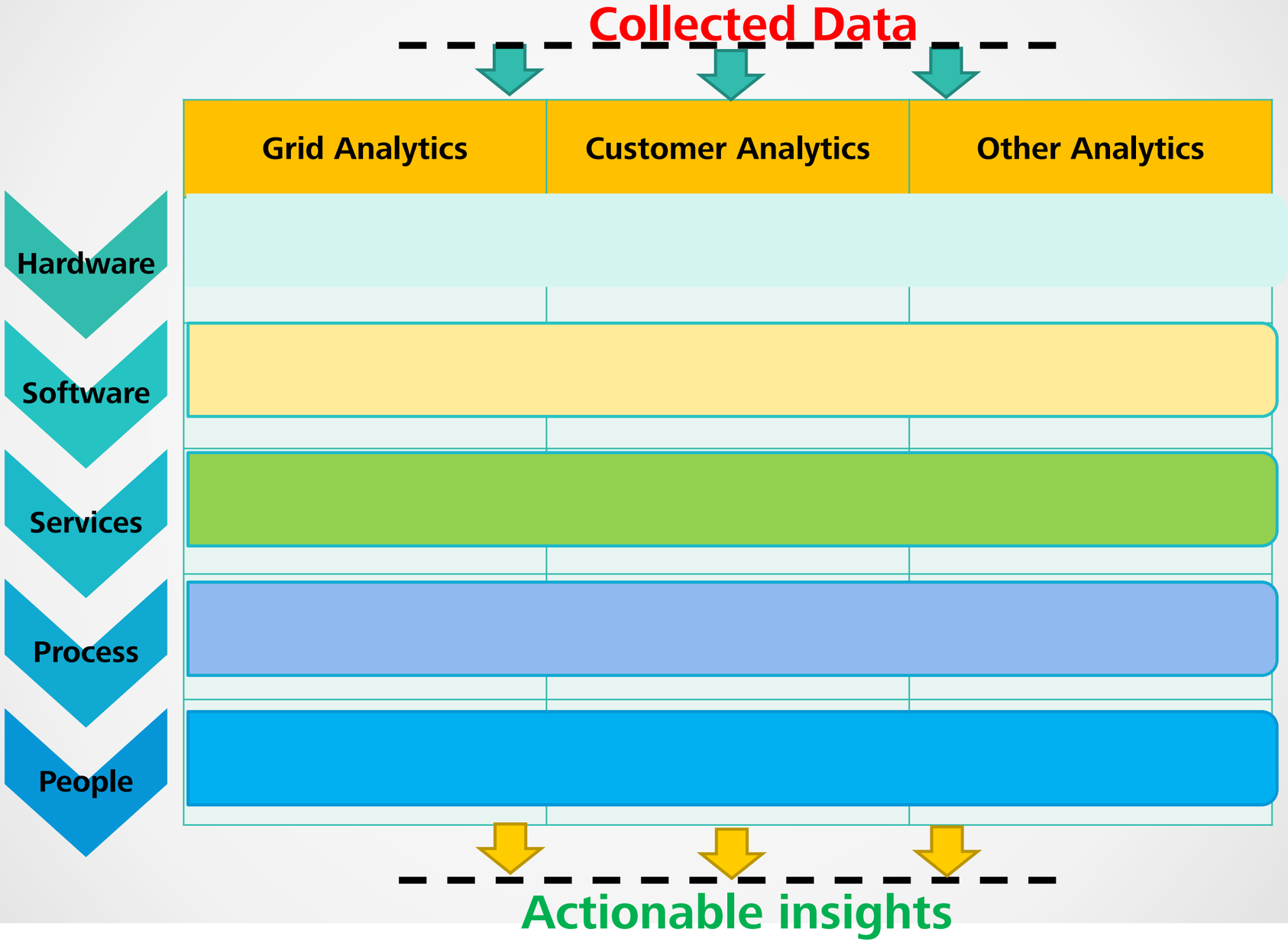
- Identify opportunities and challenges for big data management in utilities
- Use Autodesk solutions for smart grid visualization
- Integrate Autodesk Infrastructure Modeler with your smart grid data
- Use advanced features in Autodesk Infrastructure Map Server open layers

Analytics in Utilities

What if?

- Your providers of electrical network,
  - Can use information and communication technology to gather and act on the information.
  - Knows about itself and consumer its serving at all times.
  - Can request appliances at commercial customers to shut of based on load at peak.
  - Can give feedback to its managers to improve efficiency and reliability.
- That’s what is called a SMARTER GRID…

Utility analytics



Essentials

TECHNOLOGY

- Hardware specific to analytics
- Software specific to analytics
- Integration of siloed data
- Technology Leadership for this initiative

People

- Dedicated internal resources
- Supplement with outside specialists
- Change management

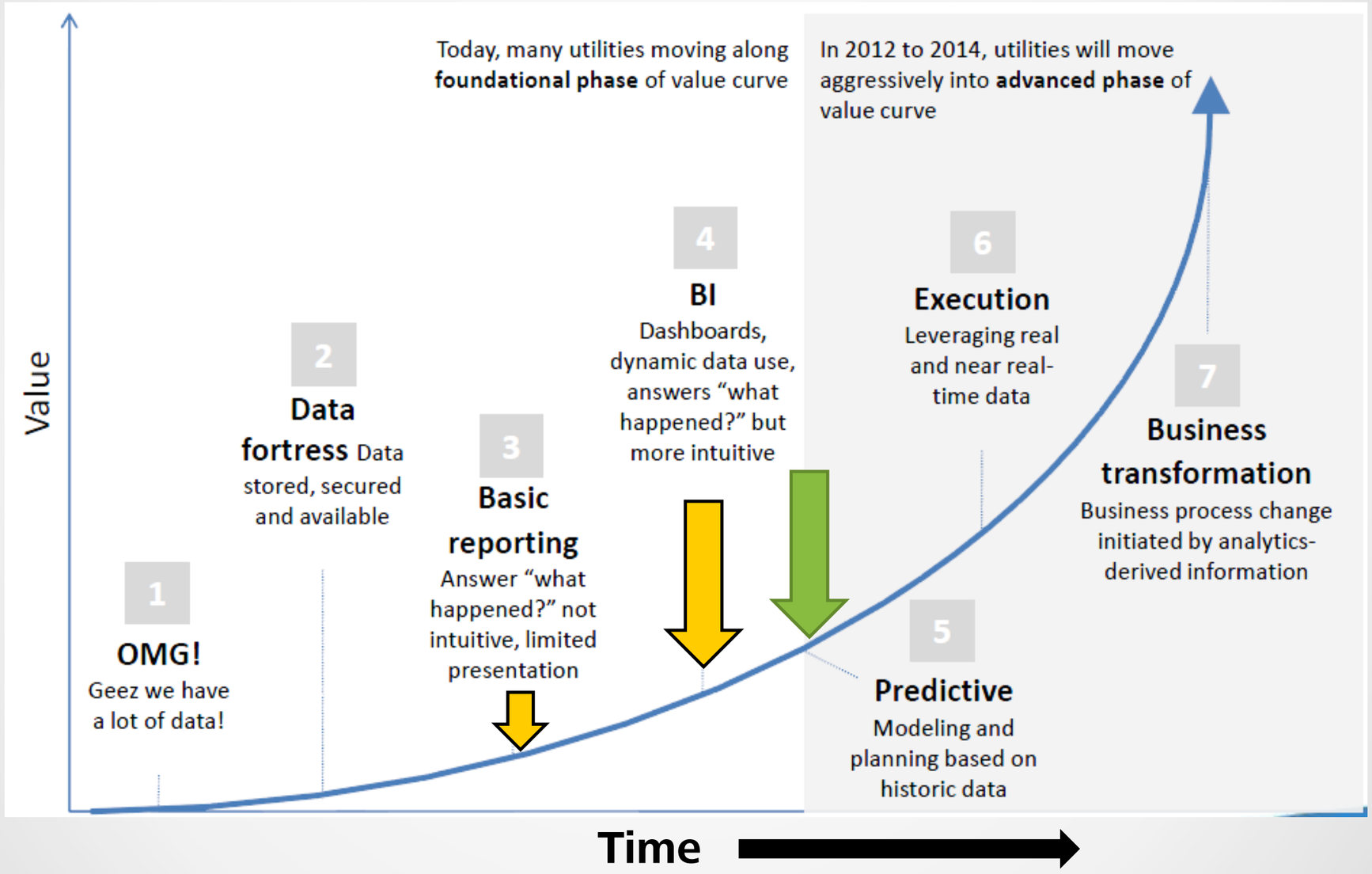
Business Process

- Change towards To-Be
- Project Management
- Integration of siloed process
- Achieve ROI

Strategy

Align with corporate strategy
Metrics/Goals
Executive Sponsor buy-in

Utility analytics value curve



Asset Optimization best practices

- Technology – Ensure it can support level of granularity needed
- Business Process – Base asset management on individual assets vs. categories
- Strategy – Tie analytics into network design | Ensure not installing over-sized assets
- People – Change management with buy-in from field operations.

Grid Optimization best practices

- Technology – Leverage existing systems and data
- Business Process – Add value to existing process
- Strategy – Connect analytics with key utility initiatives
- People – Prepare to relinquish some control of the grid data.

Customer operations best practices

- Technology – Meter data is important, but consider other sources also
- Business Process – Embed analytics in key processes | Raise visibility
- Strategy – CSAT | Value from intelligent utility investments
- People – Cross-functional teams

Smart Grid Architecture

NMS/OMS

MDM

Warehouse

Enterprise Systems

CSS

Asset Management

GIS

SmartGrid Analytics

Visualization

Reporting

Analytics

Visualization/Analytics in SCE

Big Data visualization concepts

What is Big Data?

- Unstructured data
- Large data set , difficult to process with on-hand DB tools – wikipedia
- Big Data is a tagline for a process that has the potential to transform everything
- Big Data is “a fickle, coy mistress,” inviting, yet not without risk.

Big Data Components in Utilities

Utility Sourced Data

- Customer information system
- Monthly & AMI meter data
- Pricing & rate plans
- Peak schedule
- Program participation
- Rebate redemptions
- Billing & account data

Building & Climate Data

- Demographics
- Weather
- Housing (sq. ft., age, pool, etc.)

Customer Interactions

- Utility interaction history
- Thermostats (WiFi)
- In-home devices
- Social graph

Machine Learning

- Past tip effectiveness
- Past program effectiveness
- Optimal thermostat profiles

DATA STREAMS

HIGH-FREQUENCY STORAGE

50 MILLION HOMES

100 BILLION READS

ENERGY ANALYTICS ENGINE

Normative Analytics

Dynamic Rate Engine

Energy Pattern Analysis

Customer Segmentation

Content Targeting

35 BILLION EVENTS PER MONTH • 1500 CALCS PER SEC

INTERACTION ENGINE

35 MILLION REPORTS

CUSTOMER INSIGHTS

- Optimal rate plan
- Thermoststat timing
- Seasonal profile
- Efficiency level
- Relevant rebate

Smart Grid Architecture – with Big Data Components

NMS/OMS

MDM

Enterprise Systems

CSS

Asset Management

GIS

Social Networks

Warehouse

SmartGrid Analytics

Visualization

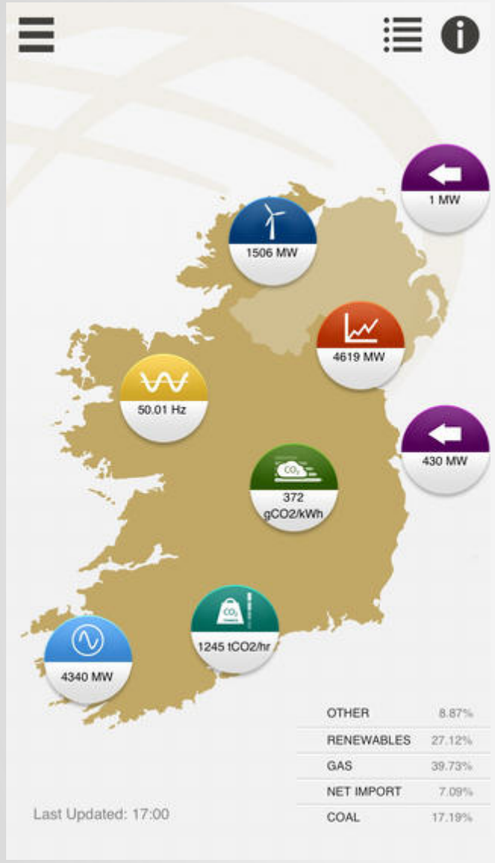
Reporting

Analytics

Leveraging Social Networks

- Power of social networks
  - Existing, mature mobile service ecosystems (e.g. Apple, Google and Microsoft) may be used as cost-effective platforms to support smart grid supply-side and demand-side services
  - Potential complexity and amount of data similar to Grid
- Share information
  - Sharing grid information with Customers (develop apps)
  - during hurricane Sandy, several electric utilities kept their customers updated through Twitter and Facebook, and used the services to post restoration schedules
- Collect information/observations and location data
  - Combining data from many different people provides more accurate knowledge
  - Allow Customers to “publish” observations related to electric network while bypassing traditional GIS software
  - Provide specialized Applications that can access GPS / location data on Customers devices
  - Geo-tagged photos of incidents/observation events

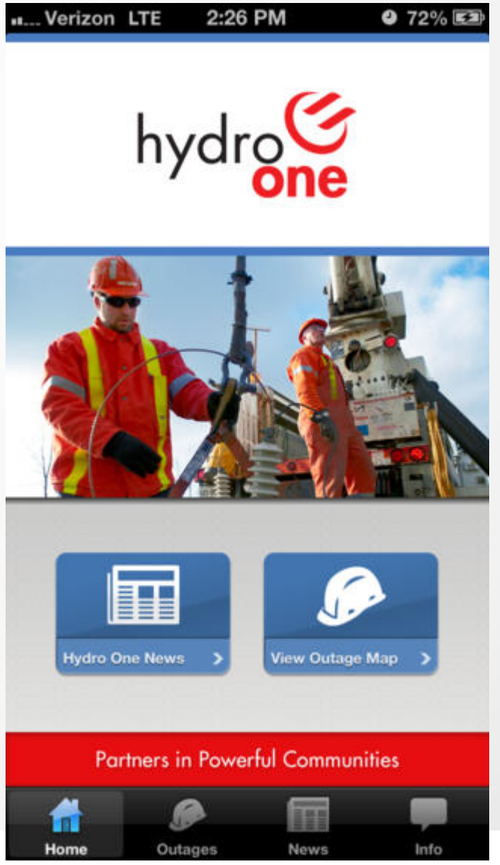
Source for information

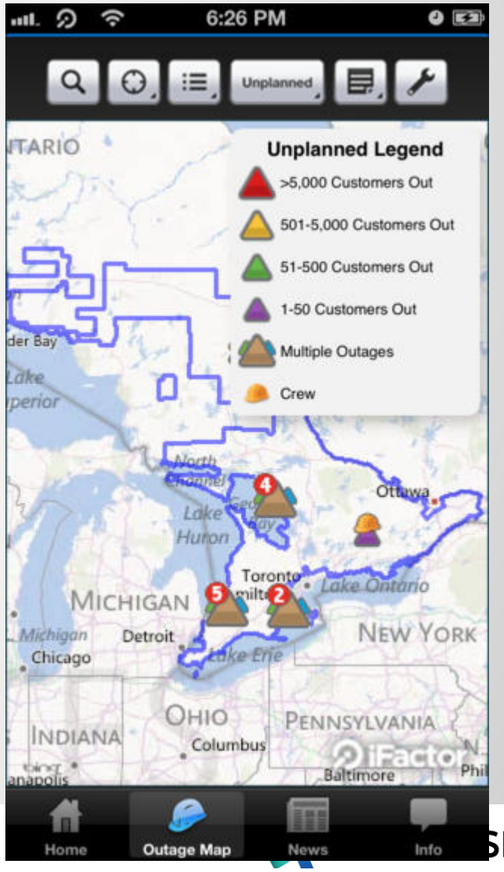


Ireland's EirGrid released the iPhone application SmartGrid, which provides customers with a real-time view of key energy-related data, including system demand, wind forecasting, carbon emissions and so on.

Hydro One's mobile application

- Allows customers to access an interactive outage map
- The map is updated every 15 minutes and displays both planned and unplanned outages





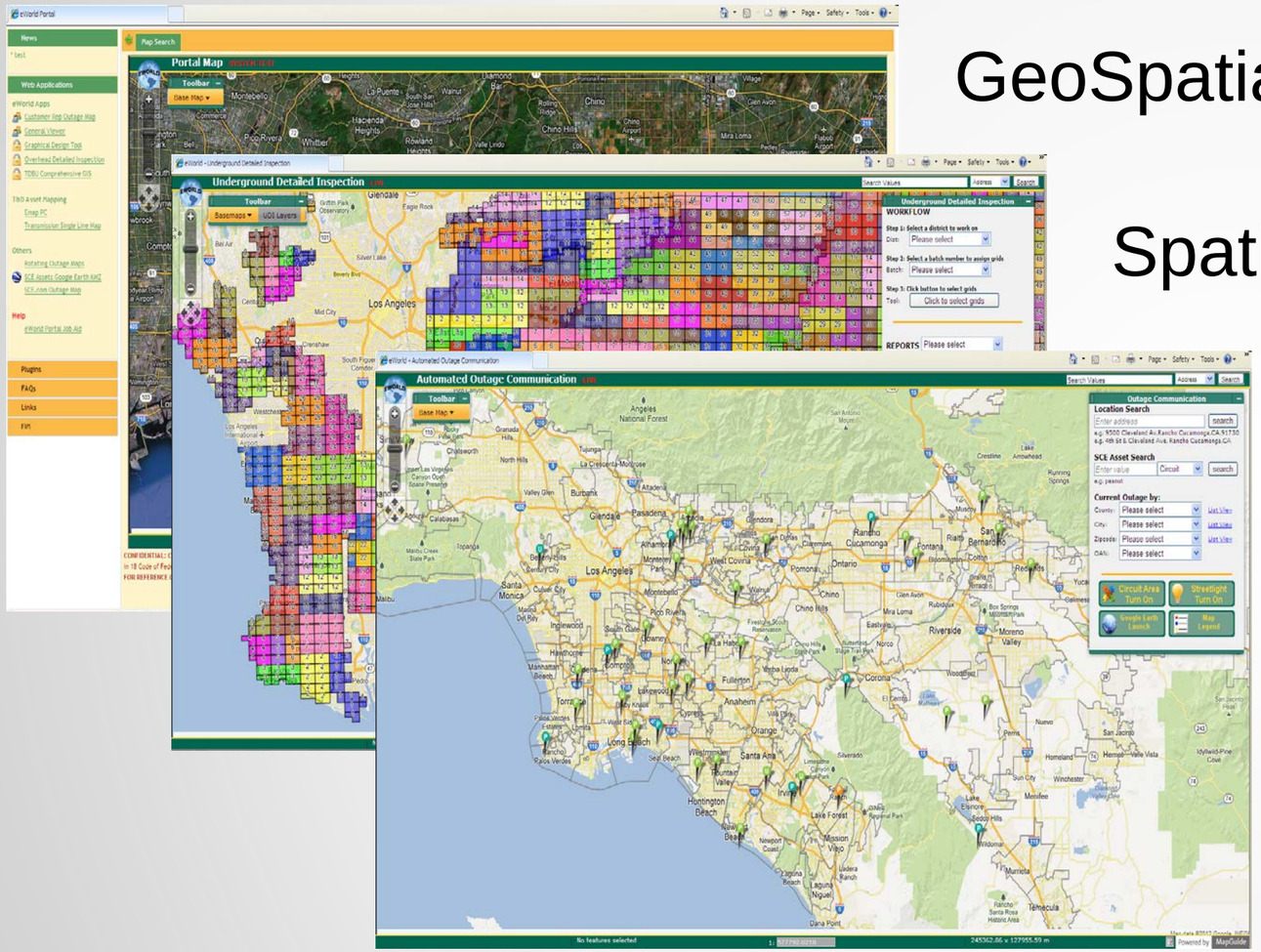
Simple example

- Google Maps
  - Google Maps Engine
  - Google Maps 2.0 API
    - Creating map mashups with data sources from Google Maps Engine and other sources
    - Place and view incidents in real time
  - Open Source QGIS Connector for Google Maps Engine

Visualization of assets

- E-world – Enterprise power asset data on web map
  - Distribution & Transmission assets
  - Circuit data
  - Customer data
  - Outage data
- GIS – Transmission single line diagrams
- SmartConnect – Initiative to provide end-to-end management of smart meters

eWorld

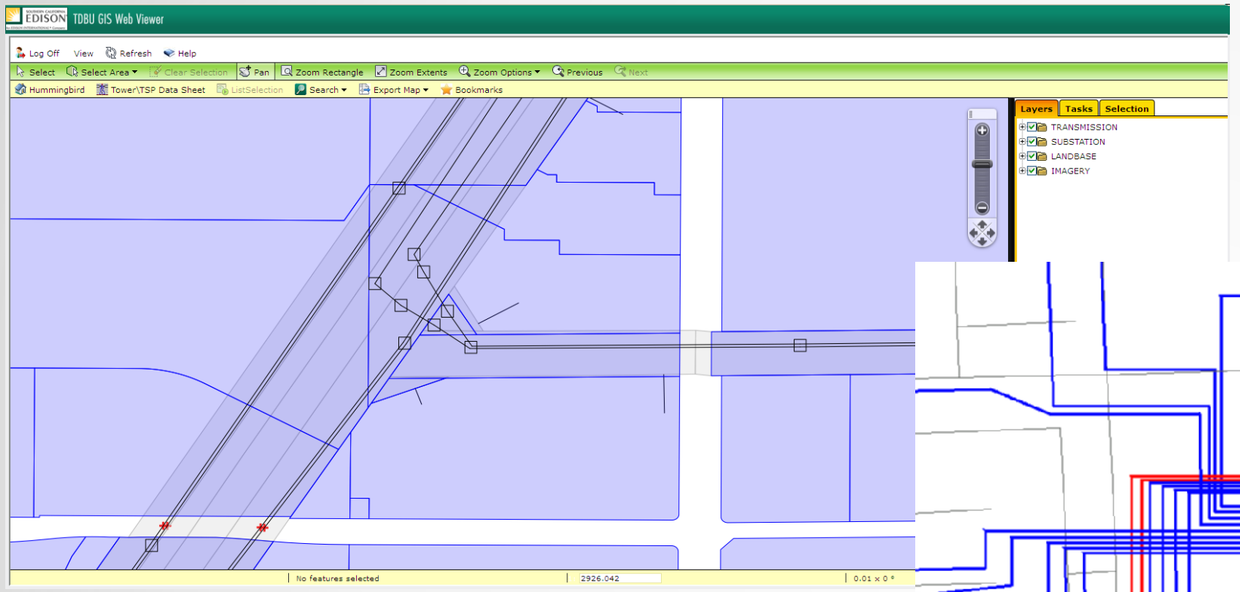


GeoSpatial one stop for asset info

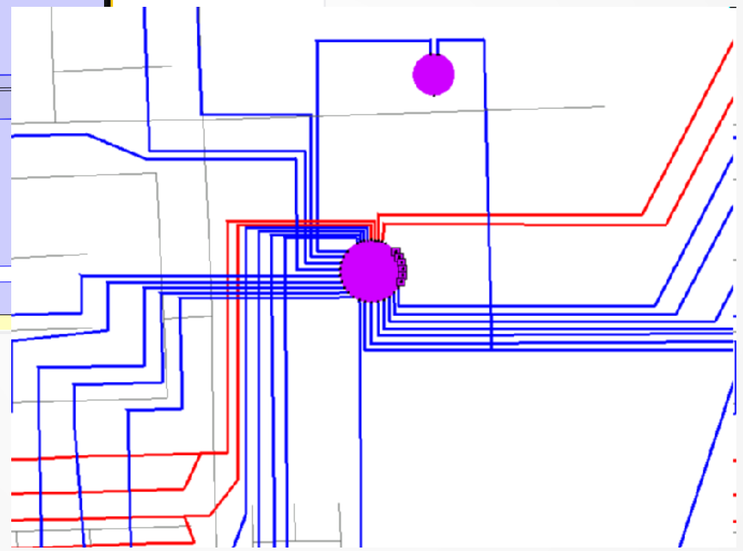
Spatially enabled workflow & management

Visualize real-time information

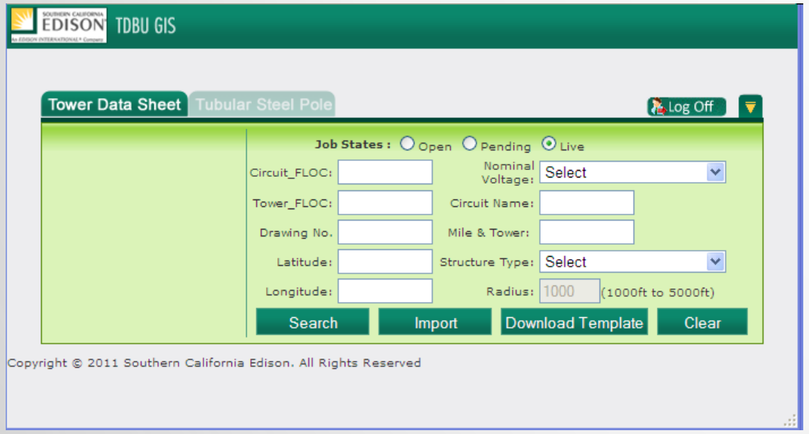
Centralized GIS mapping



Mapping against a common landb
One asset location for all other pla



Data maintenance in s
systems



Online workflow for asset change approval

SCMAS – Objective & Scope

OBJECTIVE:

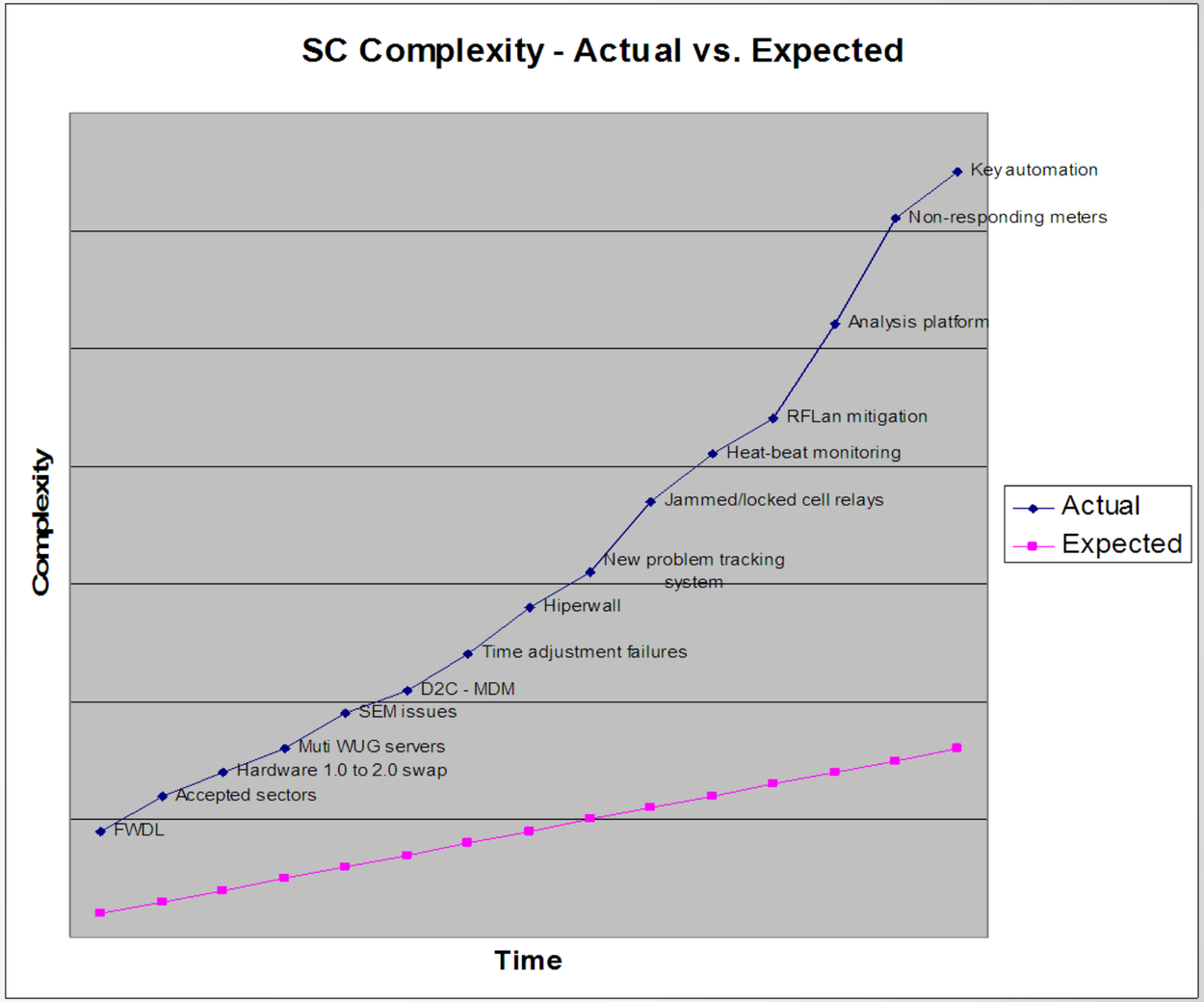
- To provide the SmartConnect Operations Center (SOC) with tools to ensure the efficient and reliable operation of the SmartConnect devices & mesh network. SCMAS will use the data from SmartConnect devices and provide correlation and analysis to identify and help mitigate over the air issues. With SCMAS, the SOC will have tools and processes to identify and address near time cascading events, optimize read performance, and maintain the reliability of SmartConnect field devices.

SCOPE:

- Data collection from field devices and access to multiple existing systems
- Data analysis and correlation using rules to identify events and incidents
- Incident and activity management to assign and track tasks in a 7/24 organization
- Incident alerting and reporting to insure issues are addressed quickly by the appropriate resources
- Advanced visualization that provides operations and management with situational awareness and a platform for advanced analytics

A $1 billion dollar AMI deployment requires reasonable tools for over-the-air operations

- Operating SmartConnect is more complex than anticipated
- On a daily basis after deployment SOC will need to address 5,000 incidents daily with an In Mitigation population of 30,000+ field devices



Key Objectives

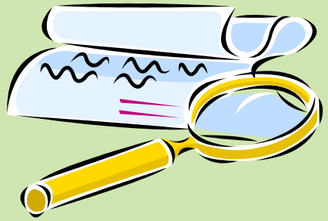
- **Identification of Real Time Catastrophic Cascading Events**
  - Experience shows that embedded bugs can occur at any time.
  - Current tools not enough to identify these problems and the analytics to mitigate in a timely fashion to reduce the business impact
- **FWDL Success Optimization**
  - High FWDL success reduces exposure to identified issues and decreases truck rolls
- **Enhanced Billing Read Performance**
  - To maintain billing read rate performance SOC must address tens of thousands of un-responding meters on a daily basis and provide appropriate solutions to reduce pick-up reads and delayed bills.
- **Security**
  - The security detection system currently addresses selected pre-identified events
  - Identify anomalies that may not have a known specific pattern
  - Ensure operational integrity of RSS operations

Storyboard

1

Communicate & Store

2

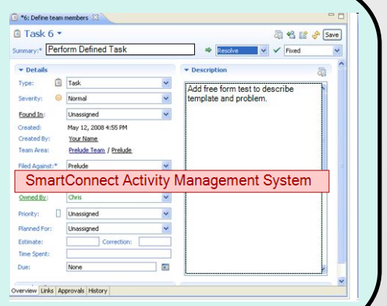


Detect Events & Incident Logging

3

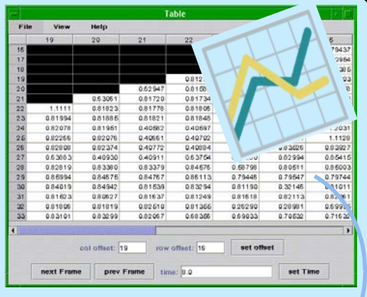
Visualize

4



Assign Work

5



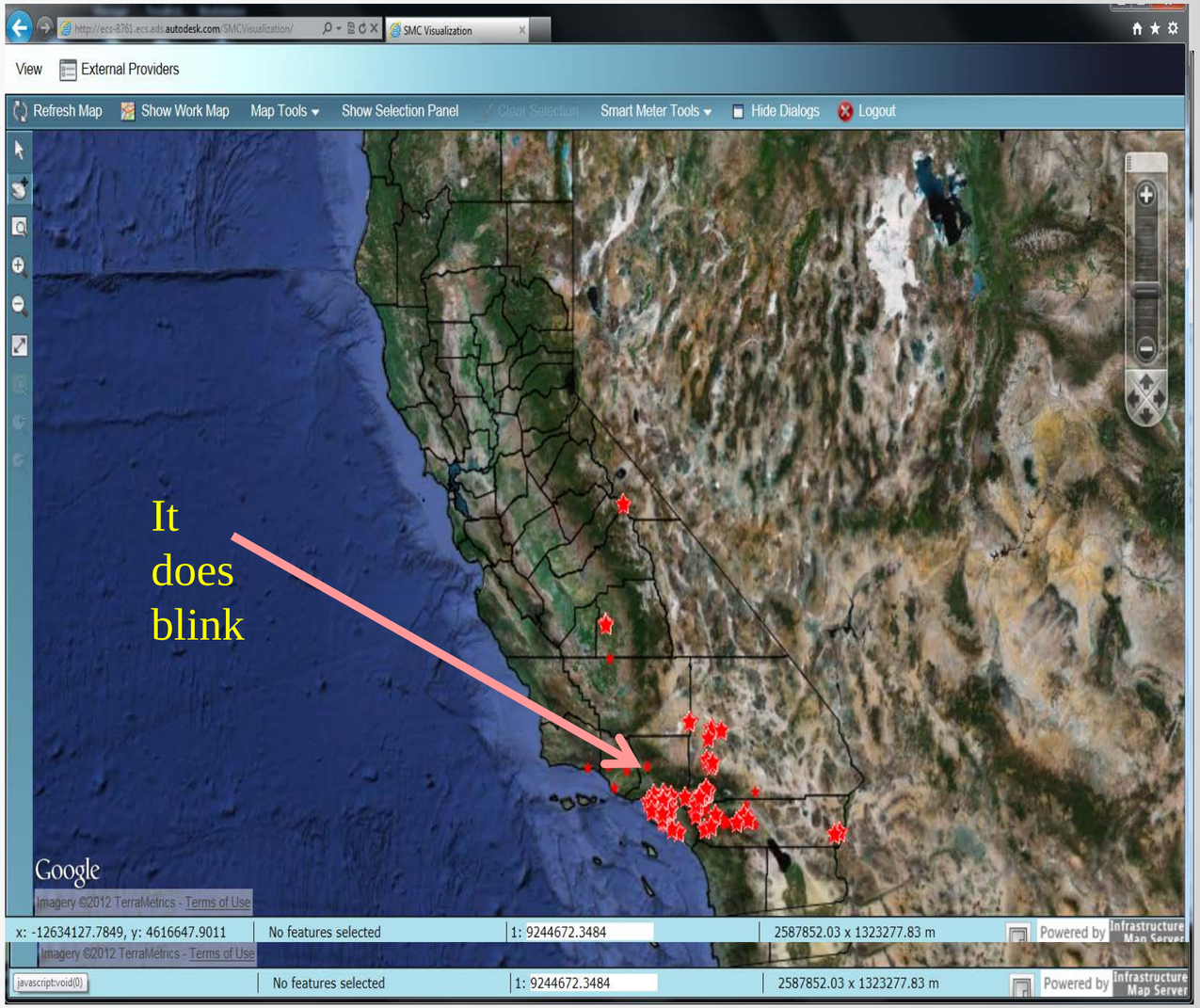
Analyze

6

Operate & Manage

Visualization Solution

- Built on top of AIMS 2012-13
- Shared env. with other AIMS applications
- Features
  - Visualization Template Management
  - Device themeing based on workgroup templates
  - Create workgroups from map
  - Analyze devices in BOBJ from map
  - Export/Import device points.
  - Query/Save maps
  - Security



AIMS in Action

AIMS Advanced features

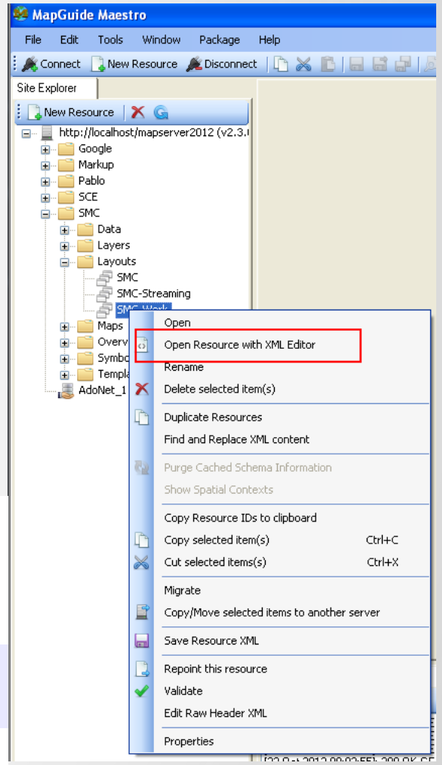
Beyond the box

- Fusion Layout
  - Multiple map management
  - Floating Dialog open/close
  - Custom widgets
  - Dynamic layers
  - Adhoc theming
  - Template Management
- Open Layers
  - Custom icons
  - Animations
- Integration
  - Business Objects
  - Active directory
  - Work management
- Google Maps
  - Background maps
  - Overlays (Weather, traffic..)
  - Street view

Google Weather Overlay

- Simple change would give great content to your map

1) After creating and saving your fusion layout (with google maps)
2) Open the AIMS site in Mapguide Maestro (open source editor)
3) Edit resource (layout) as XML
4) Go to near the end of the file. Change the GoogleScript tag to below
5) Finally, Simple Code needs to be added to **index.html**




```
1177        <Disabled>false</Disabled>
1178      </Widget>
1179    </WidgetSet>
1180    <Extension>
1181      <GoogleScript>https://maps.googleapis.com/maps/api/js?v=3.3&amp;sensor=true&amp;
          libraries=weather&amp;client=</GoogleScript>
1182    </Extension>
1183  </ApplicationDefinition>
```

Google Weather Overlay – How?

```
1177        <Disabled>false</Disabled>
1178      </Widget>
1179    </WidgetSet>
1180    <Extension>
1181      <GoogleScript>https://maps.googleapis.com/maps/api/js?v=3.3&amp;sensor=true&amp;
          libraries=weather&amp;client=</GoogleScript>
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```
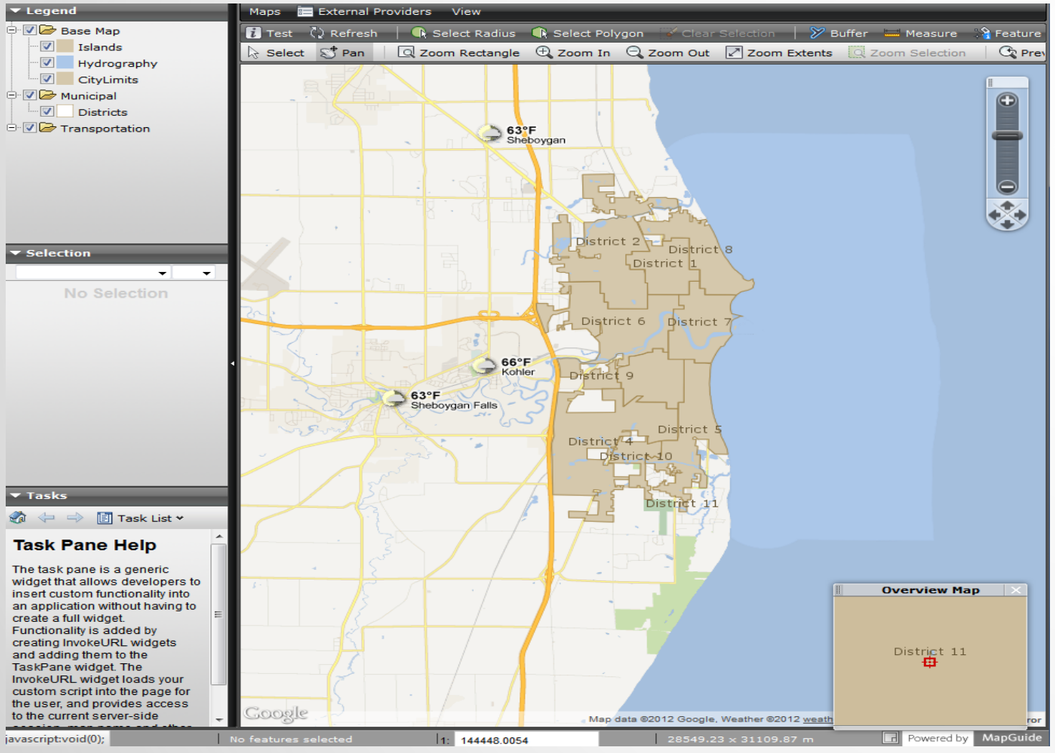
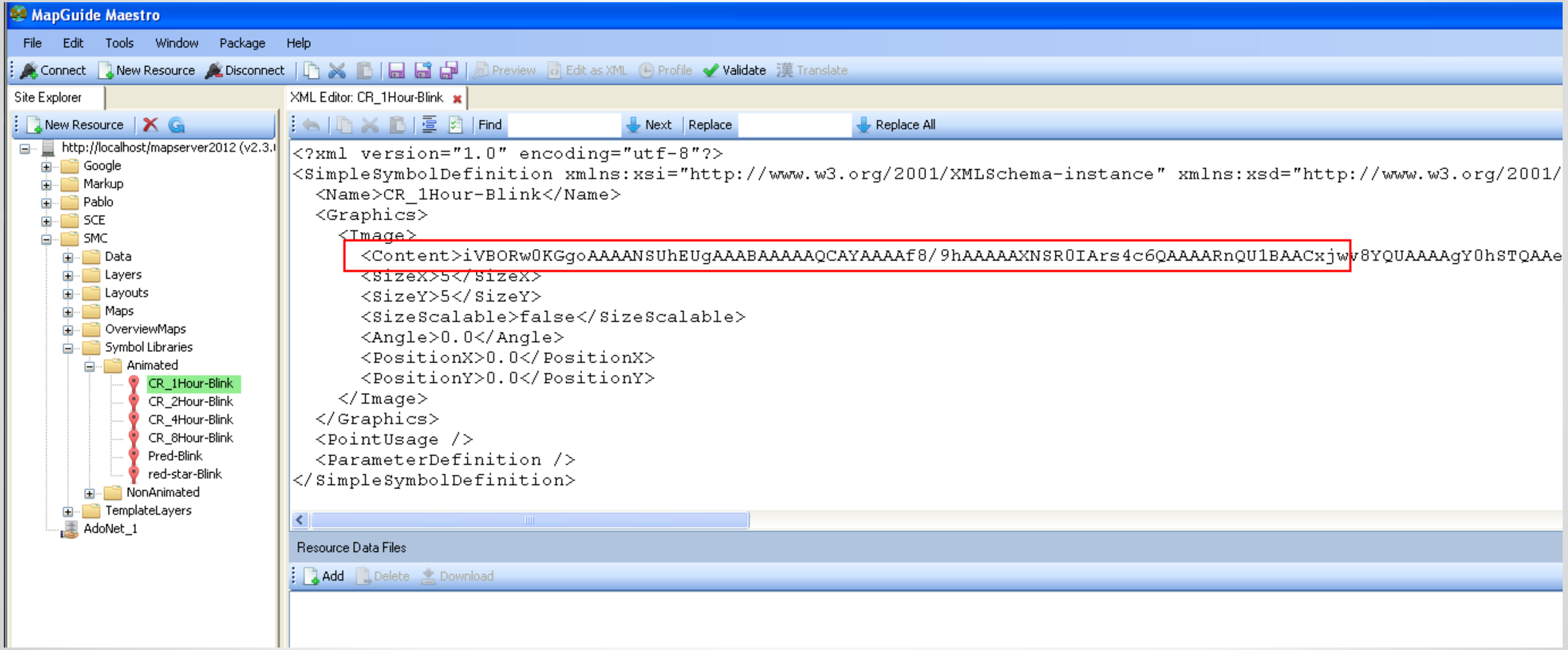




```
var fusionInitialized = function() {
  $('AppContainer').resize({forceResize: true});
  var mapWidget = Fusion.getMapById('Map');
  mapWidget.registerForEvent(Fusion.Event.MAP_LOADED, initPanelHandler);
  mapWidget.registerForEvent(Fusion.Event.MAP_LOADED, showClimate);
}

var showClimate = function() {
  var widgetSets = Fusion.applicationDefinition.widgetSets;
  for(var index = 0, len = widgetSets.length; index < len; index++ ) {
    var widgetSet = widgetSets[index];
    var maps = widgetSet.mapWidget.aMaps;
    for(var i = 0, l = maps.length; i < l ; i++) {
      var map = maps[i];
      if(map.layerType != "Google") continue;
      var googleObject = map.oLayerOL.mapObject;
      var weatherLayer = new google.maps.weather.WeatherLayer({
        temperatureUnits: google.maps.weather.TemperatureUnit.FAHRENHEIT
      });
      weatherLayer.setMap(googleObject);
      var cloudLayer = new google.maps.weather.CloudLayer();
      cloudLayer.setMap(googleObject);
    }
  }
}
```

Custom Icons

- Icons
  - No direct (easy) way to upload in Studio tool
  - How-To?
    - Choose an custom icon, ensure size 16x16 pixels
    - Use websites (http://base64converter.com/) to convert to Base64 string
    - Open site in Mapguide Maestro
    - Edit Symbol Library
    - Copy and paste Base64 to <Content> tag
    - Save the resource and use it in Mapguide Studio to author layers.

Custom Icons - How?



Animations

- How to show alerts on map?
  - Need to create the following
    - Javascript helper file to manage animation
      - Adds “marker” layer in OpenLayer
      - Get points from data source
      - Read icon from server path
      - Add icon to “marker” layer
    - Widget to turn on/off animation
    - Wire it to “map loaded” and “moveend” events

Animations – How?

```
        var markers = new OpenLayers.Layer.Markers("Markers");
        var fusionMapWidget = Fusion.getWidgetById('Map');
        var olMap = fusionMapWidget.oMapOL;

        olMap.addLayer(markers);


        var size = new OpenLayers.Size(16,16);
        var offset = new OpenLayers.Pixel(-(size.w / 2), -size.h/2);

        var icons = new Array()


        for (var i = 0; i < myObject.AnimationInfo.length; i++) {
            var theIcon = null;
            var icon = icons[myObject.AnimationInfo[i].Icon];

            if (icon == null) {
                icon = new OpenLayers.Icon(widgetBase + '../images/animation/' + myObject.AnimationInfo[i].Icon, size,
offset);
                icons[myObject.AnimationInfo[i].Icon] = icon;
                theIcon = icon;
            } else {
                theIcon = icon.clone();
            }
            markers.addMarker(new OpenLayers.Marker(
                    new OpenLayers.LonLat(myObject.AnimationInfo[i].Longitude, myObject.AnimationInfo[i].Latitude),
                    theIcon));
        }
```

Large data visualization

How to visualize large data set?

- Collect and Warehouse data
  - Grid Network data
  - As-built assets (non meter)
  - Customer Information
  - Other Enterprise data
- Data Partitioning
  - Views in database specifically tuned to map layers
  - Control joins (no of multiple table) in database views
  - Historic data view vs current data view
- Model schema
  - Star schema vs relational schema
- Layer selection & scale threshold
  - Limit selection of objects
  - Devices appear at < 100,000

References

- Building Targeted-Focus Applications Using Autodesk® Infrastructure Map Server - http://auvirtual.autodesk.com/autodesk/
- Utility Analytics Institute – http://utilityanalytics.com/
- Open Source Geospatial - http://osgeo.org/
- Open Layers – http://openlayers.org/
- Mapguide Demo site - http://enterprise.mapguide.com/

THANK YOU - Q & A

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