How we got from there to here
And what does “here” really look like?
Oncor: Who We Are

Our 3,700 employees serve 10 million people - about a third of the state of Texas.

Texas' largest regulated transmission and distribution utility - 6th largest in the U.S.
Oncor’s strategy was to:

- Build several foundational systems
  - Commercially off the shelf (COTS)
- Integrate these systems
- Build an analytics platform and develop a distributed analytics organization
  - Quickly harvest the “low hanging fruit”
  - Identify, prioritize, and attack the “high hanging fruit”
- Present information in timely user-friendly fashion
The Advanced Metering System (AMS) was the first foundational system

- Provide remote controlled disconnect device, ping capability, and on demand reads.

- Provide direct usage data between the meter and premise.

- Provide the REP's direct interaction with customer’s Home Area Network (HAN) devices.

- Interface with Distribution Operations Systems.

- Provide 15 minute usage data (day after basis).

In-home Display
Thermostats

Lighting Controls
Smart Appliances
The traditional OT systems are tightly integrated

1. TMS - Transmission Management System
2. DMS - Distribution Management System
3. OMS - Outage Management System
4. DIS - Distribution Information System
5. AMS - Advanced Metering System
6. CIS - Customer Information System
7. IVR - Interactive Voice Response
8. SCADA - Supervisory Control and Data Acquisition
Advanced technology leads to a System-of-Systems
Initial focus was to expand the direct use of OMS Advanced Metering System.

Key components:
- Distribution System Operators
- Outage Management System (OMS)
- Mobile Work Management
- Advanced Metering System
- Customer Information System (CIS)
- Supervisory Control and Data Acquisition (SCADA)
- Analytics Platform
- Operations Portal
- Traditional Customer Communication Systems
- Proactive customer messaging
- Mobile Work Management
- Contractor workforce
- April Bolduc
- Analytics Platform
- Operations Portal
### Open Outages

#### Outages by DOC

<table>
<thead>
<tr>
<th>DOC</th>
<th># Calls</th>
<th>Est Out</th>
<th>Sub Trf</th>
<th>Fdr Out</th>
<th>Dev Out</th>
<th>Trf Out</th>
<th>Svc Out</th>
<th>Critical Out</th>
<th>Biz Aware Out</th>
<th>Time of First Event</th>
<th>Max ETOR</th>
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<tbody>
<tr>
<td>EDOC</td>
<td>49</td>
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<td>1/13/2017 12:04 AM</td>
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<tr>
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<td>1/12/2017 9:45 AM</td>
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<tr>
<td>TOTALS</td>
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<td>181</td>
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<td>0</td>
<td>5</td>
<td>9</td>
<td>21</td>
<td>1</td>
<td>1</td>
<td>1/12/2017 9:45 AM</td>
<td>1/13/2017 6:00 PM</td>
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</table>

#### Outages by Region

<table>
<thead>
<tr>
<th>Region</th>
<th># Calls</th>
<th>Est Out</th>
<th>Sub Trf</th>
<th>Fdr Out</th>
<th>Dev Out</th>
<th>Trf Out</th>
<th>Svc Out</th>
<th>Critical Out</th>
<th>Biz Aware Out</th>
<th>Time of First Event</th>
<th>Max ETOR</th>
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<tbody>
<tr>
<td>Metro East Operations (MED)</td>
<td>42</td>
<td>99</td>
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<td>0</td>
<td>2</td>
<td>3</td>
<td>12</td>
<td>0</td>
<td>0</td>
<td>1/12/2017 10:35 AM</td>
<td>1/13/2017 12:04 AM</td>
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<tr>
<td>Metro/Non-Metro West (MNW)</td>
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<td>51</td>
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<td>4</td>
<td>0</td>
<td>6</td>
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<tr>
<td>TOTALS</td>
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<td>181</td>
<td>0</td>
<td>0</td>
<td>5</td>
<td>9</td>
<td>21</td>
<td>1</td>
<td>1</td>
<td>1/12/2017 9:45 AM</td>
<td>1/13/2017 6:00 PM</td>
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</tbody>
</table>

#### Outages in City of Dallas

<table>
<thead>
<tr>
<th>Service Center</th>
<th># Calls</th>
<th>Est Out</th>
<th>Sub Trf</th>
<th>Fdr Out</th>
<th>Dev Out</th>
<th>Trf Out</th>
<th>Svc Out</th>
<th>Critical Out</th>
<th>Biz Aware Out</th>
<th>Time of First Event</th>
<th>Max ETOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dallas Southwest (DSW)</td>
<td>3</td>
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<td>3</td>
<td>0</td>
<td>0</td>
<td>1/12/2017 4:59 PM</td>
<td>1/12/2017 7:10 PM</td>
</tr>
<tr>
<td>Dallas Northeast (ONE)</td>
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<td>0</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dallas North (ANO)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTALS</td>
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<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<td>0</td>
<td>0</td>
<td>1/12/2017 4:59 PM</td>
<td>1/12/2017 7:10 PM</td>
</tr>
</tbody>
</table>
### Aging Tickets for Whole System

#### Current Events
- Active Outages
- Active Outage Summaries
- Active Service Orders
- Search by
  - Event Type
  - Crews
  - Crews Notification
  - Feeder Notification

#### Performance
- Open Outages
- Open Work Orders
- Open Work Order Details

#### Storm Processes Library
- Open Events With Closed Work Orders
- By County
- By Zip

<table>
<thead>
<tr>
<th>Event Num</th>
<th>Date/Time</th>
<th>Time</th>
<th>Feeder</th>
<th>Event Type</th>
<th>Work Order</th>
</tr>
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<tbody>
<tr>
<td>T2960037</td>
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<td>9:45 AM</td>
<td>GLSCK2411</td>
<td>Service</td>
<td>Predicted Outage</td>
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<tr>
<td>T2960074</td>
<td>1/12/2017</td>
<td>10:21 AM</td>
<td>TYRSW1703</td>
<td>Flickering Lights</td>
<td>Confirmed Outage</td>
</tr>
<tr>
<td>T2960091</td>
<td>1/12/2017</td>
<td>10:35 AM</td>
<td>FRMBR1804</td>
<td>Switch</td>
<td>Confirmed Outage</td>
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<tr>
<td>T2960174</td>
<td>1/12/2017</td>
<td>11:50 AM</td>
<td>MESQT1306</td>
<td>UG Transformer</td>
<td>Confirmed Outage</td>
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<tr>
<td>T2960190</td>
<td>1/12/2017</td>
<td>11:55 AM</td>
<td>BNROR1203</td>
<td>Service</td>
<td>Confirmed Outage</td>
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<tr>
<td>T2960244</td>
<td>1/12/2017</td>
<td>12:55 PM</td>
<td>ROSCO2921</td>
<td>Fuse</td>
<td>Confirmed Outage</td>
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<tr>
<td>T2960267</td>
<td>1/12/2017</td>
<td>1:14 PM</td>
<td>MLKF21201</td>
<td>OH Transformer</td>
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<td>T2960292</td>
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<td>HRSMO1907</td>
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<td>1:47 PM</td>
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<td>UG Transformer</td>
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</tbody>
</table>
The outage history below represents the number of open outages shown in SmartGrid Reports at the recorded time. This includes momentary outages and does not include any edits made to the events during reconciliation.

**Customers Out**

3,273 Customers @ 10:59 AM

**Events**

Highest number of customers out between 12:14 AM and 5:29 PM
Initial focus was to expand the direct use of OMS
The feeder lockout portal combines information from multiple data sources in real time.
Fault maps allow the Operator the ability to compare the fault magnitude measured at the substation breaker with the calculated fault magnitude at switching devices.
Analysis on historic load data provides Operators information as to the predicted load for different temperatures.

**Expected Load Forecast**

<table>
<thead>
<tr>
<th>Study Feeder</th>
<th>ODESA</th>
<th>ODESA0231</th>
<th>All Targets Report</th>
</tr>
</thead>
</table>

The analysis is based on feeder load data between 07/22/2017 and 02/12/2019.

**ODESA0231**

- **24 Hour Limit**
- **Maximum Limit**
- **Approx Max**
- **Average Value**

**Study Feeder Amp Limits**

<table>
<thead>
<tr>
<th></th>
<th>Summer</th>
<th>Winter</th>
</tr>
</thead>
<tbody>
<tr>
<td>24 Hour</td>
<td>632</td>
<td>660</td>
</tr>
<tr>
<td>Maximum</td>
<td>600</td>
<td>600</td>
</tr>
<tr>
<td>Backstand</td>
<td>474</td>
<td>485</td>
</tr>
</tbody>
</table>

**Combined Feeder Amps**

- **24 Hour Limit**
- **Maximum Limit**
- **Approx Max**
- **Average Value**

**Devices**

- (AIR) 371_1514063559
- (AIR) 5010-2_1515248070
- (ESC) 361T_1513023624
The OMS system provides the ability to toggle between the geospatial and schematic views. Using historic AMS data, the load is predicted for each feeder segment based on the expected temperature for each hour of the day.
Significant progress is being made to predict facility damage based on weather forecast (or back-cast)

Data:
• Historical Outage Data
  • Based on creation time, cause code, device, customer count, and geographic location
• Historical Weather Data
  • Weather 4 hourly max, avg. and min based on customer density
  • Temp, wind chill, wind, wind gust, rain, and snow

Modeling Techniques
• SPSS

Benefits:
• Staging of Resources
• Shorter Restoration Times
Let’s look at the customer interface:

- **Analytics Platform**
- **Outage Management System (OMS)**
- **Supervisory Control and Data Acquisition (SCADA)**
- **Customer Information System (CIS)**
- **Advanced Metering System**
- **Operations Portal**
- **Distribution System Operators**
- **Mobile Work Management System**
- **Contractor workforce**
- **Proactive customer messaging**

Traditional Customer Communication Systems

Operations Portal

Advanced Metering System

Customer Information System (CIS)

Supervisory Control and Data Acquisition (SCADA)

Mobile Work Management System

Contractor workforce

Proactive customer messaging
Enhanced customer communications is VITAL for customer satisfaction and engagement

- Stormcenter.Oncor.com
- Text Oncor
- Interactive Voice Recognition (IVR)
- Call Center (CTA)

Providing accurate estimated time of restoration (ETOR) is high value to customers

Engaging customers on damage reporting exceeded expectations

Managing and using social media is a must, both offensively and defensively
Facility damage pictures are linked directly to Oncor’s OMS

- Customer is asked if they would be willing to send a picture
- Instructed to remain a safe distance away
- Customer is sent a link to upload pictures
- Pictures automatically tied to location and OMS
Pictures are critical to discriminate Oncor facilities from others.
Back office analytics is an extremely useful after-the-fact tool
From 2012 thru Feb 2019: 10,891 outages were avoided by analyzing data from AMS meter data

Power Quality Issues
- 10,891, 67%
- 2206, 14%
- 486, 3%
- 2526, 16%

No problem found

Tampering

Meter Issues
AMS data can identify voltage regulation issues or failing transformers prior to complete failure

Monitoring AMS voltage data has enabled Oncor to detect issues and proactively change out 1069 failing transformers since spring 2016

In 13 months, over 86,000 customer voltage issues detected and corrected

Since Dec. 2018, 123 overloaded transformers have been changed out and 91 are pending replacement using a ranking criteria that includes

- average load
- maximum load
- overload duration (Hours above 130% nameplate)
- Voltage (as a filter)
Data driven underground cable maintenance and replacement programs are starting to show promise

**System Data**
- DIS Data (cable attributes)
- OMS/UGDB Data (WO/maintenance information)
- Cable samples from field

**Prioritization Criteria**
- Lab analysis matching analytic prediction
- Lab analysis without matching analytic prediction
- Partially addressed systems
- Remaining analytic predictions

**Analytical failure prediction**
- Lab analysis at lab
- SPSS Model

**UG Cable Circuit Miles**

- Total Miles 16,498
- Pre '93 - UG Program Target
  - Pre-93 High Risk: 1%
  - Pre-93 Medium Risk: 9%
  - Pre-93 Low Risk: 22%
  - UG Cable from 1993 to Present: 68%
Higher order analytics helps predict cold-load pickup characteristics

Cold Load Pick Up:
• When a typical load has been without supply for a period of time (hours) it loses its diversity. When power is restored the load is higher than usual.

Data & Relationship:
• Ambient Temperature
• Time of day
• Season – Summer or Winter
• Outage Duration – 30 minutes vs 4 hours
• Type of Load – Residential, Non-Residential and Commercial/Industrial

![Graph showing load demand over time with annotations for: (t_{res}, t_{res}), (t_{res}, t_{steady}), (t_{out}, t_{out})]
A new frontier is image machine learning analysis

Proposed Use Cases:

- Post Storm Damage Assessment
- Seasonal Wildfire Risk Assessment
- Seasonal Structure Erosion Assessment
- Post Storm Flood Detection
- Annual Easement Intrusion Detection

Image Sources:
- University of Texas
- SkySat
- Oncor Transmission
- Google Earth
So, how do we get to the “ones and zeros”?
Oncor’s Analytics Platform provides high performance and easy access to tools and data.

Insights Foundation for Energy Platform
Oncor’s organizational approach to data analytics:

Small cross functional group for governance, guidance, data management, and strategy

Super-users imbedded and grown in the functional areas and who interact across functional lines with each other

Significantly more analytical capability throughout the organization developed and cultivated
Questions ?