Paper #1898

So you’re thinking about doing AVL and MWM?

Electric Distribution GIS - 2

Wednesday, July 14, 2010

10:15 AM – 11:30 AM

Room 28 B
So you’re thinking about doing AVL and MWM?

Wednesday, July 14, 2010
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Presentation Goal

“To provide an overview on the implementation of an AVL and MWM solution at Colorado Springs Utilities such that the audience has a better understanding of what to look for in their own implementation efforts.”
Presentation

- Colorado Springs Utilities Background
- Business Case
- RFP Process / Project Scope
- AVL / MWM Technology
- Strengths / Weaknesses
- Lessons Learned
- Future
Acronyms

- **AVL**
  Automatic Vehicle Location
  or
  Automated Vehicle Location

- **MWM**
  Mobile Workforce Management
  or
  Mobile Resource Management (MRM)
Housekeeping…

• Audience Poll:
  – How many already have AVL? MWM?
  – How many are from Operations? IT?

• While mentioned, this is not a presentation on our ArcFM Viewer for Engine Mobile GIS
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Colorado Springs Utilities

- 4 Service Utility over 120+ years old
- 1924, voted in as a citizen owned utility
- 1992, separate municipal enterprise
- Service territory of 574 square miles
- 1,800+ employees
- El Paso County, Colorado
- City of Colorado Springs population of 400,000+
- Base elevation 6,035 ft
# Colorado Springs Utilities

<table>
<thead>
<tr>
<th></th>
<th>Electric</th>
<th>Gas</th>
<th>Water</th>
<th>Wastewater</th>
</tr>
</thead>
<tbody>
<tr>
<td>Customers</td>
<td>210,000</td>
<td>184,000</td>
<td>132,000</td>
<td>129,000</td>
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<tr>
<td>Capacity</td>
<td>1,015 MW</td>
<td>29 billion cu ft</td>
<td>182 MGD</td>
<td>95 MGD</td>
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<tr>
<td>Miles</td>
<td>1,080 OH 2,431 UG</td>
<td>2,357</td>
<td>1,954 potable</td>
<td>1,627</td>
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</table>
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Old Business Case

• Started in 2005
• Benefits:
  – Safety and convenience
  – Cost and labor reduction: 20% of crew time spent receiving, filling out paperwork, and clarifying information
• 2006 – 2008, laptops for everyone!
• Mid 2008, GIS over air cards wasn’t cutting it
New Business Case

- Asset Management Initiative
- Benefits:
  - Incident response, failure reporting, reliability
  - Data integrity (moving from paper to digital)
  - Safety and cost reduction still there…
- Late 2008, deployed ArcFM Engine w/File GDB
- 2009 – 2011, AVL and MWM
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Request For Proposal

- AVL?, MWM?, or both?
- ESRI Workshop
- RFP Specification:
  - AVL: 78 requirements in 14 functional areas
  - MWM: 58 requirements in 7 functional areas
- Rocky Mountain eProcurement, 09/11/2009
- 3 bid responses:
  - Couple of no bids, 2 proprietary mobility solutions
  - 1 ESRI/Microsoft solution
Request For Proposal

- Winner = ESRI and business partners!
- Fixed price
- Master contract agreement w/task orders
- Task orders
  - #1 = Basic AVL and MWM
  - #2 = Advanced AVL and Integrated MWM
Old Project Scope

- Aggressive schedule Task Order #1
  - Award in December 2009
  - Deploy in June 2010

- Solutions
  - Basic AVL = CompassCom
  - MWM = Microsoft Sharepoint w/InfoPath configured by Idea Integration
# New Project Scope

<table>
<thead>
<tr>
<th>Task</th>
<th>Deliverable</th>
<th>Timeframe</th>
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<tbody>
<tr>
<td>1 A</td>
<td>CompassCom</td>
<td>Q1 2010 ✓</td>
</tr>
<tr>
<td>1 B</td>
<td>Out-of-the-Box InfoPath “Project” MOSS</td>
<td>Q2 2010 ✓</td>
</tr>
<tr>
<td>2</td>
<td>Production MOSS</td>
<td>Q3 2010</td>
</tr>
<tr>
<td>3</td>
<td>Integrated AVL</td>
<td>Q4 2010</td>
</tr>
<tr>
<td>4</td>
<td>Integrated InfoPath</td>
<td>Q1 2011</td>
</tr>
<tr>
<td>5</td>
<td>Advanced AVL</td>
<td>2011</td>
</tr>
</tbody>
</table>
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AVL

• ESRI Workshop
  – Levels of implementation
  – Architecture

• AVL @ Colorado Springs Utilities
  – Architecture issues
  – Reality check

• Architecture overview

• CompassCom solution
AVL Levels

AVL
1. Simplistic X,Y event layer.

AVL w/MWM
2. Basic → job status, windshield surveys, PM inspections, streetlight inventory, X,Y as an attribute.
3. GeoFence → X,Y client alerts, business action/decision based on real-time location, buffered polygons, safety zones, truck routes, etc. X,Y is imbedded into workflow.
AVL Levels

**AVL w/MWM**

4. A) **Fleet Management** → in addition to X,Y, on-board vehicle diagnostics such as speed, idle time, PTO operation, plow or boom up/down.

   B) **Computer Aided Dispatch** → dispatch augmentation tools, routing, etc.

5. **Automated Dispatch** → business rules written into artificial intelligence.
Architecture

- **Hardware**
  - GPS
  - Client
  - Server

- **Software**
  - Client
  - Server
  - COM splitter

- **Network**
  - Radio / wireless
  - VPN
  - Traffic / load

- **Data storage**
  - Current
  - Historical
Architecture Issues @ CSU

• Laptop
  – Ruggedized laptops, heated, touchscreen, etc
  – Navigational grade GPS (not mapping or survey)
  – Wireless aircard, dead/drop zones
  – VPN, no login, no AVL
  – COM splitter; 1) for local ArcFM, 2) for AVL

• Data storage
  – Ping frequency, time vs distance
  – Claim/audit requirements
Reality Check

- Low cost, must accept limited functionality
- Leverage existing laptops → Automated Laptop Location (ALL)
- Last known “near real time” location good enough
- Crew is expected to login
- Fleet Management with true AVL over trunk radio is long-term goal (may be cost prohibitive)
AVL Architecture Overview

- Laptop
  - GPS
  - Franson GPSGate w/COM splitter
  - VPN
  - AirCard
- InfoPath
- ArcFM
- Sprint
  - Franson GPSGate
- Desktop CompassTrac
- CompassLDE
- Oracle
- Oracle

Oracle

Oracle
CompassCom

- **Product Suite**
  - CompassLDE
  - CompassTrac
  - *(CompassTrac Mobile)*

- **Behind the scenes**
  - Franson GPSGate (Client and Server)
  - Oracle database schema
CompassCom
CompassCom
Behind the Scenes

• Time vs Distance
  – Configure different clients; 1) 15 sec and 2) 500 ft
  – Delta scripts built on Haversine formula

```
IF (Val_VEHICLEID_new = Val_VEHICLEID_old) THEN

T := (Val_GPSDATE_new - Val_GPSDATE_old) * 24 * 60 * 60;

LatDelta := (ABS(Val_LATITUDE_new - Val_LATITUDE_old)) * (Pi/180);
LongDelta := (ABS(Val_LONGITUDE_new - Val_LONGITUDE_old)) * (Pi/180);

-- Haversine Formula
A := POWER(SIN(LatDelta/2), 2) + COS(Val_LATITUDE_old) * COS(Val_LATITUDE_new) * POWER(SIN(LongDelta/2), 2);
C := 2 * ATAN2(SQRT(A), SQRT(1 - A));
D := R * C * 5280;
```
Behind the Scenes

• AVL normalization
  – AVL_POSITION trigger
  – AVL_POSITION_HISTORY
  – Time conversion
  – Meta-data

BEGIN
  UPDATE AVL_POSITION
  SET
  GPSDATE =
    (TO_DATE(
      TO_CHAR (:NEW.MESSAGEDATE, 'MM/DD/YYYY') || ' ' ||
      FLOOR (:NEW.MESSAGETIME/3600) || ' ' ||
      FLOOR (:NEW.MESSAGETIME - (FLOOR (:NEW.MESSAGETIME/3600) * 3600)) / 86400 || ' ' ||
      (FLOOR (:NEW.MESSAGETIME/3600) * 3600) -
      (FLOOR (:NEW.MESSAGETIME - (FLOOR (:NEW.MESSAGETIME/3600) * 3600)) / 60) * 60)
    )
      || 'MM/DD/YYYY HH:MI:SS') +
    (TO_NUMBER (TO_CHAR (SYSTIMESTAMP, 'TZH:')) / 24)
  ,
  LATITUDE = :NEW.LATITUDE,
  LONGITUDE = :NEW.LONGITUDE,
  SPEED = :NEW.SPEED,
  HEADING = :NEW.HEADING
  WHERE VEHICLE_ID = :NEW.VEHICLEID
;
END;
Raw GPS Data

• Population
  – Full install base ~ 120 laptops (vehicles)
  – 47 installed / registered
  – 20 active

• AVL_POSITION_HISTORY as of 06/03/2010
  – 1.91 million rows in 111 days
  – 50% show delta readings < 30ft
MWM

- MWM = “eForms”
- Business process → asset life cycle
- Architecture overview
- Microsoft solution
  - Microsoft Office Sharepoint Server (MOSS)
  - Microsoft Office InfoPath client
Business Process

- Asset Life Cycle
  - Plan
  - Design
  - Construct
  - As-built
  - Operate and Maintain
  - Rehabilitate / Repair
  - Retire

\{ eForms \}
Paper Job Packets

1) Pre-Job Briefing
2) Field Data
...
7) Emergency
...
22) GIS Map Change Request
MWM Architecture Overview

- Laptop
  - InfoPath
  - VPN
  - AirCard

- Hardwired
  - Sprint
    - MOSS
    - BizTalk

- Maximo
eForms Home Page

Work Packet Quick Links

**Energy Services**
- [Electric Services Work Packet](#)
  - Work Packet includes the following: Emergency Investigation, Field Data Collection, Pole Transfer, Pre Job Briefing and Inspection.
- [Gas Services Work Packet](#)
  - Work Packet includes the following: Corrosion Readings, Emergency Investigation, Fabricated Steel Riser, Field Data Collection.

**Water Services**
- [Water Services Work Packet](#)
  - Work Packet includes the following: Condition Assessment for Water Mains, Emergency Investigation, Failure Reporting Checklist.
- [Wastewater Services Work Packet](#)
  - Work Packet includes the following: WW Collection Customer Service Field Information, Pre Job Briefing and Stoppage of Flow.
MOSS Workflow

Electric Work Packet Approval Tasks: Please approve WO-1797055

Status: Completed
InfoPath Client
InfoPath Workflow
InfoPath Options

- Web client
  - Lightweight
  - Back office integration

- Local client
  - Works offline
  - Performance
  - Supports long transaction w/local disk storage
  - Integration opportunities w/ArcFM Engine
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Strengths / Weaknesses

• Weaknesses
  – VPN!!!
  – AirCard coverage
  – Laptop COM configuration
  – In-House Sharepoint technical experience
Strengths / Weaknesses

• Strengths
  – Cost effective
  – Rock solid AVL backend
  – Local InfoPath client
  – Microsoft API / tools
  – Enterprise potential with Sharepoint framework
  – Multi-disciplinary Team (Energy, Water, Asset Mgmt, IT)
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Lessons Learned

- Get IT on board early
- Educate first, deploy later
- Have a manageable deployment plan
- Installed does not mean deployed
- Know your hardware
- Figure out your MOSS strategy
Lessons Learned

- Really understand your data requirements
- Do not underestimate “big brother” fears
- Find enthusiastic champions
- Prepare for senior management “discussions”
- Really figure out “who’s on first?”
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Future

- **AVL**
  - ArcGIS Server as GPS service → consumed by other enterprise applications
  - Computer Aided Dispatch for Operations
- **MWM**
  - Local client consumption of GeoFences in InfoPath
  - Integrated w/ArcFM, asset information
  - Automated, task-based time keeping
  - Write instead of Read Only to our WMS
Future Perfect Scenario

1. O&M crew reported broken asset the day before
2. In the morning, repair crew pulls work order into InfoPath
3. Crew Supervisor uses routing scenario for most efficient travel
4. On site, AVL confirms general asset location (because the crew is new to Colorado Springs)
Future Perfect Scenario

5. GeoFence then alerts them to soil hazard submitted by Environmental a week prior

6. Crew alters their Pre-Job Briefing to include new safety hazard for excavation

7. Realizing they need to isolate the asset, they run a trace in ArcFM

8. A buffer along the trace identifies Critical Customer flags that need to be addressed
Future Perfect Scenario

9. Once excavated, they find the asset information in the GIS is wrong (never happens), so they invoke ArcFM to markup changes.

10. They also note some corrosion issues, so they fill out the Condition Assessment form.

11. Customer Service receives a call, using their AVL fed Computer Aided Dispatch they notice that the crew is only 2 blocks away, so they have the Crew Supervisor go check out the issue (it gets resolved).
Future Perfect Scenario

12. Crew packs up, submits InfoPath data and ArcFM markups with new asset information

13. Ready, repeat
Questions
David Totman

For additional information, RFP spec’s, etc.
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