

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



Colorado Springs Utilities
It's how we're all connected

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

	Electric	Gas	Water	Wastewater
Customers	210,000	184,000	132,000	129,000
Capacity	1,015 MW	29 billion cu ft	182 MGD	95 MGD
Miles	1,080 OH 2,431 UG	2,357	1,954 potable	1,627

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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

Task	Deliverable	Timeframe
1 A	CompassCom	Q1 2010 ✓
1 B	Out-of-the-Box InfoPath "Project" MOSS	Q2 2010 ✓
2	Production MOSS	Q3 2010
3	Integrated AVL	Q4 2010
4	Integrated InfoPath	Q1 2011
5	Advanced AVL	2011

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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

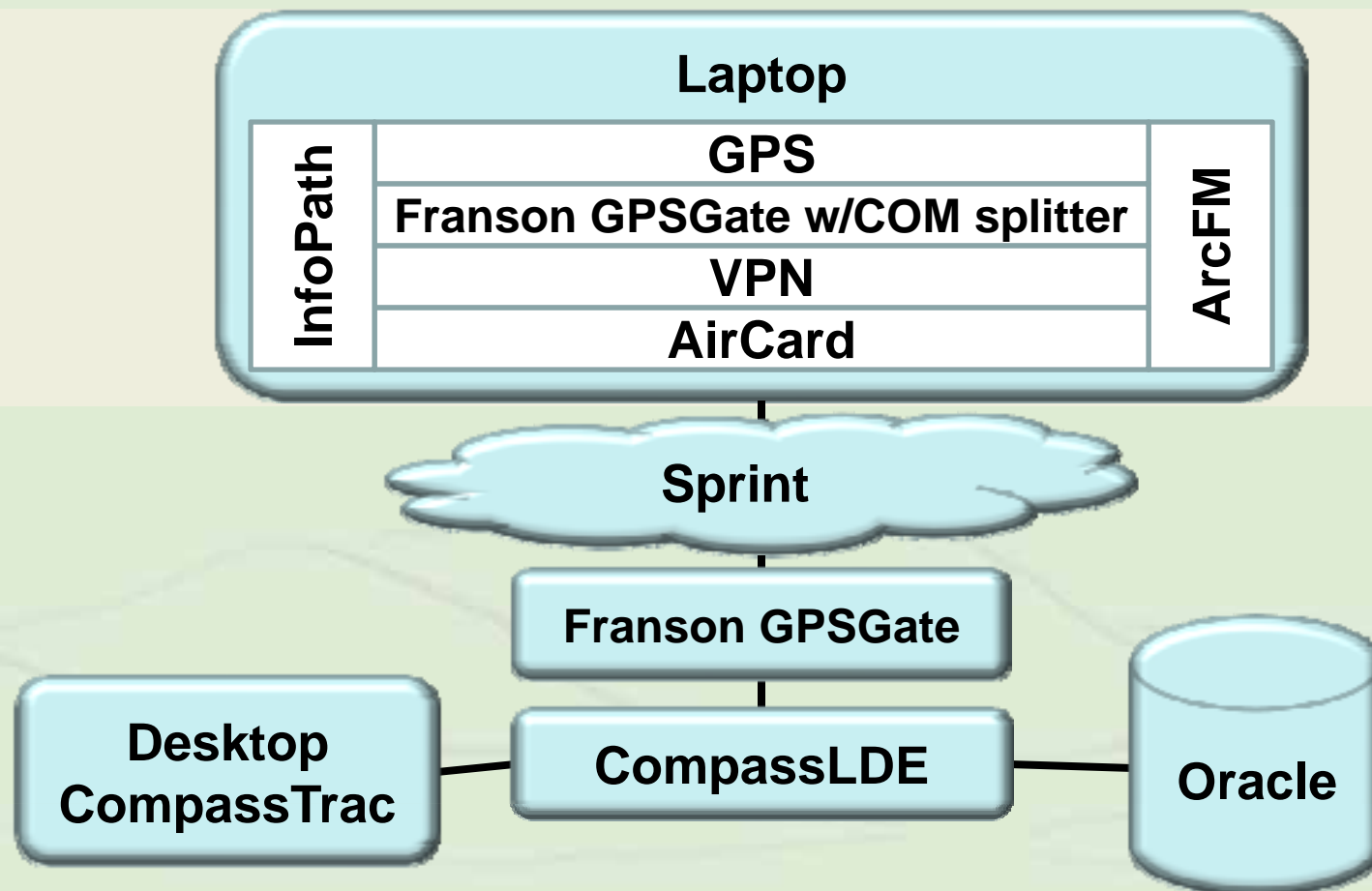
Architecture Issues @ CSU

- 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



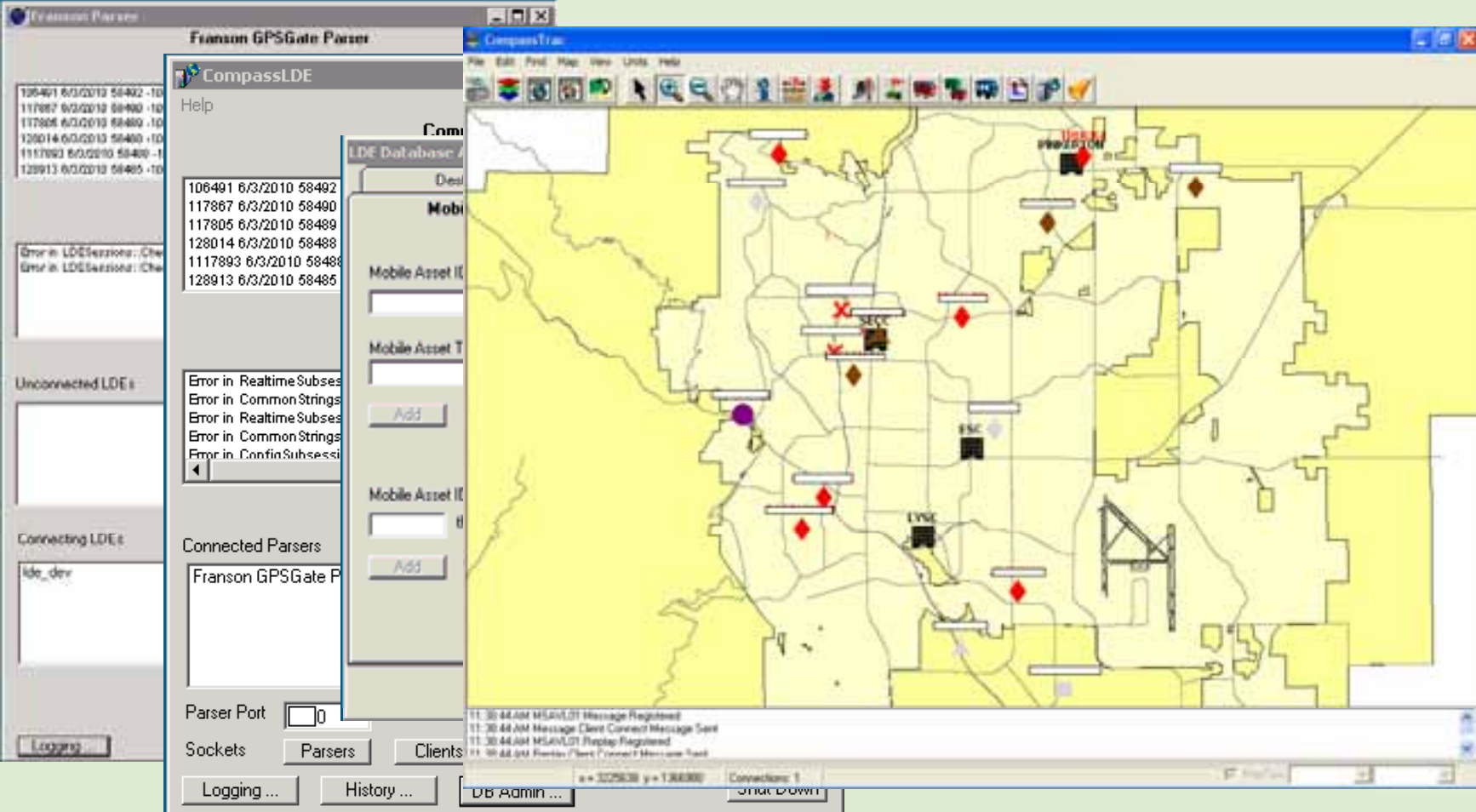
CompassCom

- Product Suite
 - CompassLDE
 - CompassTrac
 - *(CompassTrac Mobile)*
- Behind the scenes
 - Franson GPSGate (Client and Server)
 - Oracle database schema

CompassCom

The screenshot displays the CompassCom software interface. On the left, there are several panels: 'Franson GPSGate Parse', 'CompassLDE', 'Unconnected LDEs', 'Connecting LDEs', and 'Connected Parsers'. The 'CompassLDE' panel contains a list of data points with columns for ID, date, and time. Below this, there are sections for 'Parser Port' (set to 1250) and 'Sockets' (Parse, Clients). At the bottom left, there are buttons for 'Logging...', 'History...', and 'DB A'. The main area is a map titled 'CompassTrac' showing a yellow-toned map with various markers (red diamonds, black squares, purple circles) and labels like 'ESC' and 'LYNC'. A status bar at the bottom right shows coordinates (x=322638, y=136396) and 'Connections: 1'. A log window at the bottom of the map displays system messages such as '11:30:44 AM MSGVLE1 Message Registered'.

CompassCom



The screenshot displays the CompassCom software interface, which is used for AVL and MWM. The interface is divided into several sections:

- Top Left:** A window titled "Franson GPSGate Parser" containing a table of data with columns for ID, date, and time. The data includes entries like "106491 6/3/2010 58492 -10".
- Top Center:** A window titled "CompassLDE" with a "Help" button and a list of IDs: "106491 6/3/2010 58492", "117867 6/3/2010 58490", "117805 6/3/2010 58489", "128014 6/3/2010 58488", "1117893 6/3/2010 58485", and "128913 6/3/2010 58485".
- Top Right:** A window titled "CompassTrac" showing a map of Colorado Springs with various colored markers (red diamonds, purple circles, black squares) indicating asset locations. The map includes street names like "LYNE" and "LYNE".
- Bottom Left:** A section for "Connected Parsers" with a table containing "Franson GPSGate P" and a "Parser Port" field set to "0". Below this are buttons for "Logging...", "Sockets", "Parsers", and "Clients".
- Bottom Center:** A status bar showing coordinates "x=329538 y=136390" and a "Connections: 1" indicator.
- Bottom Right:** A log window showing system messages such as "11:30:44 AM MSGVLOT Message Registered" and "11:30:44 AM Message Client Connect Message Sent".

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
  GPSPDATE =
    (TO_DATE((
      TO_CHAR(:NEW.MESSAGE_DATE, 'MM/DD/YYYY') || ' ' || ' ' || ' ' || ' '
      FLOOR(:NEW.MESSAGE_TIME/3600) || ':' || ' ' || ' '
      FLOOR((:NEW.MESSAGE_TIME - (FLOOR(:NEW.MESSAGE_TIME/3600)*3600))/60) || ':' || ' ' || ' '
      FLOOR((:NEW.MESSAGE_TIME -
        (FLOOR(:NEW.MESSAGE_TIME/3600)*3600) -
        (FLOOR(:NEW.MESSAGE_TIME - (FLOOR(:NEW.MESSAGE_TIME/3600)*3600))/60)*60)
      ))),
      'MM/DD/YYYY HH24:MI:SS') +
    (TO_NUMBER(TO_CHAR(SYSTIMESTAMP, 'TZH'))/24)
  ),
  LATITUDE = :NEW.LATITUDE,
  LONGITUDE = :NEW.LONGITUDE,
  SPEED = :NEW.SPEED,
  HEADING = :NEW.HEADING
WHERE VEHICLEID = :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

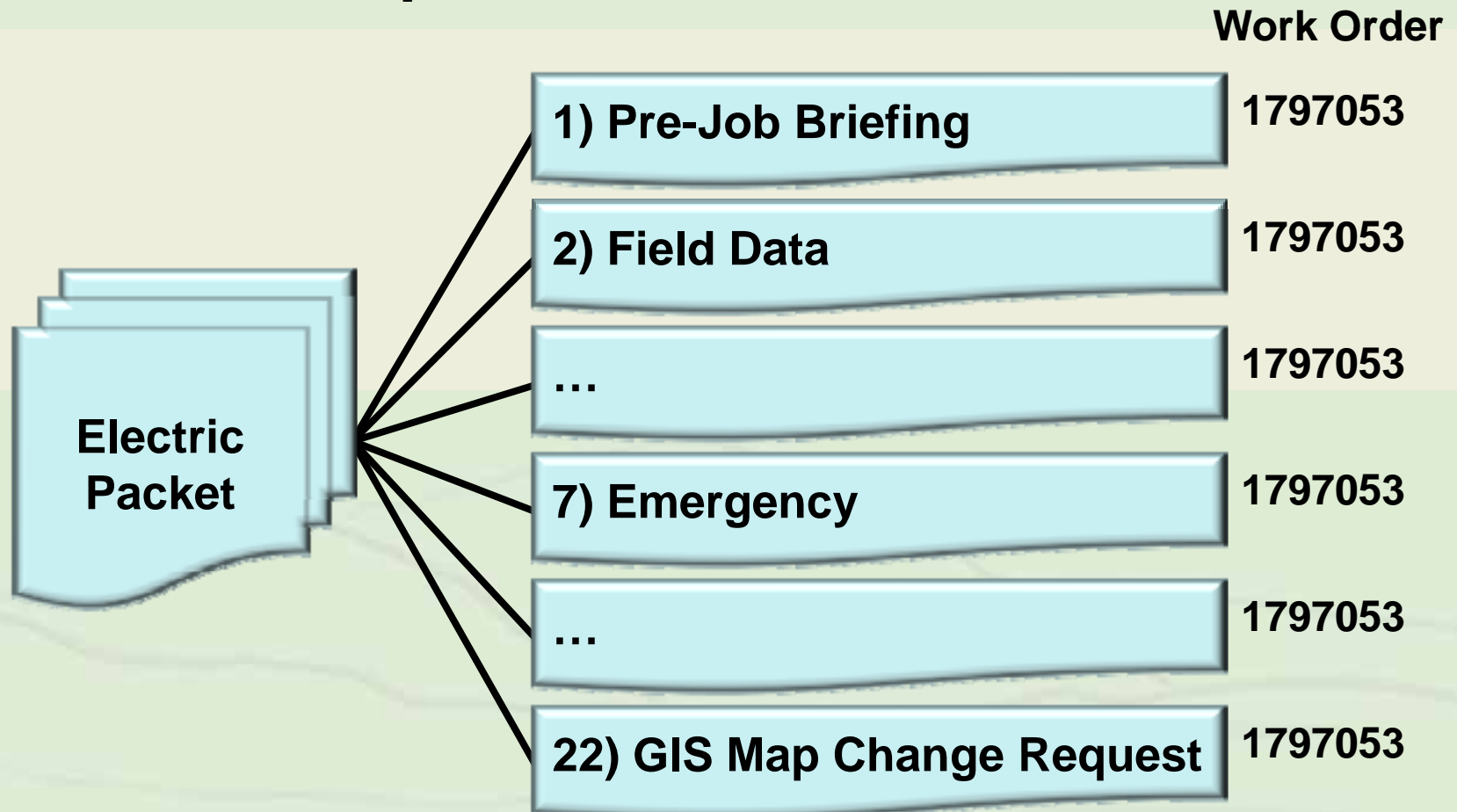
Business Process

- Asset Life Cycle

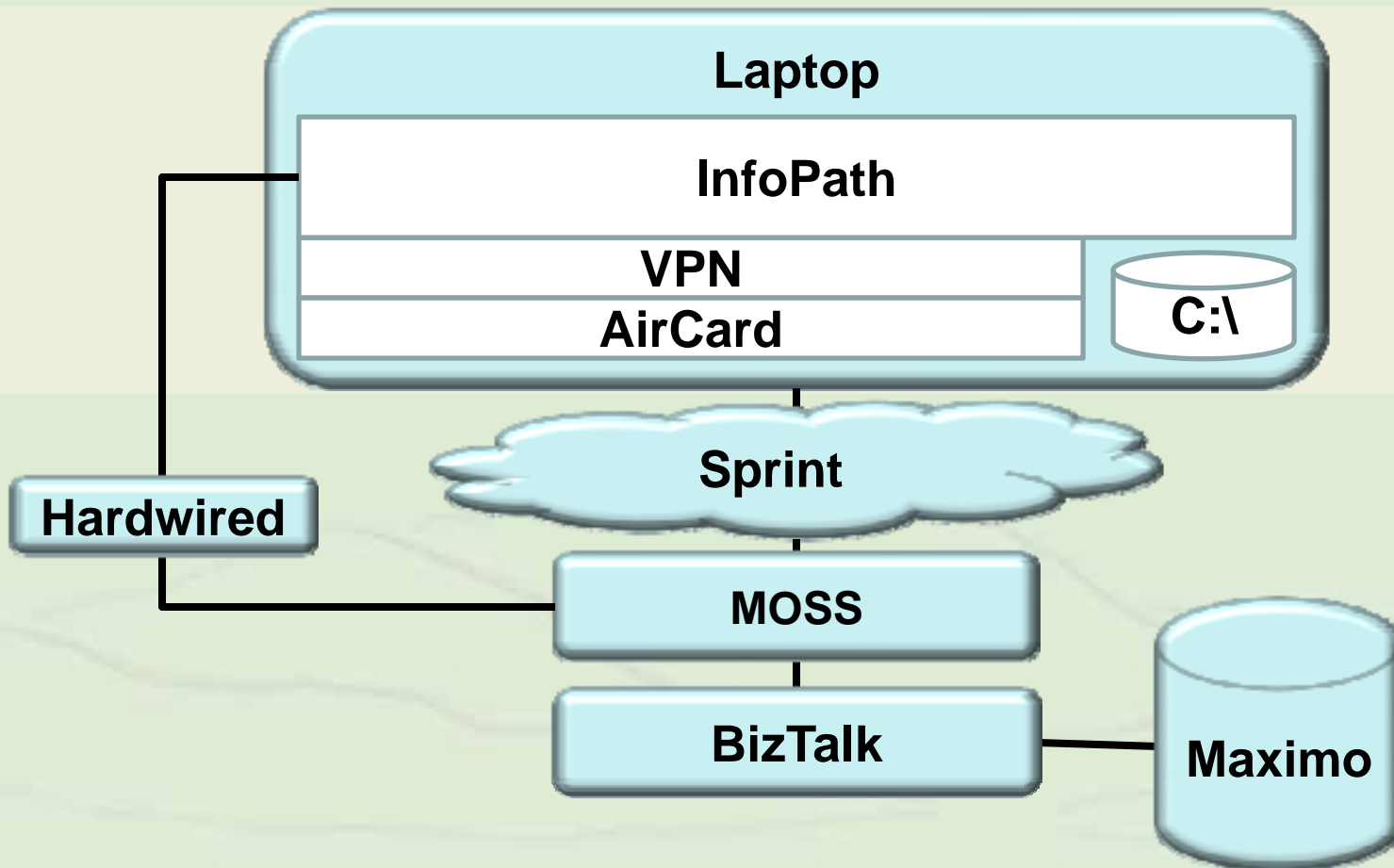
- Plan
- Design
- Construct
- As-built
- Operate and Maintain
- Rehabilitate / Repair
- Retire

} eForms

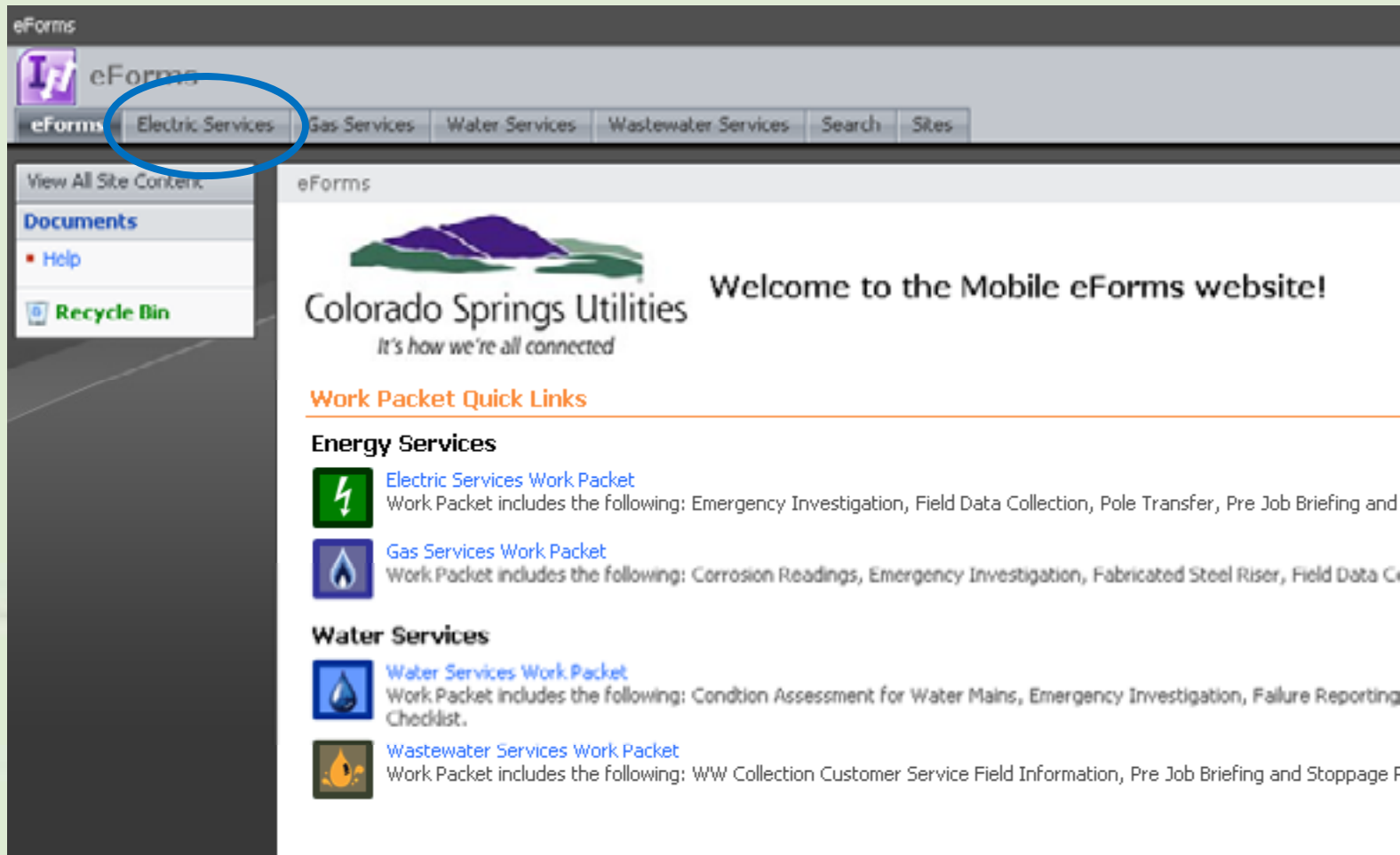
Paper Job Packets



MWM Architecture Overview



eForms Home Page



The screenshot shows the eForms Home Page. At the top left, there is a navigation menu with the following items: eForms, Electric Services, Gas Services, Water Services, Wastewater Services, Search, and Sites. The 'Electric Services' item is circled in blue. Below the navigation menu, there is a sidebar with the following items: View All Site Content, Documents, Help, and Recycle Bin. The main content area features the Colorado Springs Utilities logo and the text 'Welcome to the Mobile eForms website!'. Below this, there is a section titled 'Work Packet Quick Links' which lists the following services:

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

MOSS Workflow

eForms > Electric Services > Drop-Off Library

Drop-Off Library

New | Upload | Actions

Type	Name	Work Order	File Size	Content Type
	WO-1797055			Electrics Services Work Packet

My Electric Work Packet Approval Tasks

Title	Status	Priority
Please approve WO-1797055	Completed	(2) Normal
Please approve WO-1797053	Completed	(2) Normal

eForms > Electric Services > Electric Work Packet Approval Tasks > Please approve WO-1797055

Electric Work Packet Approval Tasks: Please approve WO-1797055

[Delete Item](#)

This workflow task applies to WO-1797055.

Approval Requested

Status: Completed

InfoPath Client

Home

- Emergency / Investigation (1)**
 - Field Data Collection (0)
 - Pole Transfer (0)
- Pre Job Briefing (1)**
 - Street Light Repair (0)
- COMMON FORMS**
 - Delay and Extra (0)
 - Employee Incident Report (0)
 - GIS Map/Data Change Request (0)
 - Material Ticket (0)
 - Restoration and Excavation (1)**
 - Traffic Complaint (0)

[eForms Help](#)

CMN - EMERGENCY ELECTRIC INFORMATION / INVESTIGATION

LIST OF EMERGENCY / INVESTIGATION FORMS

Complete	Count	Created
<input type="checkbox"/>	1	06/02/2010 9:26:28 AM

EMERGENCY / INVESTIGATION DETAILS: ID 1

Work Order: _____ Date Started: _____

Work Order Type: _____ Date Completed: _____

Police Dept: _____ Notification Time: _____

Trouble Shooter Work Order: _____ Arrival Time Shop After Hours: _____

Energy Delivery Work Order: _____ Arrival Time Job Regular Hours: _____

Map Grid: _____ Job Started: _____

Area: _____ Crew Supervisor Name: _____

Delayed Emergency Response Remarks: _____

Address / Vicinity: _____

InfoPath Workflow

ELECTRICITY

Instructions: Enter the Work Order from the Work Order details are not retrieved, then

Work Order:

File Edit

Submit

Submit Work Packet

Close work Packet

File Edit View Insert Format Tools Table Help

- Fill Out a Form... Ctrl+Q
- Design a Form Template...
- Open... Ctrl+O
- Close
- Save Ctrl+S
- Save As...
- Merge Forms...
- Import Form Data...
- Export To
- Page Setup...
- Print Preview Ctrl+F2
- Print... Ctrl+P
- Permission
- Start Workflow
- Submit**
- Work Offline
- <http://eforms.csu.org/gas/DropO.../WO-1993467.xml>
- Exit InfoPath

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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