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2003 ESRI Electric and Gas
User's Conference
October 14, 2003



Utilizing ArcMap/ Map Control in a Utility System Integration Framework for Network Asset Management



Presentation Outline

- WHY?
 - Goals of Utility Systems Integration
- What?
 - Plans to achieve Systems Integration goal
- How?
 - R&D Now
 - Implementation
- Utility System Integration Use Cases
 - MAPCONTROL
 - ARCMAP

Who is ABB?

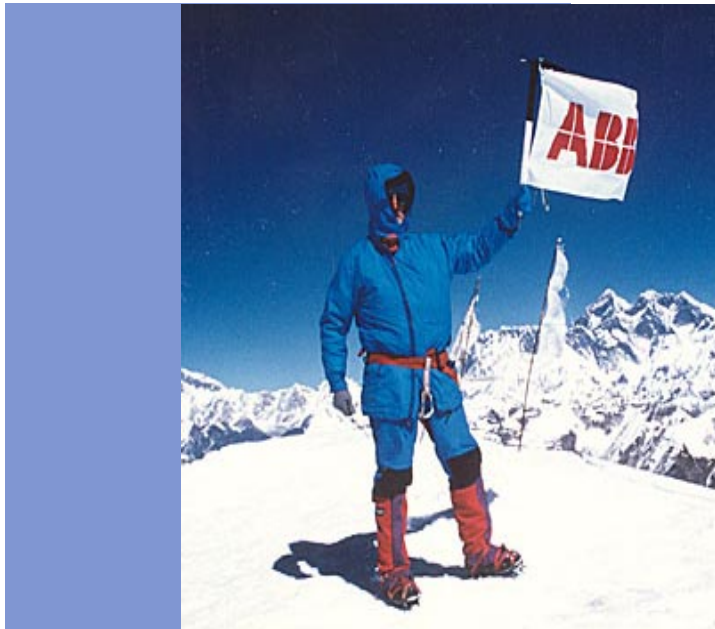


ABB is a global leader in power and automation technologies that enable utility and industry customers to improve performance while lowering environmental impact.

Our aim is to create value for all our stakeholders. We seek to meet the needs of our customers, our employees and the communities where we do business, and create value for our shareholders.



ABB Corporate Research



Objectives

- Keep and build technology leadership in power and automation products, applications and services

Research and Development

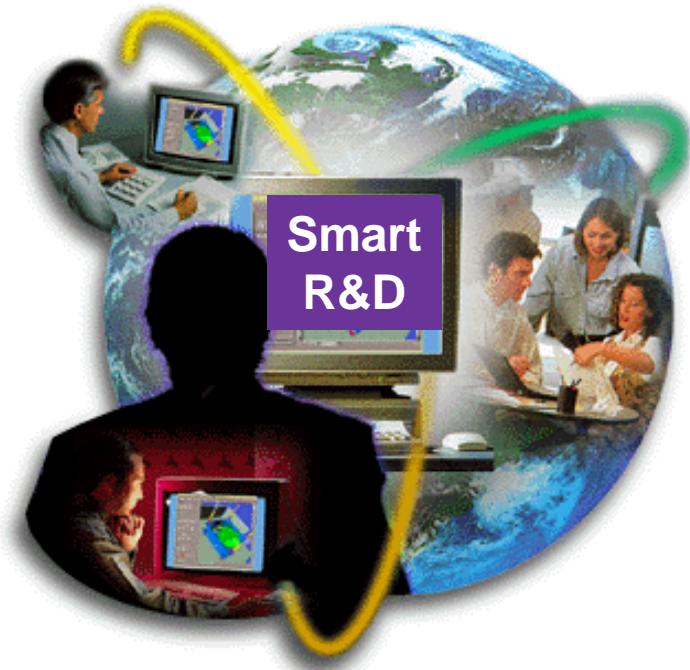
- New R&D center opened in China in 2003. Two centers, India and Singapore, opened in 2002

Investment in technology

- ABB spent around 5 percent of revenues on research and development in 2002

Group R&D: Tasks of Laboratories

Significant impact on ABB's business

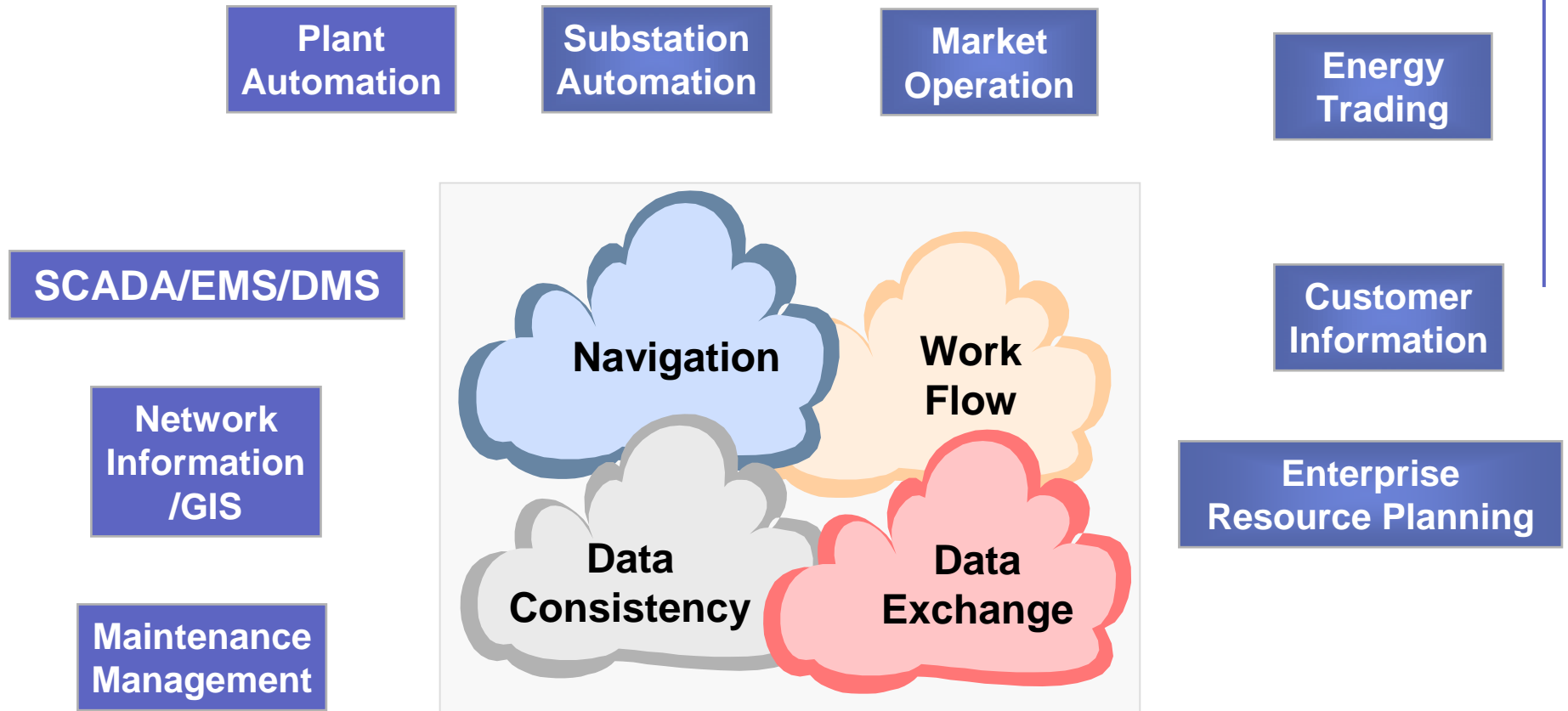


- Vision & breakthrough innovations, attractive patent portfolio
- Support ABB business divisions in standards and platforms
- Recruit and transfer excellent employees
- Network with universities and other research facilities
- Technical leadership supporting marketing

Goals for Utility System Integration

- Integration of systems & services to optimize utilities profit due to:
 - Navigation between sub-systems
 - Data exchange/consistency between sub-systems
 - Optimal utility business workflow process
 - Higher utilization of the network assets
 - Reduced data maintenance and improved decision support
- Key Focus Areas:
 - Cross-application navigation in sub-systems (SCADA, GIS, CMMS)
 - Improved data engineering and maintenance through-out sub-systems
 - Asset Management applications and user operations
- Key IT sub-systems:
 - Network operations - SCADA / EMS / DMS
 - Asset Maintenance – CMMS / ERP
 - Network Information – GIS / NIS

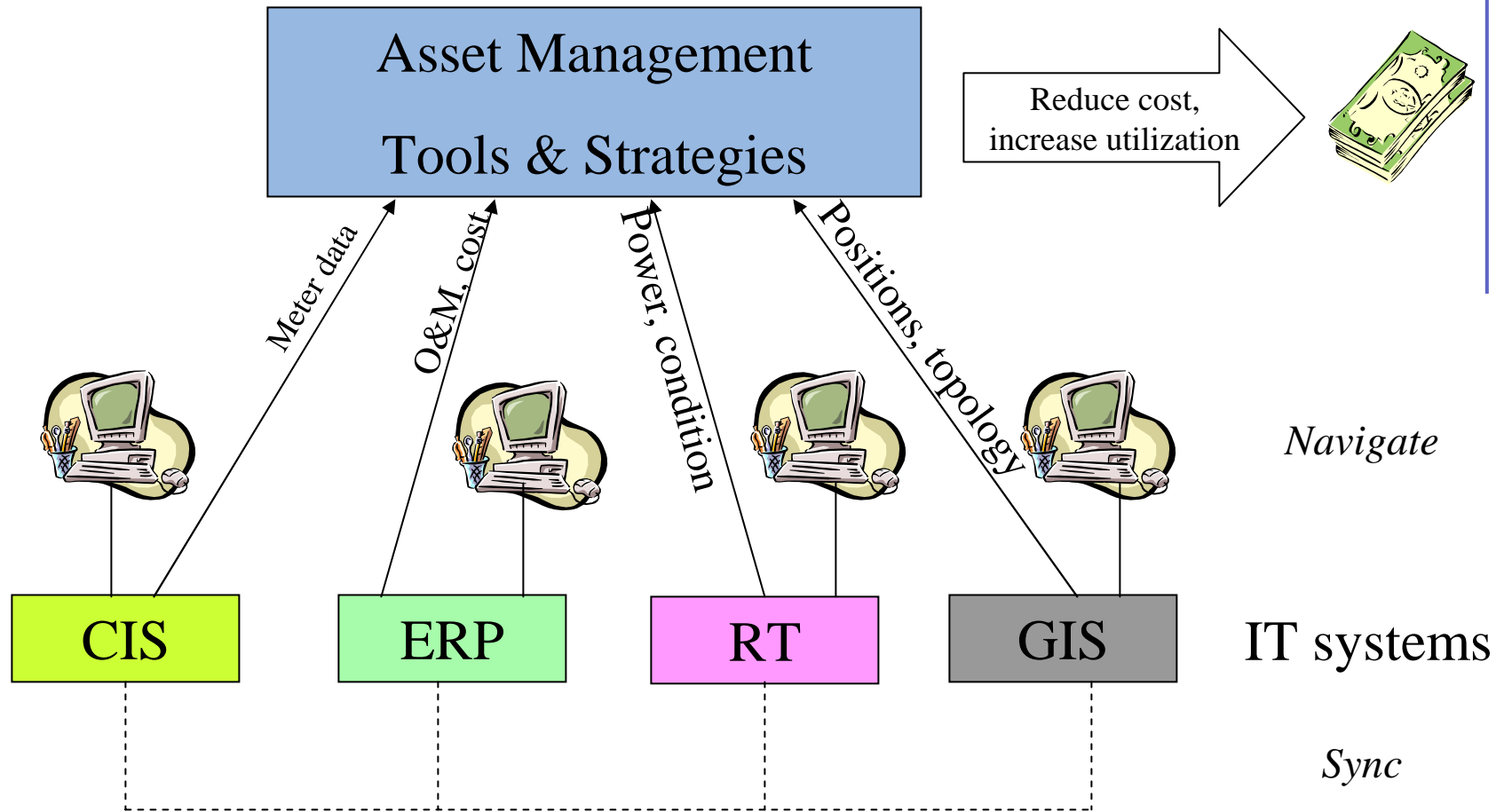
Utility needs for System Integration



Currently, utilities struggle with creating value from data of multiple IT subsystems



Network Asset Management – the big picture



Market Trends and Drivers

- Reduced O&M cost
 - Reduced cost for data engineering
 - Condition based maintenance
 - Higher utilization of mobile crew

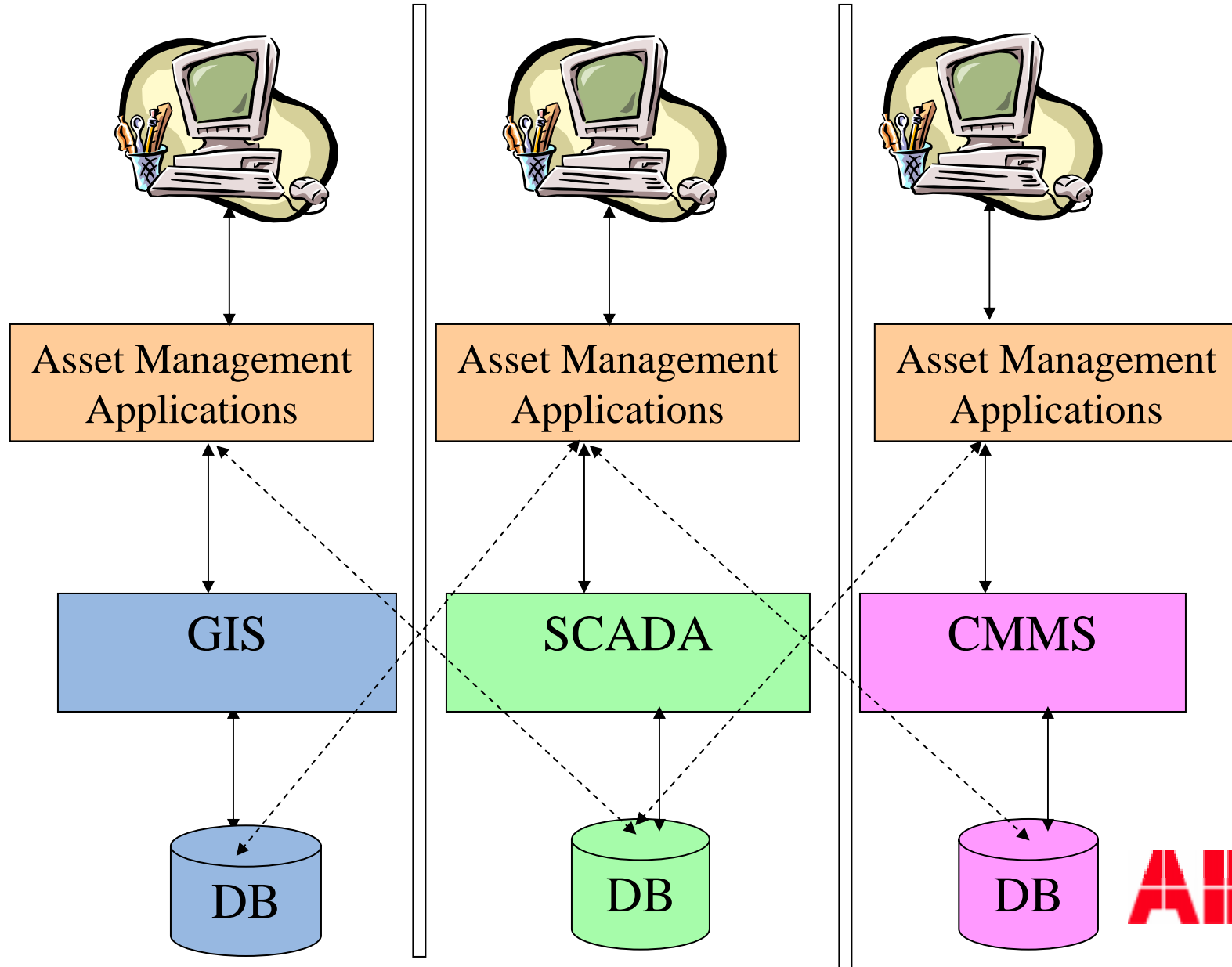
- Power System Reliability
 - Timely access to right information
 - All relevant data
 - Correct decisions

- Reduced Investment cost
 - Consistent asset data
 - improved asset utilization
 - Optimal replacement strategy

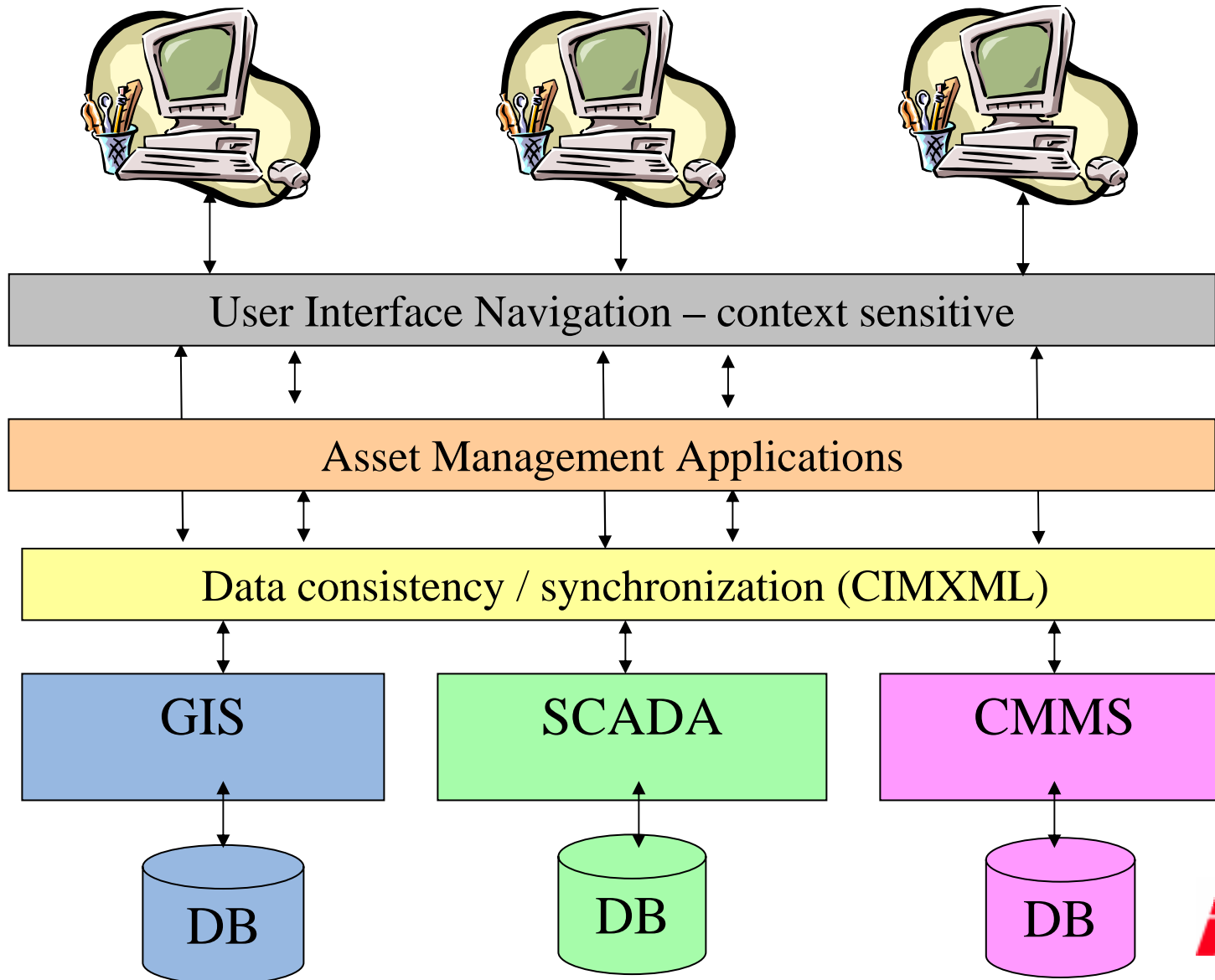
- Asset Management
 - Life Cycle Assessment
 - Condition monitoring
 - Dynamic Loading

Stovepipe Applications

Standard interfaces ———
Custom interfaces - - - - -



Integrated Network Asset Management (NAM)

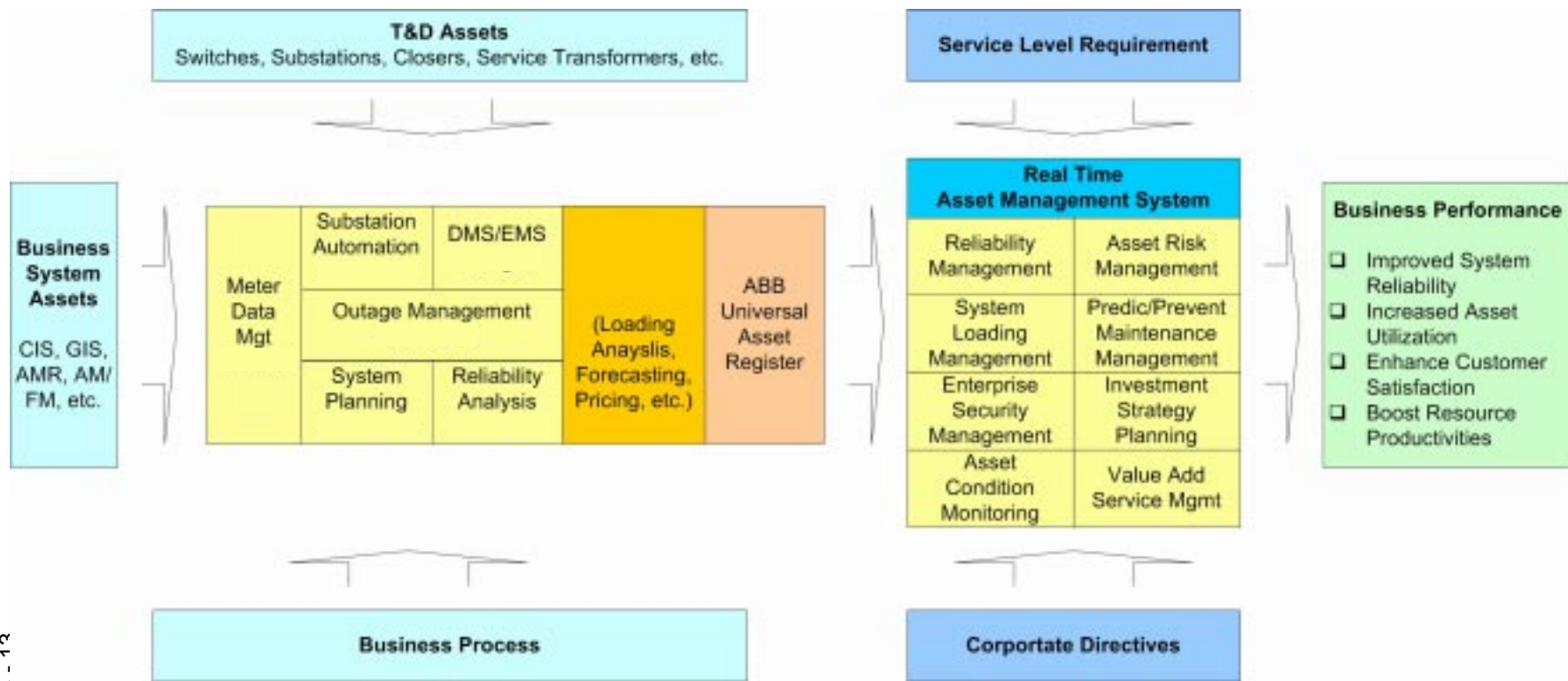


Customer values in development steps

Development stage	Customer value	Comment	Data Type
Step 3	Asset optimization	Lifecycle, utilization	CIM/XML
Step 2b	Consistency	Add/delete objects consistently	Structure
Step 2a	Data exchange	Consistent values, CIM model	Attribute
Step 1	Navigation	Context sensitive, Aspect Object	Object

Multi-Year System Integration Effort

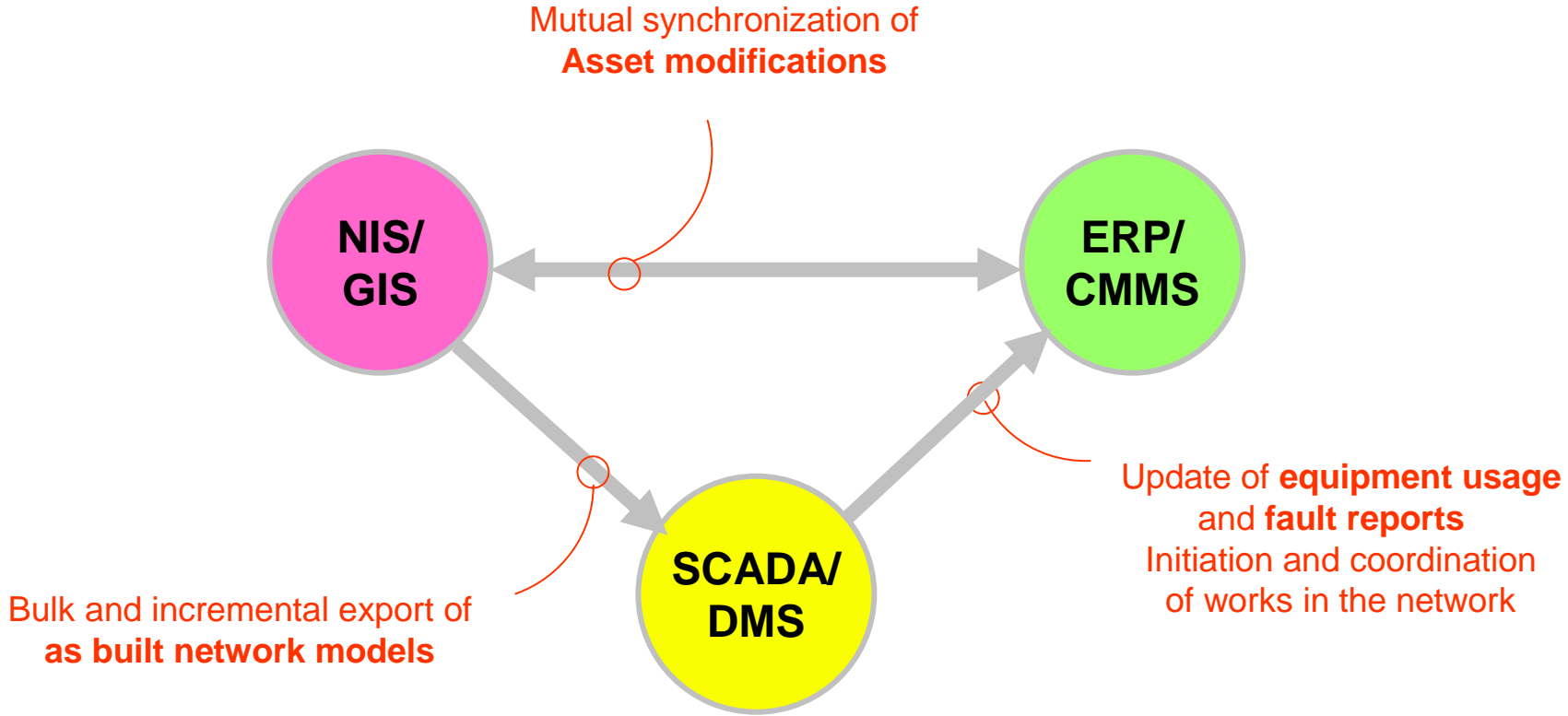
- Develop and leverage systems integration strategy for both ABB and 3rd Party Components with a focus on *Real-Time Asset Management*.



- Benefit will be more effective utilization of existing real-time data from IT systems for making better decisions regarding the use and maintenance of assets.



Data Flow Case Example



— On-line interchange

Asset master is GIS – planning and extensions
Data synchronization with SCADA and CMMS



Cross Application Navigation

- GIS request views from CMMS
 - GIS user right clicks on map object
 - GIS displays context menu / User selects CMMS item
 - CMMS invoked showing detailed information on equipment
 - CMMS invoked showing detailed work order on equipment
- SCADA request view from GIS
 - Operator wants geographical information on equipment
 - Operator right clicks on SCADA object and chooses GIS menu entry
 - ArcMap is launched zooming in map object
 - Map shows geographical coordinates, nearest access road, terrain, etc.

Data consistency / synchronization

- Add new object (in all relevant systems)
 - Object created in each system based on object templates
 - Connections between systems established automatically
- Delete object (in all relevant systems)
 - Delete defined object in each system
 - Delete object connections (links)
- Access object attributes (all)
 - Select object by identifier (any system)
 - Read out any object property independent of source
- Modify object attribute(s)
 - Select object by identifier (any system)
 - Update attribute in source system (owner)
 - Replicate data to other systems (readers of the data)
 - Maintain object connections (links)

Aspect Objects™ – Navigation (HMI)

ABB offers unique technology:

- effective integration for lower cost
- seamless integration for easy-to-use

Aspects

CMMS

Maintenance

NIS

Network and GIS

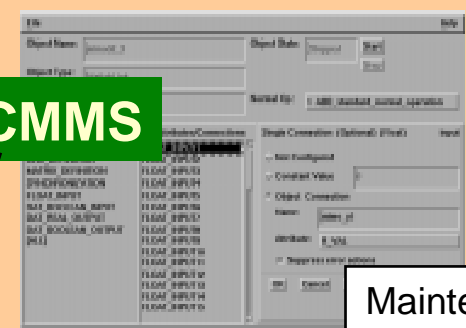
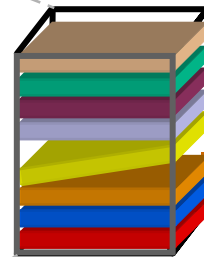
SCADA/EMS

One-line diagram

Aspect Systems

Real Object

Aspect Objects™



Aspect Objects and GIS Integration

- Cross application navigation was accomplished using:
 - ABB
 - Aspect Objects
 - Aspect Integrator Platform
 - ESRI Technology
 - ArcGIS 8.2
 - MapControl
 - ArcMap and ArcMap Extensions
 - ArcObjects

MapControl For Operations



The ESRI ArcObjects MapControl

- OCX with limited ArcMap Capability
- Great way to access ArcObjects object model
 - Symbology, geoprocessing
- Comes with full range of events
 - Mousedown, click, etc.
- Excellent for visualization

Map Control Enhancements

User interface functionality

- Network Element Color Coding
 - Line flow threshold violations
- Real Time Measurement Display
 - Voltage/power flows
- Fault Location
 - Pinpoint transmission line fault
 - Blinking graphic object
- Object Locate

ESRI ArcObject Implementation

- Object Rendering
 - IUniqueValueRenderer Interface
- Dynamic Text Annotations
 - IAnnotationFeature Interface
- Adding graphic symbol
 - IGraphicsContainer Interface
 - AddSymbol method
- Zooming in to selected object

Map Control Demo – Water leakage

- Possible leakage condition
- Color coding of District Metering Area in Main water utility GIS map (PIC #1)
- Navigate into District Metering Area (PIC #2)
- Color coding of possible leakage in DMA (PIC #3)
- CMMS active work orders (PIC #4)
- Issue a fault report – basis for maintenance work order
 - CMMS create fault report (PIC #5)
- Store leakage information (PIC #6)
- Analyze leakage history (PIC #7)

ESRI-GIS AIP Integration for WLMS

System : USABBRDUL05102 System - Workplace : Plant Explorer Workplace

Functional Structure

- DemoDMANodes
 - DMA1, Demo DMA
 - DMA1 - DMA3, Demo Pipeline
 - DMA2, Demo DMA
 - DMA2 - DMA3, Demo Pipeline
 - DMA3, Demo DMA
 - DMA1 - DMA3, Demo Pipeline
 - DMA2 - DMA3, Demo Pipeline
 - DMA3 - DMA4(1), Demo Pipeline
 - DMA3 - DMA4(2), Demo Pipeline
 - DMA3 - DMA4(3), Demo Pipeline
 - DMA3 - DMA4(4), Demo Pipeline
 - DMA4, Demo DMA
 - DMA3 - DMA4(1), Demo Pipeline
 - DMA3 - DMA4(2), Demo Pipeline
 - DMA3 - DMA4(3), Demo Pipeline
 - DMA3 - DMA4(4), Demo Pipeline
 - DMA4 - DMA5, Demo Pipeline
 - DMA5, Demo DMA
 - DMA4 - DMA5, Demo Pipeline
- DemoPipelines
 - Line-1, Demo Pipeline
 - Line-3, Demo Pipeline
 - Line-4(2), Demo Pipeline
 - Line-6(2), Demo Pipeline
 - Line-7(2), Demo Pipeline
 - Line-8, Demo Pipeline
 - Line-9(1), Demo Pipeline
 - Line-9(3), Demo Pipeline
 - Line-Main, Demo Pipeline
- DMAValves
 - Boundary Valve-1, Demo Valve
 - FH-1, Demo Valve
 - FH-2, Demo Valve
 - FH-3, Demo Valve
 - Meter-1, Demo Valve
 - Valve-1, Demo Valve
 - Valve-2, Demo Valve
 - Valve-3, Demo Valve
 - Valve-4, Demo Valve

Plant, Site

Aspects of 'DMA1 - DMA3'	Desc...	Inherited	Category name	Type name
ArcGIS Map		True	ArcGIS Map	ArcGIS Map
Demo Pipeline Type Reference		False	Demo Pipeline	Object Type
DMA Map		True	ArcGIS Map	ArcGIS Map
Functional Structure	The ...	False	Functional Stru...	Basic Property ...
Functional Structure	The ...	False	Functional Stru...	Basic Property ...
lines	This ...	False	GDB Feature	GDB Feature
Name	The ...	False	Name	Basic Property ...
WLMS Leakage List		False	WLMS Leakage ...	WLMS Leakage ...
WLMS Tracking		True	WLMS Tracking	WLMS Tracking

DMA1 - DMA3:ArcGIS Map

37°45'46"N 122°34'37"W

ESRI-GIS AIP Integration for WLMS

The screenshot displays a software interface for a water management system. On the left is a 'Functional Structure' tree view showing a hierarchy of DMA nodes, pipelines, and valves. The top right contains a table titled 'Aspects of DMA1 - DMA3' with columns for description, inheritance, category name, and type name. The central map view shows a geographical area with several DMA nodes (DMA1, DMA2, DMA3) highlighted in red and green. A context menu is open over the map, listing various aspects and actions available for the selected feature.

Aspects of 'DMA1 - DMA3'	Desc...	Inherited	Category name	Type name
ArcGIS Map		True	ArcGIS Map	ArcGIS Map
Demo Pipeline Type Reference		False	Demo Pipeline	Object Type
DMA Map		True	ArcGIS Map	ArcGIS Map
Functional Structure	The ...	False	Functional Stru...	Basic Property ...
Functional Structure	The ...	False	Functional Stru...	Basic Property ...
lines	This ...	False	GDB Feature	GDB Feature
Name	The ...	False	Name	Basic Property ...
WLMS Leakage List		False	WLMS Leakage ...	WLMS Leakage ...
WLMS Tracking		True	WLMS Tracking	WLMS Tracking

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Navigation using AIP context menu



ESRI-GIS AIP Integration for WLMS

The screenshot displays the ESRI-GIS AIP integration for WLMS. The interface is divided into several sections:

- Functional Structure Tree:** A hierarchical tree on the left showing the system structure, including DMA2, DMA3, DMA4, and DMA5, along with various pipes and valves.
- Aspects of 'Line-Main':** A table listing various aspects and their properties.
- Map View:** A zoomed-in map of a DMA (Line-Main) showing pipe networks, valves, and real-time pressure measurements (e.g., 107 psi, 102 psi, 105 psi). The map also displays leakage history and boundary valve status.

Aspects of 'Line-Main'	Desc...	Inherited	Category name	Type name
ArcGIS Map		True	ArcGIS Map	ArcGIS Map
Demo Pipeline Type Reference		False	Demo Pipeline	Object Type
DMA Map		True	ArcGIS Map	ArcGIS Map
Functional Structure	The ...	False	Functional Stru...	Basic Property ...
Name	The ...	False	Name	Basic Property ...
PipeMain	This ...	False	GDB Feature	GDB Feature
WLMS Leakage List		False	WLMS Leakage ...	WLMS Leakage ...
WLMS Tracking		True	WLMS Tracking	WLMS Tracking

Zoomed-in DMA map with leakage history, pipe leakage color coding, real time pressure measurements, and boundary valve status



ESRI-GIS AIP Integration for WLMS

The screenshot displays the ArcGIS interface with the following components:

- Functional Structure Tree (Left):** A hierarchical tree view showing DMA2, DMA3, DMA4, DMA5, Demo Pipelines, DMAPipes, DMAValves, and Plant/Site information.
- Table (Top Right):** A table titled 'Aspects of 'Line-Main'' listing various aspects and their properties.

Aspect	Desc...	Inherited	Category name	Type name
ArcGIS Map		True	ArcGIS Map	ArcGIS Map
Demo Pipeline Type Reference		False	Demo Pipeline	Object Type
DMA Map		True	ArcGIS Map	ArcGIS Map
Functional Structure	The ...	False	Functional Stru...	Basic Property ...
Name	The ...	False	Name	Basic Property ...
PipeMain	This ...	False	GDB Feature	GDB Feature
WLMS Leakage List		False	WLMS Leakage ...	WLMS Leakage ...
WLMS Tracking		True	WLMS Tracking	WLMS Tracking
- Map View (Center):** A network diagram showing pipes (Line-1, Line-2, Line-3, Line-4(2), Line-5, Line-6(2), Line-7(2), Line-8, Line-9(1), Line-9(3), Line-Main) and valves (Boundary Valve-1, FH-1, FH-2, FH-3, Meter-1, Valve-1, Valve-2, Valve-3, Valve-4). Pressure labels include '107 psi', '102 psi', and '105 psi'. A 'Close' button is visible near Boundary Valve-1.
- Work Order Window (Bottom Right):** A window titled 'AMHERST: Active Work Orders' showing a table with columns for Object ID, Site, and Description. The table contains one entry for 'AMHERST' at 'Site' 'TD'. Below the table are sections for 'Work Order Details' and 'Work Order Info, Description, Location, Status (Manual Start Priority)'. Copyright information for 2001 is also visible.

Check CMMS work order status



ESRI-GIS AIP Integration for WLMS

System : USABBRDUL05102 System - Workplace : Plant Explorer Workplace

Functional Structure

- DMA2, Demo DMA
 - DMA2 - DMA3, Demo Pipeline
- DMA3, Demo DMA
 - DMA1 - DMA3, Demo Pipeline
 - DMA2 - DMA3, Demo Pipeline
 - DMA3 - DMA4(1), Demo Pipeline
 - DMA3 - DMA4(2), Demo Pipeline
 - DMA3 - DMA4(3), Demo Pipeline
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 - DMA3 - DMA4(3), Demo Pipeline
 - DMA3 - DMA4(4), Demo Pipeline
- DMA4 - DMA5, Demo Pipeline
- DMA5, Demo DMA
 - DMA4 - DMA5, Demo Pipeline
- DemoPipelines
- DMA Pipes
 - Line-1, Demo Pipeline
 - Line-3, Demo Pipeline
 - Line-4(2), Demo Pipeline
 - Line-6(2), Demo Pipeline
 - Line-7(2), Demo Pipeline
 - Line-8, Demo Pipeline
 - Line-9(1), Demo Pipeline
 - Line-9(3), Demo Pipeline
 - Line-Main, Demo Pipeline
- DMA Valves
 - Boundary Valve-1, Demo Valve
 - FH-1, Demo Valve
 - FH-2, Demo Valve
 - FH-3, Demo Valve
 - Meter-1, Demo Valve
 - Valve-1, Demo Valve
 - Valve-2, Demo Valve
 - Valve-3, Demo Valve
 - Valve-4, Demo Valve
- Plant, Site
- Root, Domain
- Sample ePlant, Site Sample

Aspects of 'Line-Main'	Desc...	Inherited	Category name	Type name
ArcGIS Map		True	ArcGIS Map	ArcGIS Map
Demo Pipeline Type Reference		False	Demo Pipeline	Object Type
DMA Map		True	ArcGIS Map	ArcGIS Map
Functional Structure	The ...	False	Functional Stru...	Basic Property ...
Name	The ...	False	Name	Basic Property ...
PipeMain	This ...	False	GDB Feature	GDB Feature
WLMS Leakage List		False	WLMS Leakage ...	WLMS Leakage ...
WLMS Tracking		True	WLMS Tracking	WLMS Tracking

Line-Main:DMA Map

3766800*117 481309*391E

107 psi

102 psi

Line-1

Line-2

Line-3

Line-4(2)

Line-6(2)

Line-7(2)

Line-8

Line-9(1)

Line-9(3)

Line-Main

Line-5 FH-1

Boundary \

Close

Fault Report Wizard

Welcome to the Fault report wizard!

If you want to connect an object to your fault report, please register object id.

Reported by: [User]

Title: [Title]

Object ID: [Object ID]

Description:

Next > Cancel

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ESRI-GIS AIP Integration for WLMS

The screenshot displays the ESRI ArcMap interface with the 'Aspects of Line-1' table open. The table lists various aspects and their properties:

Aspect	Desc...	Inherited	Category name	Type name
ArcGIS Map		True	ArcGIS Map	ArcGIS Map
Demo Pipeline Type Reference		False	Demo Pipeline	Object Type
DMA Map		True	ArcGIS Map	ArcGIS Map
Functional Structure	The ...	False	Functional Stru...	Basic Property ...
Name	The ...	False	Name	Basic Property ...
PipeMain	This ...	False	GDB Feature	GDB Feature
WLMS Leakage List		False	WLMS Leakage ...	WLMS Leakage ...
WLMS Tracking		True	WLMS Tracking	WLMS Tracking

Below the table, a data table for 'Line-1:WLMS Leakage List' is visible:

PipeLine	Time Stamp	Substation	Distance
Line-1	5/8/2003 6:22:26 PM	DMA Pipes	50

A 'Store Leakage History' dialog box is open, showing the following fields:

- Pipeline: Line-1
- Substation/Valve: DMA Pipes
- Distance: 90 %

The dialog box includes 'Store' and 'Cancel' buttons.



ESRI-GIS AIP Integration for WLMS

System : USABBRDUL05102 System - Workplace : Plant Explorer Workplace

Functional Structure

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 - DMA2 - DMA3, Demo Pipeline
 - DMA3, Demo DMA
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 - DMA3 - DMA4(2), Demo Pipeline
 - DMA3 - DMA4(3), Demo Pipeline
 - DMA3 - DMA4(4), Demo Pipeline
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 - DMA4 - DMA5, Demo Pipeline
 - DMA5, Demo DMA
 - DMA4 - DMA5, Demo Pipeline
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 - FH-2, Demo Valve
 - FH-3, Demo Valve
 - Meter-1, Demo Valve
 - Valve-1, Demo Valve
 - Valve-2, Demo Valve
 - Valve-3, Demo Valve
 - Valve-4, Demo Valve

Plant, Site

Aspects of 'DMA1 - DMA3'	Desc...	Inherited	Category name	Type name
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Demo Pipeline Type Reference		False	Demo Pipeline	Object Type
DMA Map		True	ArcGIS Map	ArcGIS Map
Functional Structure	The ...	False	Functional Stru...	Basic Property ...
Functional Structure	The ...	False	Functional Stru...	Basic Property ...
lines	This ...	False	GDB Feature	GDB Feature
Name	The ...	False	Name	Basic Property ...
WLMS Leakage List		False	WLMS Leakage ...	WLMS Leakage ...
WLMS Tracking		True	WLMS Tracking	WLMS Tracking

DMA1 - DMA3:ArcGIS Map

37°36'33"N 122°18'25"W

Leakage history shown as red dots on pipelines



ArcMap

For

Operations/Planning

ArcMap Extensions

User interface functionality

- ESRI Object Mapping to AIP
 - Aspect Object Assignment
- Location function
 - Zoom in to selected object
 - Levels of zooming
- ESRI Object Context Menu
 - Cross referencing map object-
aspect object
- Invoking menu item
 - Enabling cross application
navigation



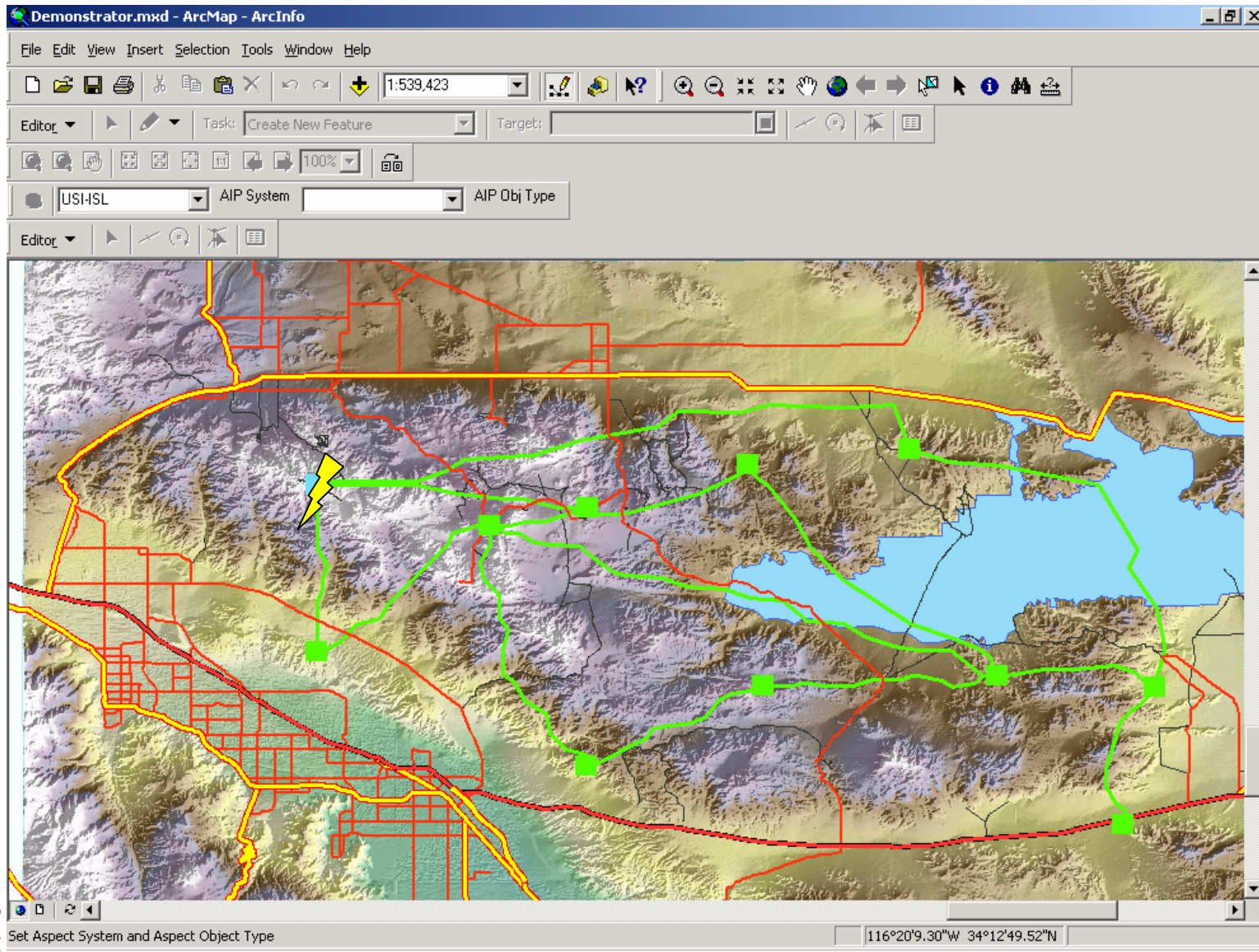
ESRI ArcObject Implementation

- IFeatureCursor/Spatial Filter
 - + AIP Aspect Automation Lib
- IEnvelope Interface
 - Expand Method
 - CommandLine launching
- IMultitem Interface
 - +AIP Aspect Automation
Lib/Integration Service Layer
- IMultitem Interface
 - +AIP Aspect Automation

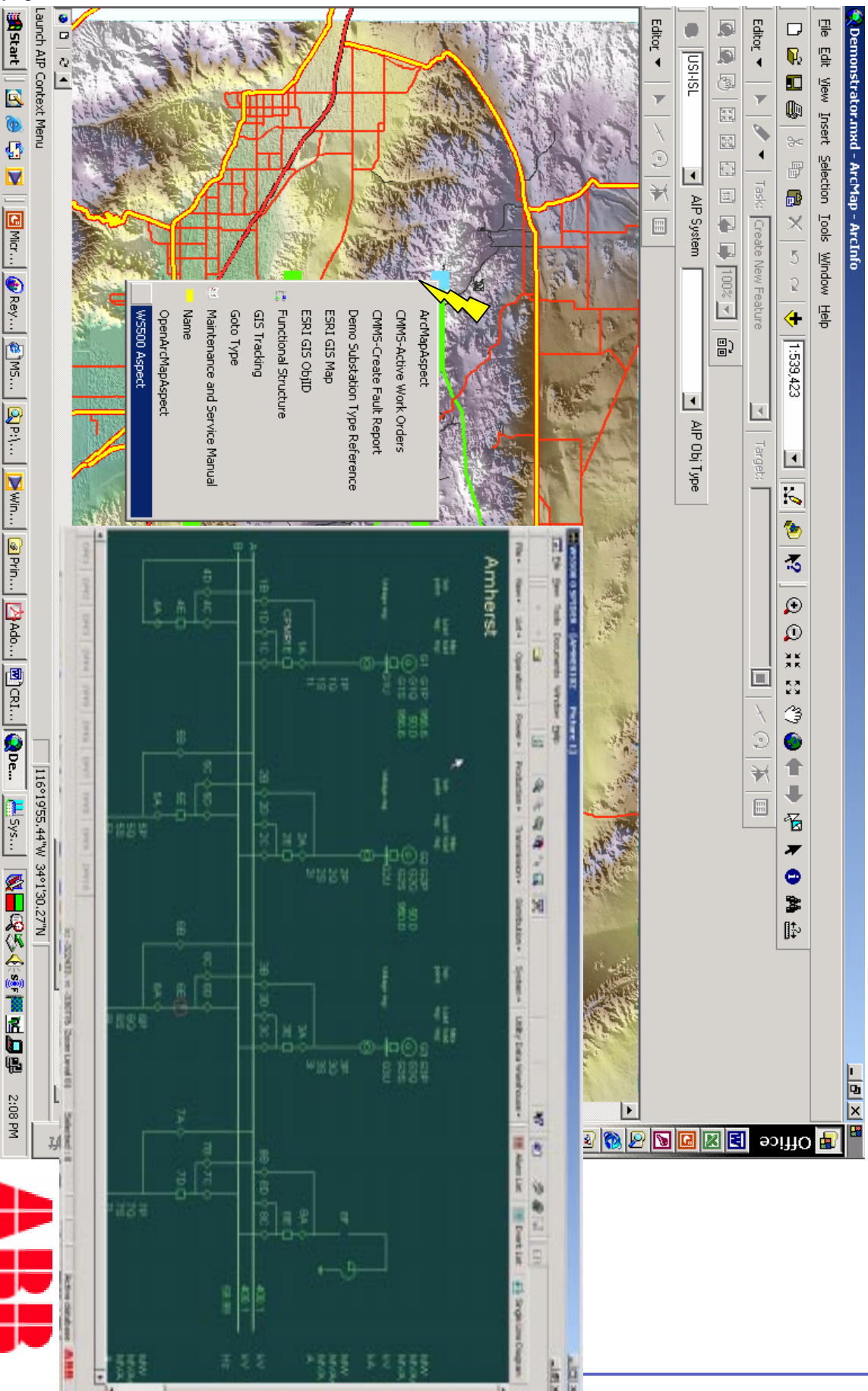
Demo – breaker fault scenario

- Fault reported on GIS
 - Select faulty location (PIC #1)
- Launch SCADA HMI (PIC #2)
- Acknowledge fault alarm in SCADA and operate SCADA to isolate and restore network condition (PIC #3)
- Check maintenance information
 - CMMS active work orders (PIC #4)
- Access relevant product documentation
 - DOC - Maintenance and service manual for selected object (PIC #5)
- Issue a fault report – basis for maintenance work order
 - CMMS create fault report (PIC #6)

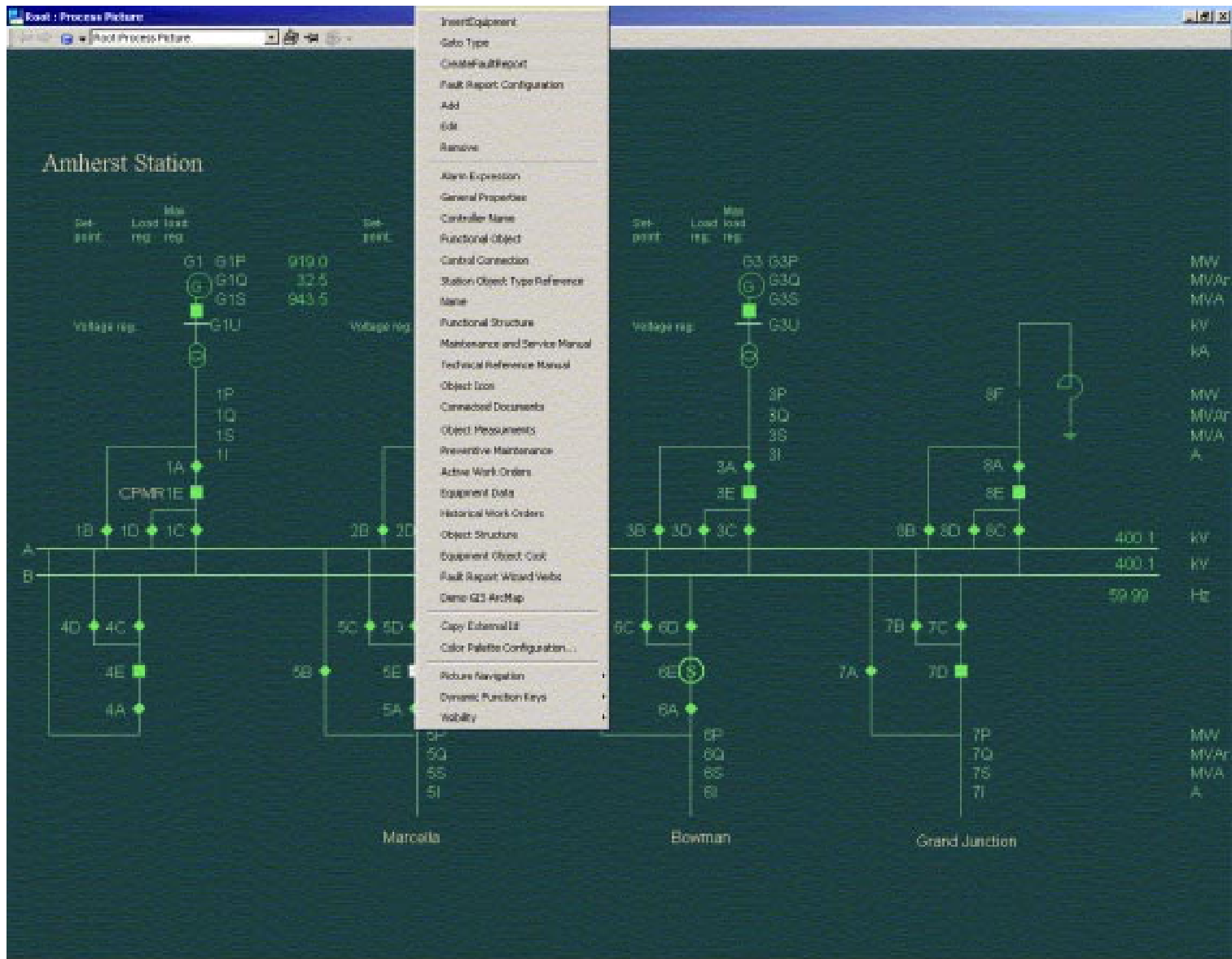
Fault reported at Substation (#1)



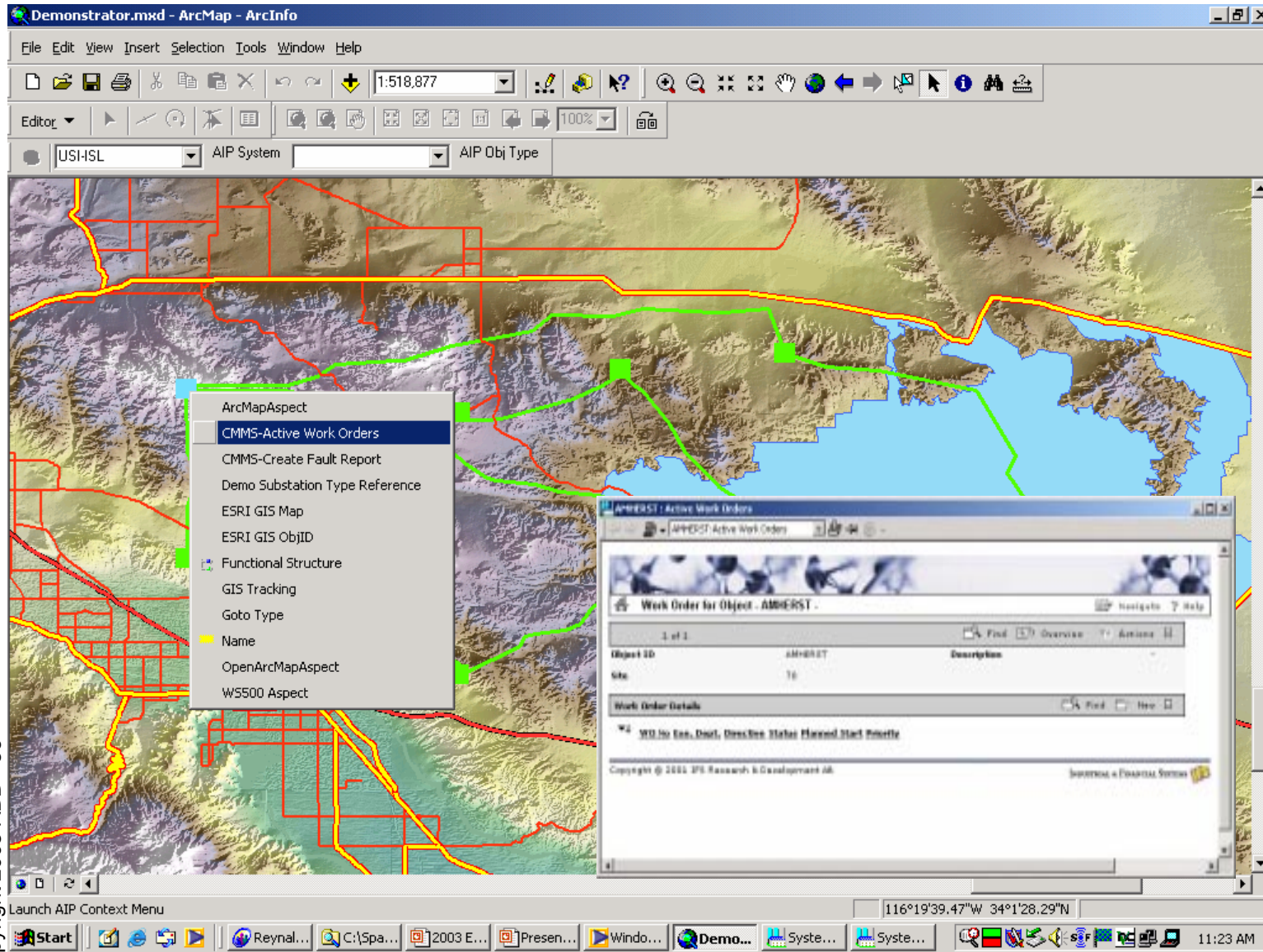
Launch SCADA HMI (#2)



Acknowledge SCADA Alarm (#3)



CMMS show active work orders (#4)



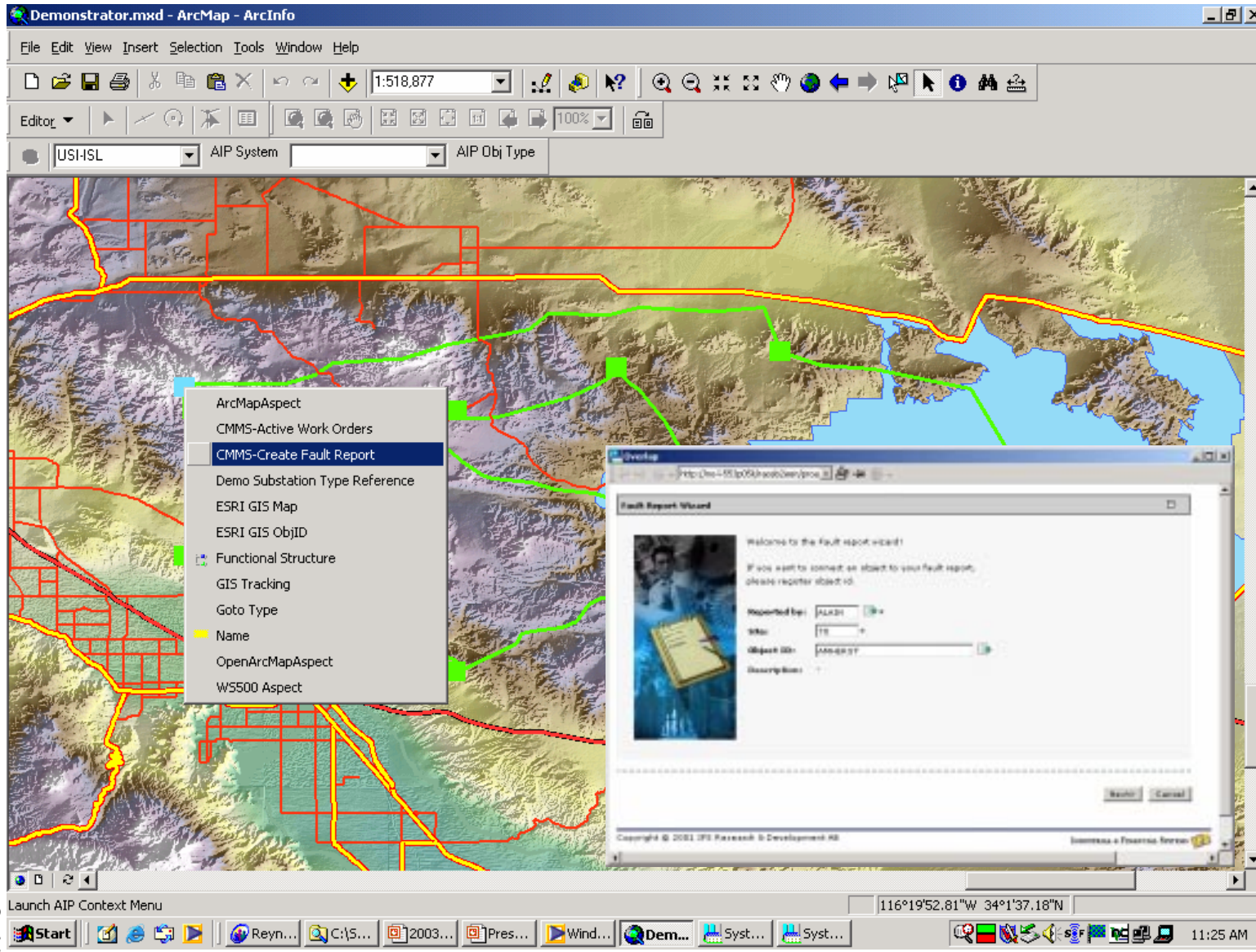
Display product documentation (#5)

The screenshot shows the ArcMap interface with a GIS map. A context menu is open over a green line, listing various actions such as 'Maintenance and Service Manual', 'ESRI GIS Map', and 'Functional Structure'. An inset window displays technical specifications for 'LTB D SF₆ circuit-breakers'.

Parameter	Value
Rated voltage	72.5 - 170 kV
Rated current	3150 A
Rated breaking current	80 kA
Rated frequencies	50 and 60 Hz
Installation	Outdoor and indoor



Create Fault Report/Work Order (#6)



Conclusions

- Utility System Integration For Network Asset Management:
 - Reusable solutions based on standard products
 - Seamless user interface integration – SCADA, CMMS, GIS
 - Methods and technologies to optimize the use, care and replacement of physical equipment and facilities
- Added value is seen through:
 - Consistent access to sub-systems
 - Consistent data (object data and application data) throughout sub-systems
 - Common methodology to engineer system and exchange data
 - Support for workflows, guidance through business processes
 - Asset Optimization and Utilization
 - Optimal maintenance strategies (condition based, RCM, etc)



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that enable utility and industry customers to improve
performance while lowering environmental impact

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