ABINEE TEC

9 de Outubro de 2003

Automação de Subestações

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ALSTOM

Scope of the presentation

ALSTOM

- Introduction on Power Automation
- PACiS - PROTECTION, AUTOMATION & CONTROL INTEGRATED SOLUTION
  - Concepts
  - Components
  - Systems

EAI - Energy Automation & Information

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UTILITIES
SUBSTATIONS

INDUSTRIAL
PLANTS

DISTRIBUTED
GENERATION

INFRA-
STRUCTURES

DCS AUTOMATION EVOLUTION

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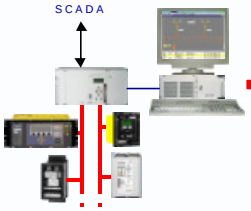
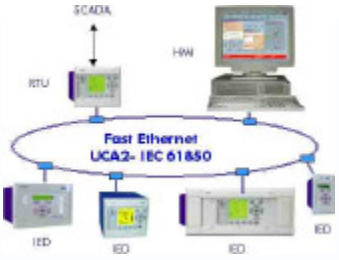
1980'	1990'	2000'
		
RTU	SAS Ethernet based/Private protocol or RS485 based/T103-DNP3	SAS Ethernet based/Standard UCA/IEC 61850
Monitoring Simple control	Monitoring Protection Slow automation	Monitoring Protection Fast automation Standard engineering

Introducing PACiS

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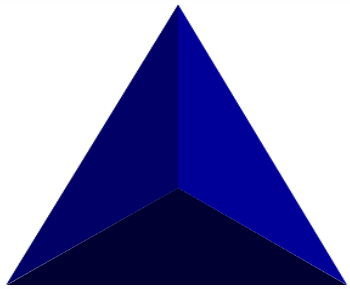
SCALABLE SOLUTION

Scope, Functions, Architecture, Engineering



HIGH STANDARDIZATION LEVEL

Communication, Bay/Substation, Services

DEDICATED TO POWER AUTOMATION

Security, Outage minimization, Topological automation, EMC

PACiS: a scalable solution

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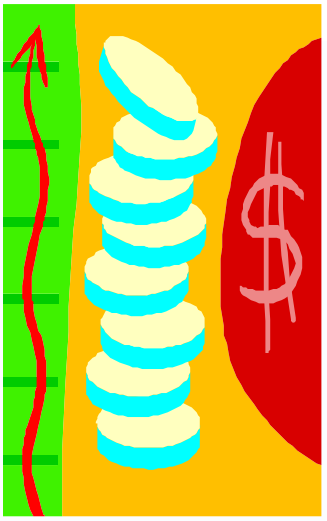
SCOPE

- Network
- Site
- Substation
- Voltage level
- Busbar
- Bay



FUNCTIONS

- M + C + P + Power Management
- M + C + Protection
- M + Control
- Monitoring

Modular, Standard, Expandable

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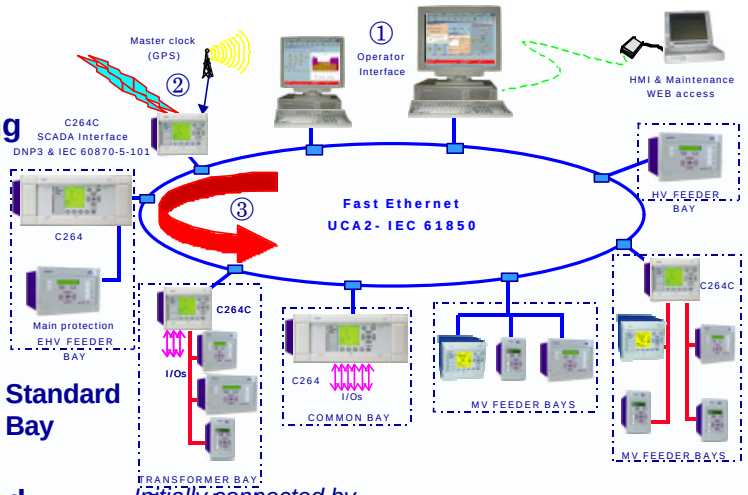
Standard bay

① Monitoring

② Control

Standard Bay

③ Distributed Automation



Standard Bay

Initially connected by parallel links to RTU, SOE, Mimic

UCA2/IEC 61850: Key benefits vs. previous generation

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- Speed: 100 Mbps instead of few 10 kbps
  - More data for a better operation & maintenance
- Peer-to-peer: No extra hardware
  - Design of innovative automation schemes, late tuning
- IP (Internet Protocol) routing: Ubiquitous data access
  - Capability to extend the system outside of the substation
- Client-server: Instead of master-slave
  - Flexible designs easy to upgrade
- Pre-defined names: Single vocabulary between users
  - Easier engineering between teams
- XML references: Formal interfaces
  - Consistency between engineering tools

ALSTOM background in UCA2

- Prototypes demonstrated in UCA2 first in 1999
- Commercial product available in 2000
- First inter-operability tests in 2000

ð Practical experience (not only paper !)

PACiS Elements

- PACiS OI
- MiCOM IEDs
  - Computers C26x range
  - Protections P range
  - Measurements, Quality and Disturbance M range
- MiCOM Ethernet Switch
  - PCI boards
  - DIN rack range
- PACiS Engineering tools
  - Configuration tool
  - Management & Maintenance tool
  - Simulator tools

HMI: A NEW ERGONOMY

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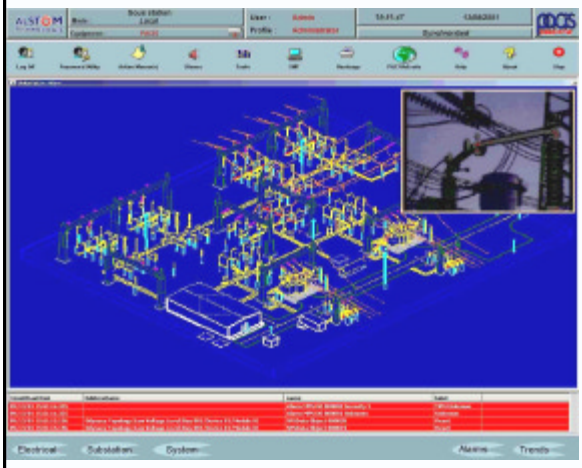
PACiS OPERATOR INTERFACE



- Native integration of substation needs
- Intuitive and fully secure interface
- Scalable platform tailored per project
- Consistent suite of operator tools
- Open interfaces ready for the future

MORE OI

A SCADA platform

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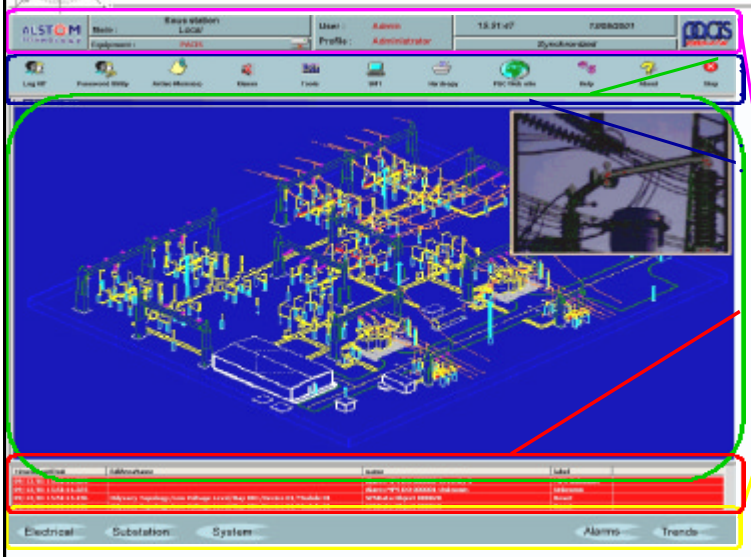
PACIS OI main functions

- An integrated solution
  - Local and remote Command & Control tools
  - Configuration & Maintenance software
  - Asset & Analyse applications
- Easy to use through the display of the substation network reality
- Security for the local control and command
  - User identification tools (fingerprints, electronic key)
  - User code
  - WEB firewall

Advanced SCADA features



ubstation screens

Control & Command area

Generic data

3D plant visualisation
- Name
- Localisation
- User profile
- Generic information
- Date & time
- Dedicated tools
- Help
- Internet access

Menu bar

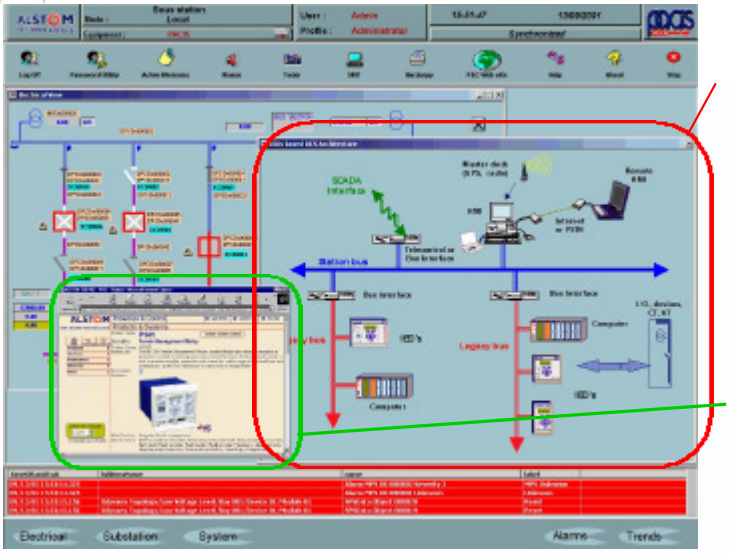
Alarm windows

- Most recent alarms
- Nature
- Status
- Severity
- Time Stamping

Substation data explorer bar

Customer design access buttons

WEB monitoring



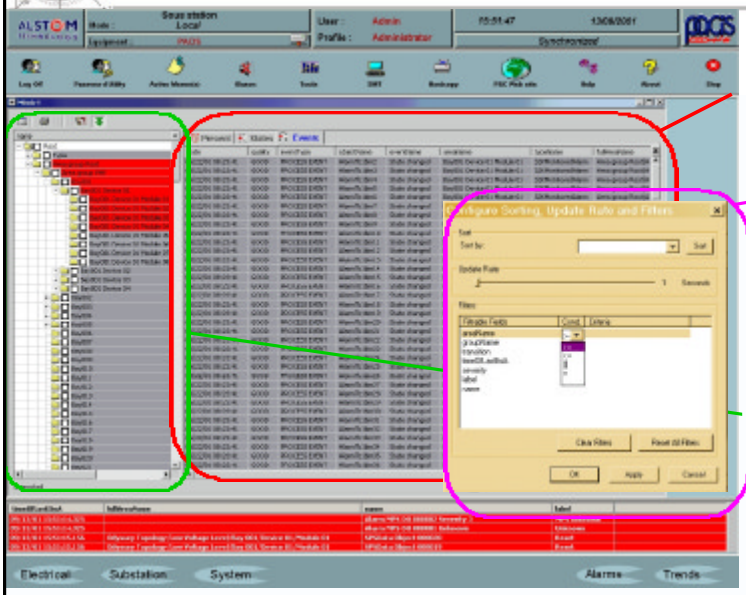
Monitoring window

- Physical system architecture
- Equipment status
- Failure indication

Web monitoring

- On-line help
- IED documentation remote access
- Hotline connection

Events browser

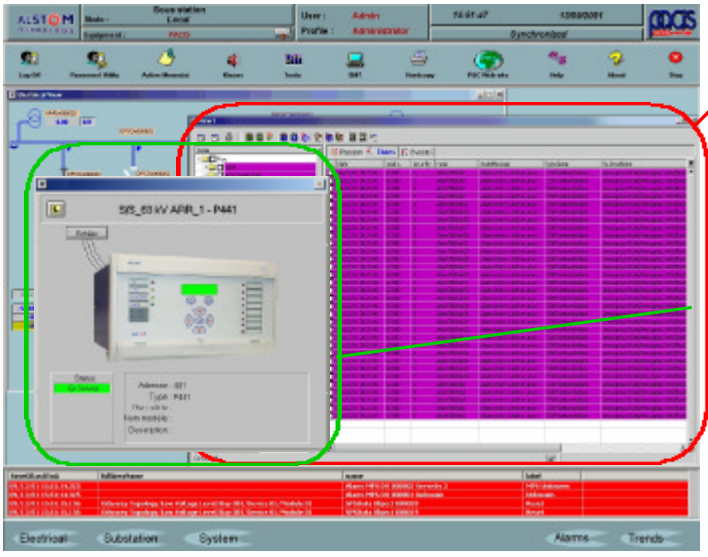


Event list
- 1 ms datation
- Customisable
- Colors indication

Event sorter
- Logic condition
- Name
- Date or time
- Device
- Bay
- Voltage level

Events browser
- Tree presentation
- Event per device
- Icon identification

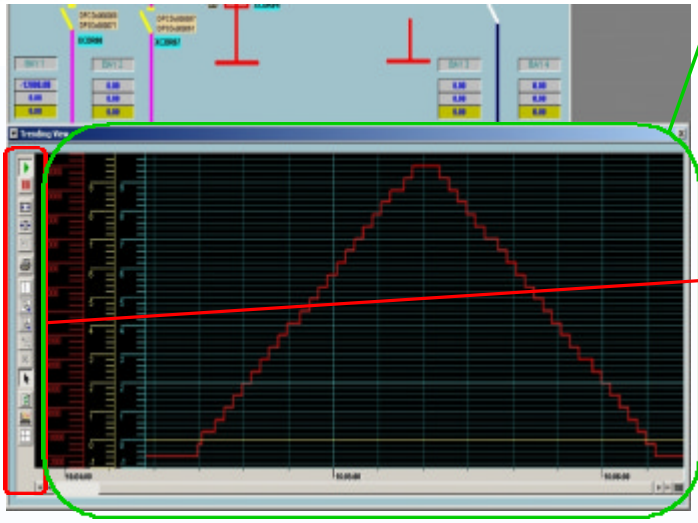
Maintenance tools



State viewer
- Equipment status
- Severity
- Sorting/filtering
- Physical localisation
- Report

Equipment maintenance window
- Status
- Maintenance report
- Board identification

Trend viewer



Trend screen

- up to 5 curves
- real time refreshment
- Zooming facilities
- Freezing facilities

Trending tools

- Zoom
- Print
- Scale change
- Freeze

Analyse tools

Quality analyser

- File from M720
- Voltage swell
- Dips contracts
- Statistics
- Power quality graphics

Waveforme analyser

- Comtrade file format
- Vectorialrepresentation
- Faults localisation
- Phase rotation

Remote communications

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PACIS OI exchanges data through

- SCADA links
  - Embedded communication boards DNP3 and IEC 60870-5-101
  - Specific communication stacks for any SCADA protocols (dedicated hardware may be needed)
- Process Control System
  - via OPC on an Ethernet link
  - through files exchange from the SQL database

Characteristics

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PACIS OI performances

- HMI (local or remote): up to 8
- Data points per system: up to 20 000
- Transit time on operator action: 500 ms
- Input to mimic time on event: 500 ms
- Input bandwidth (real-time): 1 000 events/s
- Time resolution: 10 µs.

AN UNRIVALED IEDs BASIS

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MiCOM RANGE

MiCOM Pxxx: Protection Relays

MiCOM Cxxx: PLCs, Bay Computers and RTUs

MiCOM Mxxx: Measurement & Power Quality

AN UNRIVALED IEDs BASIS

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- Complete MiCOM range in EAI
  - Plate-form approach reducing spare parts
  - Uniform engineering tool facilitating training, maintenance and evolution
  - Various functional mix: protection only, control only, protection and control, etc.
  - Total system integration

AN UNRIVALED IEDs BASIS

- Open integration of third party products using:
  - UCA2/IEC 61850
  - IEC 60870-5-103
  - DNP3
  - MODBUS
- ALSTOM competitor products or complement such as:
  - PLC
  - Partial discharge monitoring
  - Site security
  - etc.

MiCOM C264 /C264C

Latest State of the Art RTU Technology

The MiCOM Designed Substation Computer

RTU / Controller / PLC

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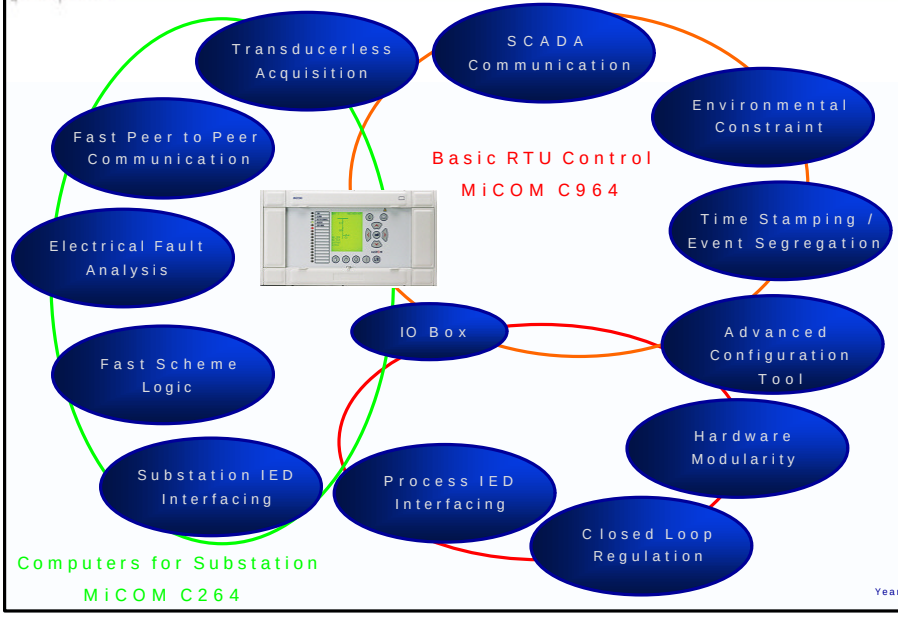

MiCOM C264 / C264C

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Key Salient Features

MiCOM C264 (40T)

MiCOM C264 (80T)

- 40T/80T 19'' Racks
- Flexible I/O
- Direct CT/VT Connection
- PLC with IEC1131 libraries
- Up to date XML Configuration Tool
- Station Bus Communication through Ethernet UCA2 / IEC 61850
- IEDs Concentrator with 4 sub-networks
- Upstream SCADA Communication

Options

- Local display
- Energy and Power Quality
- IRIG-B External synchronization

MiCOM C264 Rack

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Mechanical Arrangement

MiCOM C264C
4U / 40 TE
with 6 slots for
I/O boards

MiCOM C264
4U / 80 TE
with 15 slots for I/O
boards

2 Typical 4U Modular Design
19" and ½ 19"

MiCOM C264 Connections

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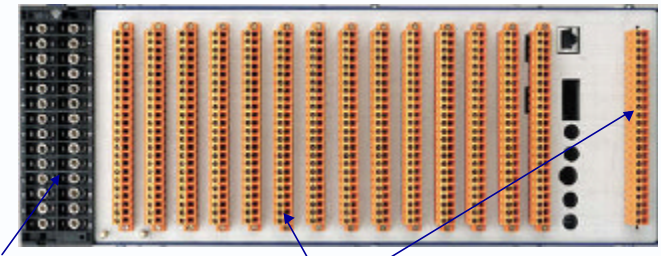
Board Modularity

Board Types : 16 DI (1 Common for 2 DI)
10 DO (No Common) - 4 AI (Non Common)
CB Control (8DI, 4DO) - CT/VT Board (2 Slots)



Specific connectors
for 4 mm^2 wires
direct CT/VT
connection

Removable connectors for I/Os
boards and Power supply

Direct CT-VT /Removable Connectors

Communication Protocol Capability

- Up to date SCADA communication port
  - Ethernet IEC 60870-5-104
  - IEC 60870-5-101
  - DNP3.0 Level 3
  - MODBUS RTU (future)
- Open /Flexible IED interfacing Capability
  - IEC 60870-5-103
  - Modbus RTU
  - IEC 60870-5-101
  - DNP3.0 Level 2
- Local Substation Data Port
  - Ethernet UCA2/IEC61850 (future)

Communication Interface

- Up to 4 Serial Communication Ports (Master or Slave Selectable)
  - Base : RS232 or RS485 for the main 2 ports
  - Option : 2 extra ports : RS232, RS484 or Optical
- Up to 6 Ethernet Ports
  - Base : 1 Port 10-100Tx (RJ-45)
  - Option 1 : 1 Port 100Fx (mono-mode or multi-mode)
  - Option 2 : Internal Hub Switch (1 slot) : 4TX or 4TX+2FX, FX being redunded
- 1 Optional IRIG-B Port

MiCOM C264 Key Components

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Electronic Design Principle

- 32-bit processor-based
- Real time multitasking firmware
- Powerful floating-point Digital Signal Processor (DSP) for transducerless acquisition
- Ethernet-Based communication
- Internal rugged Ethernet switch board
  - Point to point single connections
  - Optional redundancy management in optical ring (4FX ports)
- Serial links Master or Slave configurable up to 38.4 kbps

Ethernet 100Mbit/s Technology Compliance

MiCOM C264 Processing

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Maximum Processing Capability

- 1024 binary inputs
- 256 analogue inputs
- 256 digital outputs
- 40 Binary count inputs
- 48 set points
- 2 redundant SCADA links, 4 IEDs links or mixed configurations
- Integrated up to 6-ports Ethernet switch
- 16 IEDs per serial link
- 200 records of sequence of events
- 5 fault disturbance records

MiCOM C264 Input/Outputs

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Typical Input/Output Characteristics

- **Digital inputs**
  - Circuit Breaker Position
  - Disconnecting Switch Position
  - Tap changer Position (BCD)
  - Pulse accumulator
  - Alarm input
  - 1 ms time acquisition
  - Programmable debounce filter
  - Single/double input
- **Digital outputs**
  - Direct control
  - Select Before Operate control
  - Settable Control Pulse duration
  - For CB control board no interposing relay required
  - Trip Circuit Supervision
- **Analogue measurements**
  - Current or voltage inputs
  - 16 bits ADC
  - 0.1 % accuracy
  - 6 programmable thresholds
  - Linear or quadratic scaling
  - Cyclic or variation telemetry
- **Transducerless inputs (CT/VT)**
  - 4CT (4I+Io), 4VT (3V+1VBB)
  - Class 0.2 metering accuracy
  - True RMS measurement : U, I, P, Q
  - Waveform capture

MiCOM C264 Waveform

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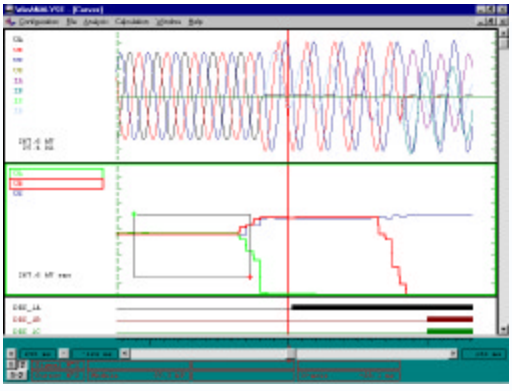
CT-VT Waveform Capture

- Up to 8 AC analog channels and 128 I/Os
- Fast Sampling rate: 32 samples / cycle (1,6kHz)
- Slow trending sampling : 20ms to 1h
- COMTRADE format



Combined Waveform and Trend Capture

MiCOM C264 PSL

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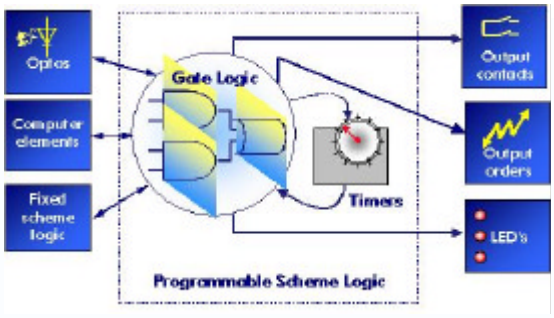
Programmable Scheme Logic (Reflex)



- Typical Cycle time of less than 5ms
- G raphical configuration tool
- Example : Trip Circuit Supervision

User Configurable Programmable Scheme Logic

MiCOM C264 PLC

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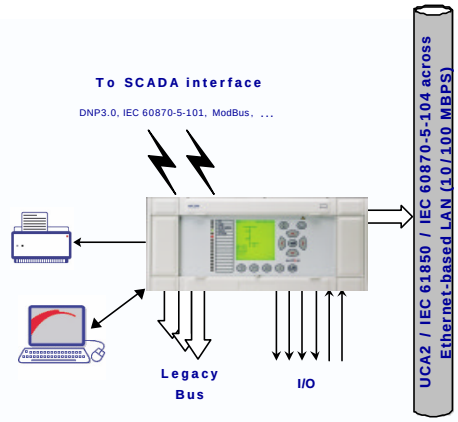
Programmable Logic Controller

- Sequential Automation Capability
- Isagraph Configuration tool (IEC1131)
- Examples:
  - Switching device control
  - Transformer Voltage regulation (built-in)
  - Auto-recloser (built-in)
  - Synchro-check (built-in)
  - Closed-loop

Possibility of Library of automation schemes

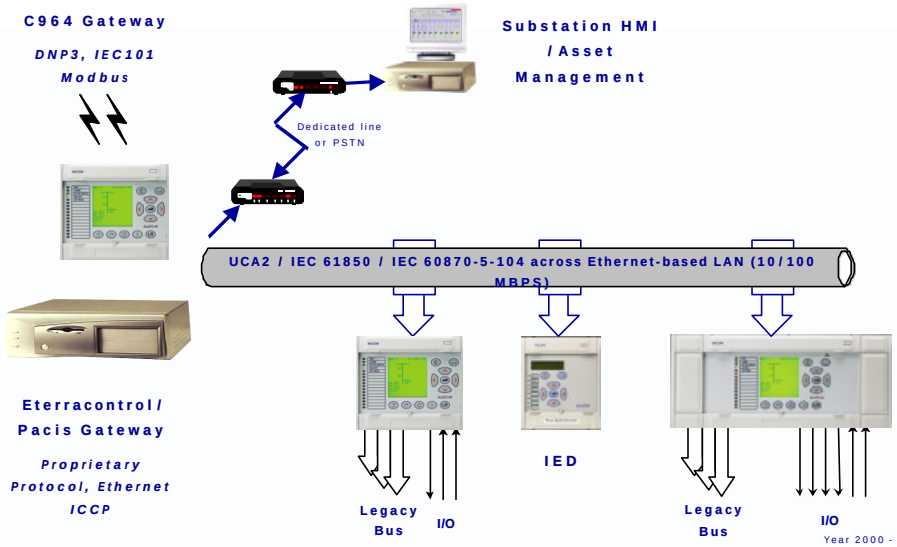
MiCOM C264 Centralised

Centralised architecture - Mono rack



MiCOM C264 Distributed

RTU Distributed Architecture



MiCOM C264 Multi-rack

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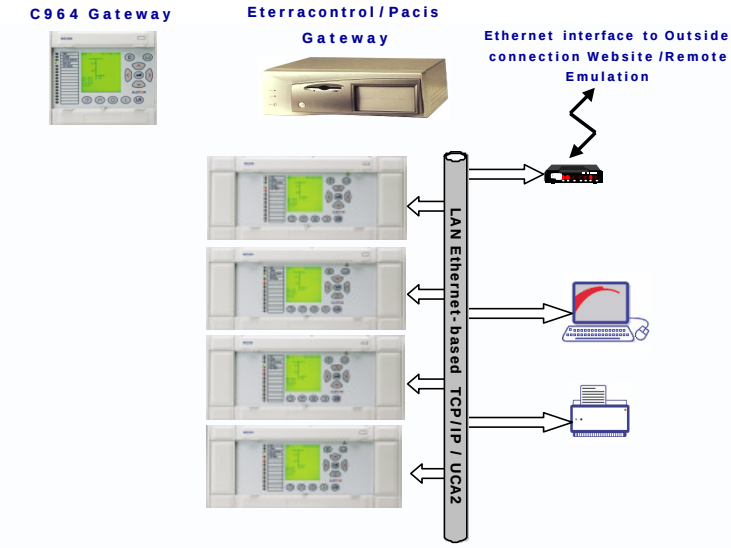
Centralised Multi rack Architecture



Station Bus Communication

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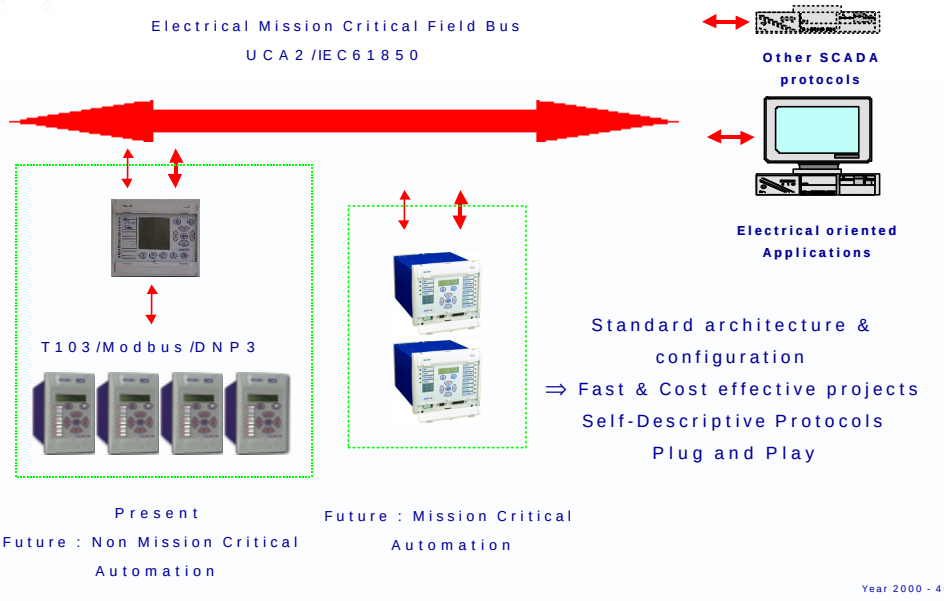
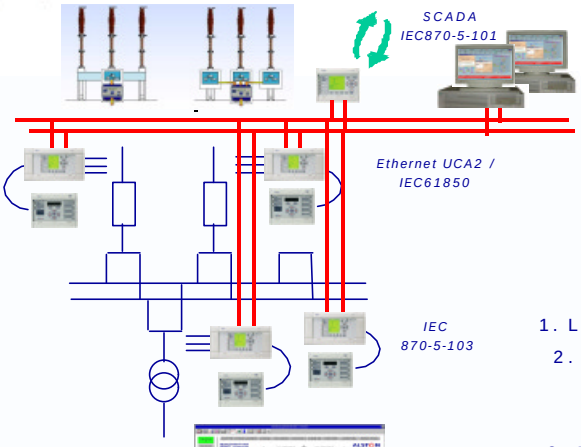


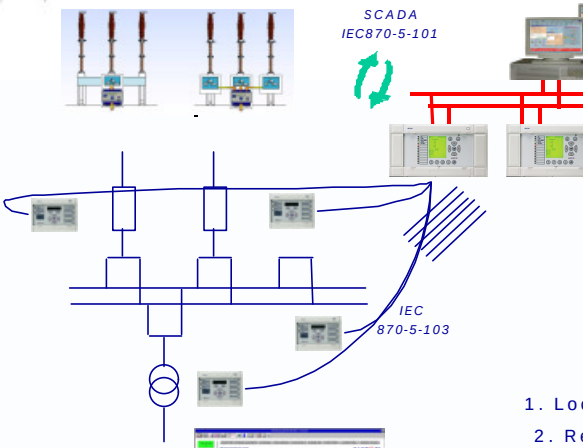
Transmission EHV/HV - Distributed



Key Differentiation

1. Local Integration capability
2. UCA2 technological gap (wide possibilities of scheme automation)
3. Relay Optimal Integration
4. Switchyard Field Distribution
5. Asset Management Interface

Transmission EHV/HV - Centralised



Key Differentiation

1. Local Integration Capability
2. Relay Optimal Integration
3. SCADA Protocol Integration

Substransmission HV - Distributed

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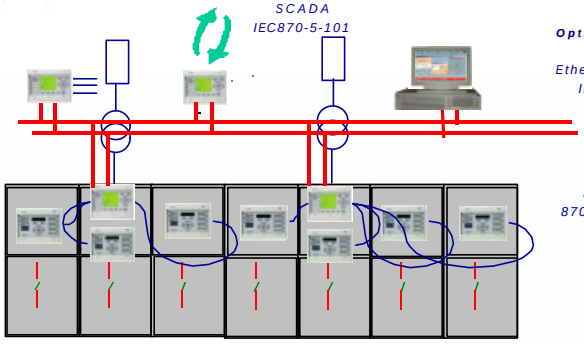

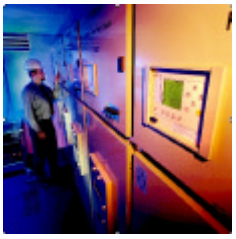

MiCOM C264

MiCOM P

Key Differentiation

1. HMI Standardisation
2. Local Integration capability
3. Relay Optimal Integration
4. Switchgear Integration

SubTransmission - Centralised

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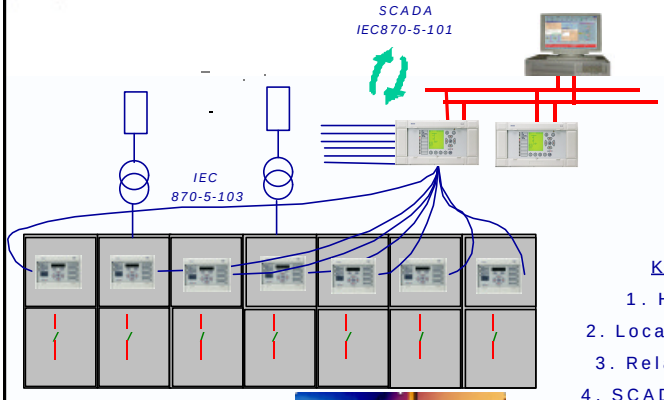
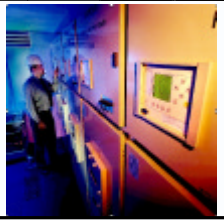




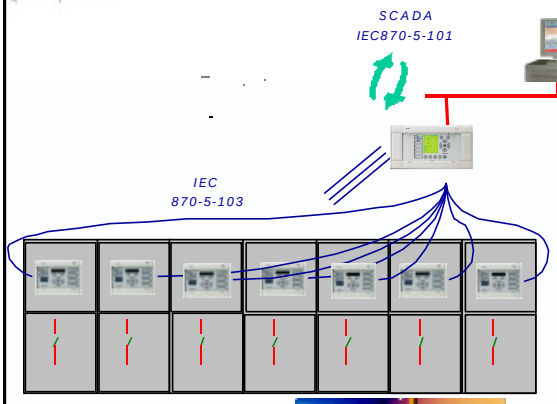
MiCOM C268

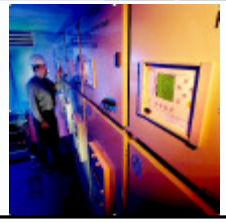
MiCOM P

Key Differentiation

1. HMI Standardisation
2. Local Integration Capability
3. Relay Optimal Integration
4. SCADA Protocol Integration

Distribution - Centralised





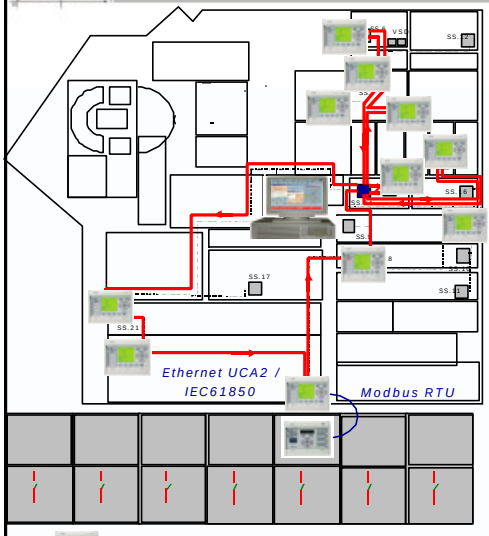
MiCOM C264

MiCOM P

Key Differentiation

1. HMI Standardisation
2. Local Integration Capability
3. Relay Optimal Integration
4. SCADA Protocol Integration

Large Industries - Plant Electrical SCADA



MiCOM C264

MiCOM P

Key Differentiation

1. Scheme Automation
(Load Shedding/restarting,...)
2. Third Party Interface Integration
3. LV Interfacing
3. Flexibility to communication medium

Small Industries / Infrastructure - Centralised

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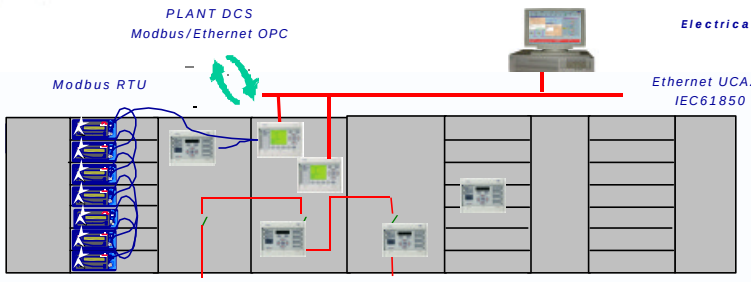

MiCOM C264

MiCOM P

Key Differentiation

1. HMI Standardisation
2. Process DCS Open Interface
2. VAR Integration
3. Relay Optimal Integration

Railway - Electrical SCADA

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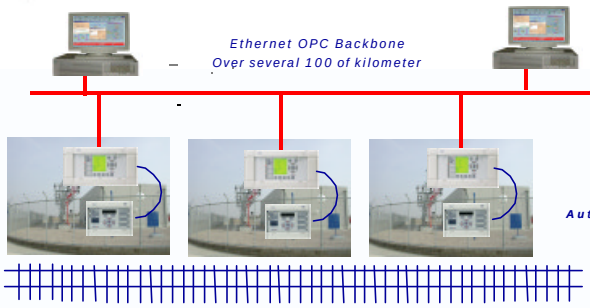


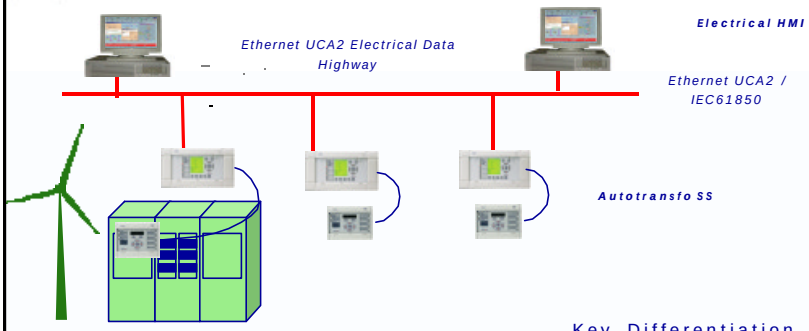
MiCOM C264

MiCOM P

Key Differentiation

1. Capability for Long Distance Ethernet Backbone
2. VAR Integration
3. Relay Optimal Integration

Windfarm - Electrical SCADA



Key Differentiation

1. Scheme Automation
(Load Shedding/VAR control,...)
2. VAR Integration
3. Relay Optimal Integration
4. Flexibility to communication medium

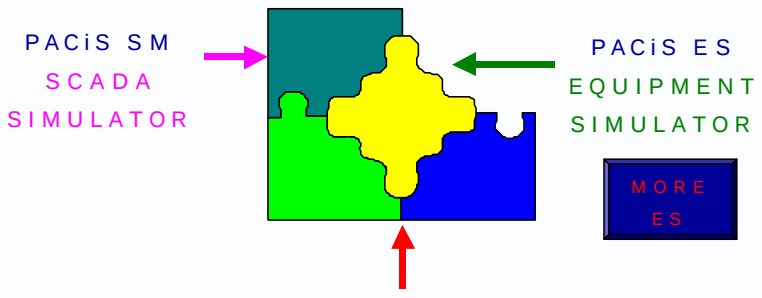
MiCOM C264

MiCOM P

POWERFUL ENGINEERING TOOLS

APPLICATION SIMULATORS

- Reduce test and commissioning costs
- Secure application upgrades



Architecture example

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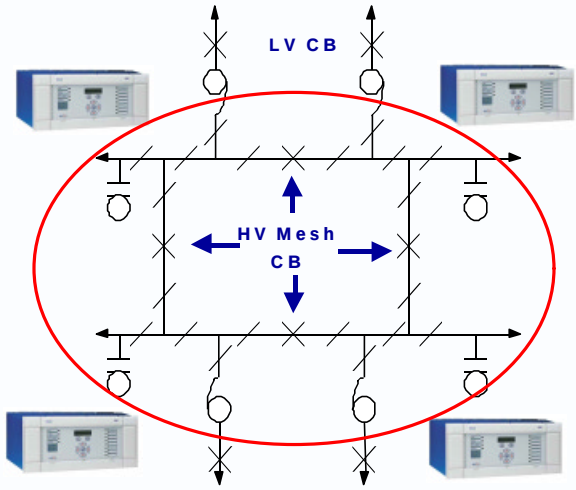
- Mesh corner auto-recloser, NGC (UK)
  - in service since 2001



Architecture example (NGC)

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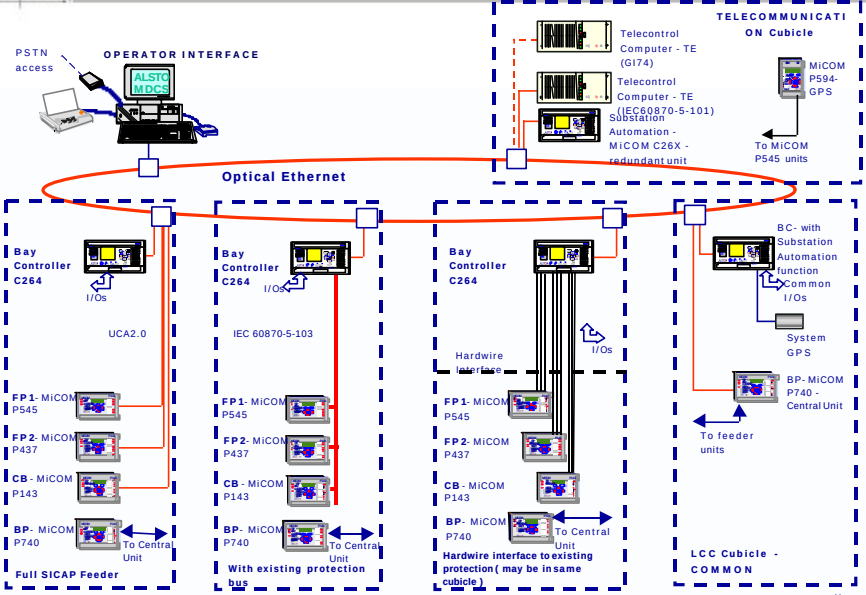

A WORLD-WIDE APPLICATION EXPERIENCE

ALSTOM

- World-wide experience in electrical control systems since 15 years:
  - >500 installations of true distributed systems
  - New installations and retrofit
  - AIS, GIS and hybrid primary technology
  - From 300 V up to 800 kV

A KEY KNOW-HOW IN PROJECT MANAGEMENT

ALSTOM

- Methodologies:
  - From preliminary studies up to site decommissioning
  - Time, costs, risks, people, communication
- Local ressources for improved flexibility
  - France, UK, Germany, India, USA, Brazil, Australia


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