Distribution Automation

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From one-way energy-only grid to two-way energy+data Smart Grid

- Bi-directional flow of energy and...data!
  New ways to balance supply / demand

Key components:
1. Renewable Energy Plants
2. Distributed Generation
3. Active Energy Efficiency: Energy visibility & Means to act
SE scope: 5 key domains, all connected...

To continue to efficiently balance supply & demand, the grid needs to become smarter...
Electricity networks are more complex and less stable!

- Growing electricity demand
- Need to reduce CO₂ emissions
- Constraints on existing networks
- Technology availability
- Active government & regulators
- Active end-users

making the smart grid happen
Challenges to operate/maintain network

Needs for Utilities

- Manage load / demand to shave peaks
- Increase supply availability & flexibility
- Reduce losses

Ensure flexibility and scalability over time to integrate new sources and demand

- Manage bi-directional power flow & intermittent behavior (network instability)
- Manage power quality & voltage constraints
- Manage EV load & energy storage

Defer capital expenditures through step-by-step and easy implementation

- Re-design network to allow for bi-directional flows
- Increase focus on OPEX
- Increase upgrade investments

Improve reliability and quality of service

- Improve supply availability & power quality
- Optimize investments
- Manage impacts of high volatility prices
- Reduce technical & non technical losses

Lower operational & maintenance costs

- Improve supply availability & power quality
- Improve reduction of grid management costs
- Improve customers information

Increase in base and peak load consumption

Integration of Renewable/Distributed Generation and EV

Aging networks in mature economies

Regulatory pressure on grid performance & market liberalization

Growing end-users sensitivity in power & supply interruption
Why the Smart Grid? Traditional solutions are not enough

Traditional solution vs. Smart solution

- **Asset management**
  - Curative maintenance

- **Enhanced outage management**
  - Field crew to restore power intervention based on customers’ calls

**Traditional solution**

**Smart solution**

- Preventive maintenance based on real-time asset monitoring and dynamic rating of transformers
  - Benefits: more than $30M of savings / year

- Automated outage management systems based on Advanced Smart Metering information
  - Benefits: SAIDI improvement by 10%
Flexible Distribution

Key component of Smarter Grid deployment success

Before: Conventional Grid
- Very low monitoring of the network
- Network management
- Network Planning based on historical data
- No prediction on energy flow
- Curative process on fault location
- Poor Energy Efficiency on Network

After: Smarter Grids
- High penetration of sensors, actuators and distributed automation at all levels
- Convergence network management with AMM at feeder level
- Self healing MV network
- Real time Energy flow management
- Advance application for asset management, work force and network evolution planning
- Cyber security

Need real time Smarter Grid Management
Flexible Distribution is connected to other domains

- Transmission Distribution
- Centralised Generation
- Industry
- Buildings
- Data Centres
- Infrastructure
- Renewable Energy Plants
- Residential
- Electric Vehicles
- Energy Storage

Flexible Distribution is connected to other domains.

- Flexible Distribution
- Distributed Generation
- Integration & Smart Generation
- Smart Generation

Evolving, scalable and easy to use network architecture & management including Smart-grid ready products, Smarter Automation and Advanced Grid Services.

Demand Side management

- Efficient homes
- Efficient Enterprise

Demand Side management for Utilities

Residential

Industry

Buildings

Data Centres

Infrastructure

Distributed Generation
Schneider Electric is Smart Grid-ready

Flexible Distribution

HV/MV – MV/MV – MV/LV
Consulting
Switchgear
Efficient transformer
Protection
Metering
Substation Automation
Feeder Automation
SCADA DMS

Demand Side Management

Demand Response
EE solutions
Energy Management Solutions
Consulting

Efficient Home

Residential energy management
Circuit Protection
IS&C
& EV charging spots

Efficient Enterprise

Power Management
IT Management & Secure Power
Building Management & Security Management
Process & Machine Management
EcoStruxure integrated architectures
Performance Contracting
Turnkey projects
& EV charging spots

Smart Generation

In-plant MV, LV, SCADA* & Automation
Services & Retrofit

Renewable farms (Trans or Dis)
Pro-sumer Renewable installations
Renewable energy integration

* SCADA: Supervisory Control And Data Acquisition
Flexible Distribution

Distribution Automation:
All Voltage Levels
Distribution Management System
Substation automation
Feeder automation

Renewable integration

MV Primary solutions
MV & LV Secondary solution

Smarter Automation
Advanced services

Smarter Equipment

Advanced services

MV Primary solutions
MV & LV Secondary solution

Smarter Equipment
Gradually implementation of functionalities

**Phase 1:**
- **Past for mature countries**
- **Present for emerging**
  - **Reliability (Saidi / Saifi)**

**Phase 2:**
- **Now to next 5 years**
  - **DG Integration**
  - **Market Flexibility**

**Phase 3:**
- **After 5 to 10 years**
  - **Full distributed Management & Open DG Market**

**Distribution Automation:**
- Distribution Management System
- Substation automation
- Feeder automation

**New network management:**
- Micro grid implementation, iFCL, Cyber security,
- Local demand and DG aggregator for network ancillary services,
- Distributed iDMS & flexible SA

**Agent architecture:**

**Smarter Equipment**

**Smarter Automation**

**Advanced services**

**Bi-directional Energy & Data:**
- REN integration (DLR)
- MV/LV Substation with AMM Mgt
- Dynamic overload capacity
- Consulting

**Stability & Efficiency**

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**Stability & Efficiency**
Implementation of Network Functionalities

**Phase 1**: Central Distribution Automation: DMS/OMS, basic planning
- Numerical HV & MV Substation Automation
- Feeder Automation
- Industrial Micro Grid
- Power Quality
- AMR for Billing
- Customer management

**Phase 2**: Smart Equipment, Smart sensors U,I,P,Q,
- Volt Var Management
- Distributed Generation Integration (farm & local)
- Energy market drive Demand response
- Dynamic overload capacity
- Improve AMM with operational tools & network management
- Smart MV/LV substation & LV monitoring and control

**Phase 3**: Agent architecture with Micro grid, DG, DSM and new blackout prevention
- Partial DC network
- Distributed iDMS and automatic network reconfiguration
- Advance services & network planning
- Advance tools workforces & network planning
- Dynamic protection reconfiguration & flexible HV/MV substation

**Phase 4**: Telecom monitoring
- Cyber security
- Volt Var Management
- Distributed Generation Integration (farm & local)
- Smart MV/LV substation & LV monitoring and control
- Improve AMM with operational tools & network management
- Dynamic overload capacity
- Energy market drive Demand response

**PAST**

**PRESENT**

**FUTUR**
Utilities will need a combination of Equipment, Automation and Services

New generation equipment with Smarter features to integrate safely and efficiently all Smart Grid components
- New protection schemes, efficient & reliable connection to integrate Distributed Generation
- Life-cycle optimization solutions (condition monitoring)
- Energy efficient products to reduce CO₂ reduction (low-loss transformers)

Smart Distribution Automation and DMS to enable active energy management, efficient and safe operations based on new information coming from DG\textsuperscript{1}, smart meters, EV\textsuperscript{1} or smarter network equipment
- Enhanced Distribution Management system
- Smart MV/LV substation
- Feeder automation

New services to make the most of the existing infrastructure and address network increasing complexity, while integrating demand-side management
- Asset management services
- Network consulting
- Demand response
Flexible distribution: New offers

**Project Tango (PMP)**
MV/LV utility substation controller integrating network control and automatic meter management (AMM)

- **Productivity:** ★★★★
- **Availability:** ★★★★★
- **Energy Efficiency:** ★★★★★

Improvement of supply availability by fast fault identification and network reconfiguration
Labour cost reduction on meter reading
Optimisation of LV network

- **Services**
  - Supervision of electrical utility LV network
  - Power management
    - Current and voltage measurement
    - MV and LV fault location with distributed generation and EV
    - Fast fault restoration
    - MV & LV monitoring & control
    - AMM data concentrator linked with network management
  - Services
    - Energy consumption audit
    - Energy theft detection
    - System Programming & configuration
    - Installation, tests & Commissioning
    - Asset management

**Project intelligent Fault Current Limiter (OTM)**
Innovative solution to protect the network vs. overloads and excessive short circuit currents

- **Safety:** ★★★★
- **Availability:** ★★★★★
- **Energy Efficiency:** ★★

Improvement of supply availability and renewable integration

- **Services**
  - Protection of MV feeder
  - Power management
    - Fault limitation
    - Self activation & recovery
    - Losses reduction
    - Supply availability
  - Services
    - Installation, tests & Commissioning
    - Asset management
    - Overload capacity
    - Network consulting

**Project SmartScan (Patent)**
Utility LV Network supervision software

- **Productivity:** ★★★★
- **Availability:** ★★★★★
- **Energy Efficiency:** ★★★★

Gain visibility of LV customer location in the network, measurement of supply quality per individual customer

- **Services**
  - Supervision of electrical utility LV network
  - Power management
    - Measurement of network losses
    - Voltage level monitoring by customer
    - LV network phase balancing
  - Services
    - Voltage profile reporting
    - Energy theft detection
    - Network operation consultancy
    - System Programming & configuration
    - Installation, tests & Commissioning
to become the most agile in implementing pilots projects

**Phase 1:**
Past for mature countries
Present for emerging
→ Reliability (Saidi / Saifi)

**Phase 2:**
Now to next 5 years
→ DG Integration & Market Flexibility

**Phase 3:**
After 5 to 10 years
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Improving efficiency with MV/LV Substations

Solution offer
- Services: License contracts, dedicated support team
- Substations: Walk-in, non walk-in and half-buried – with external operation, underground kiosk

Key benefits...
- Safety for public and operators
- Cost savings: factory assembled and type tested
- Time savings: plug and play solution
- Faster time-to-market: immediate availability

Differentiation factors
- Business model either direct to end customer or through partners
- Adaptation to meet local needs (equipment, climate, standards)
Controlling the network through Distribution Automation Systems

Solution offer

- Network Management and Planning
- Up-to-date information flow
- Assistance for complex switching operations
- Links with customer information services

Key benefits

- Improve reliability and quality of service
- Lower operational and maintenance costs
- Defer capital expenditures through step-by-step and easy implementation

Differentiation factors:
- Flexible and scalable architecture.
- Integrated distribution management functions
Automating feeders for reliability and lower cost of operation

Solution offer

- Remote control systems and units
- Communicating fault passage indicators
- SMS alert functionality
- Reclosers and circuit breakers

Key benefits

- Higher service quality and network reliability
- Operation and capital costs reduction
- Flexible and modular approach
- Easier implementation than Scada project

Differentiation factors:
- Cost efficient solution
- Fast and flexible project development
- Integration to existing SCADA system
Distribution: Power quality and metering

Solution offer
- Equipments
  - Power Quality and Energy Metering (ION Meters)
  - Power Metering (PM800)
  - Circuit monitor (CM4000)
- Power management software (ION-E, SMS)
- Services: Commissioning, Customized report HMI, Consulting
- Global communication system

Customer Benefit
- Quickly identify the cause of Power Quality events
- Increase revenue (guaranty power quality to customers)
- Show compliance to Power Quality standards
- Lower operations costs with automated and accurate billing data acquisition
Multi-sites substation automation / IEC 61850

- IEC 61850 communication backbone open to 3rd party components
- Scalable solution from single RTU to large industrial sites, single or redundant seechers all over the architecture
- Engineering tools facilitating the integration and tests of the system
Make the most of your energy™
Our Smart Grid strategy

● The Grid will be Smart once all users are smart grid-ready and connected to the network.
  ▪ Energy-efficient companies and active end-users will drive smarter Demand, to maximize the cost & environmental benefits from Energy Efficiency.
  ▪ Utilities will drive smarter Supply, to manage increasing demand, network complexity and environmental concerns.

● Schneider Electric is smart grid-ready and serves all 5 key domains of the Smart Grid:
  ▪ efficient homes (incl. EV charging infrastructure)
  ▪ efficient enterprise (buildings, industrial facilities & datacenters and incl. EV charging infrastructure)
  ▪ demand-side management
  ▪ flexible distribution (HV/MV, MV/MV, MV/LV)
  ▪ smart generation (bulk, distributed and renewable)

● Our vision: smarter grids call for smarter interactions:
  ▪ 1. we connect our customers to the smart grid
  ▪ 2. we connect our customers with each other
  ▪ 3. we connect with complementary players to build alliances & partnerships
  ▪ 4. we collaborate and experiment in pilot projects on new technology and business models
Project Objectives

The aim of the INTElligent GRId Sensor Project is to define a novel ICT System enabling implementation of Smart Grid New Functions in the Distribution Field.

Technologically, the project focuses on:

- The development of a WSN (Wireless Sensor Network) inside the MV/LV substations
- The use of Broad Band PLC over the MV Loop.
- The distribution of intelligence between Distribution Management System and substations.
- The implementation of SOA (Service Oriented Architecture) between DMS and RTUs.
- The opportunity to use the new AMM smart meters as LV WSN.

Project: 5.6M€ total cost, 3.4 M€ funding
SEI: 0.9M€ cost (0.4M€ in 2011), 0.5M€ funding
GreenLys Smart Grid project

- Business model & technical experimentation project in France, supported by ADEME
- Project: Consortium with leader ERDF, Total budget: #40 M€, SE Contribution: #8 M€, project duration: 4 years
- SE objectives
  - Test full smart grid solutions & services at a regional scale (Rhône Alpes), leveraging smart meter deployment, both for DNO QoS and grid management (LV & MV) and for retailer (customer automation for Energy efficiency and peak shedding) and discover the best business model which maximize the value for SE
  - Understand value to be created by SE for different actors, identify business model which maximize value for SE
  - Increase SE awareness in a highly visible project

- Lyon: LV grid & AMM demonstration, ERDF leader (15 RTU/Concentrator, 500 Home box, Building + REN +EV +CHP)
- Grenoble: Global demonstrator, GEG & GDF SUEZ leaders (15 RTU/Concentrator + 1 self healing MV loop reconfiguration, 500 Home Box (EH step 0, EH step 1), 3 SE “Smart Grid” plans (EV, REN, Building Management)
EnR-Pool Smart Grid project

- Business model & technical experimentation project in France, supported by ADEME
  - Project: Consortium with leader Energy-Pool, Total budget: 2.2 M€, SE Contribution: 0.8 M€, project duration: 3 years
  - SE objectives
    - Test smart grid solutions & services at a regional scale (Rhône Alpes), industrial mass peak shedding and discover the best business model which maximize the value for SE
    - Understand value to be created by SE for different actors, identify business model which maximize value for SE
    - Increase SE awareness in a highly visible project

- Industrial peak shedding > 100MW with Large flexible plant.
- Trying to balance the large PV production with the flexible industrial consumption.
● An exemplary partnership joining an industrial, a leading energy supplier and a specialized university
  ▪ Founded in 2000 on a four years basis, renewed in 2004 and 2008.
  ▪ A team of 20 people (teacher-cum-researcher, master, Ph.D. students and management).

● A clear strategic research axis for coming years:
  ▪ Innovative network architectures
  ▪ "observability" of the distribution network for an efficient network & asset management
  ▪ Connection of renewable energies to the grid