Seminar
IEC 61400-25
Communications for Monitoring and Control of Wind Power Plants

Boulder 17 November 2003

Program

9:00 to 12:00 am
- Welcome and introduction
- Background to standardization of wind power plant communication
- The standardization process
- Development of communication solutions
- 10:15 to 10:30 Break
- A north american DNP3 based solution from GE Wind Energy
- Scope and purpose of IEC 61400-25
- Basic approach of IEC 61400-25

12:00 am to 1:00 pm
Lunch

1:00 am to 5:00 pm
- Wind power plant information and information exchange
- Mappings to protocol stacks
- 2:30 to 3:00 Break and demo setup
- Implementation of IEC 61400-25
- Example/demonstration
- Questions and answers

Who is Anders Johnsson?

Senior research engineer at Vattenfall Utveckling AB.
Vattenfall Utveckling is Vattenfalls resource for corporate research activities.

Master of Science in Electrical Engineering and Licentiate (pre-PhD) degree in Communications at the Royal Institute of Technology in Sweden.

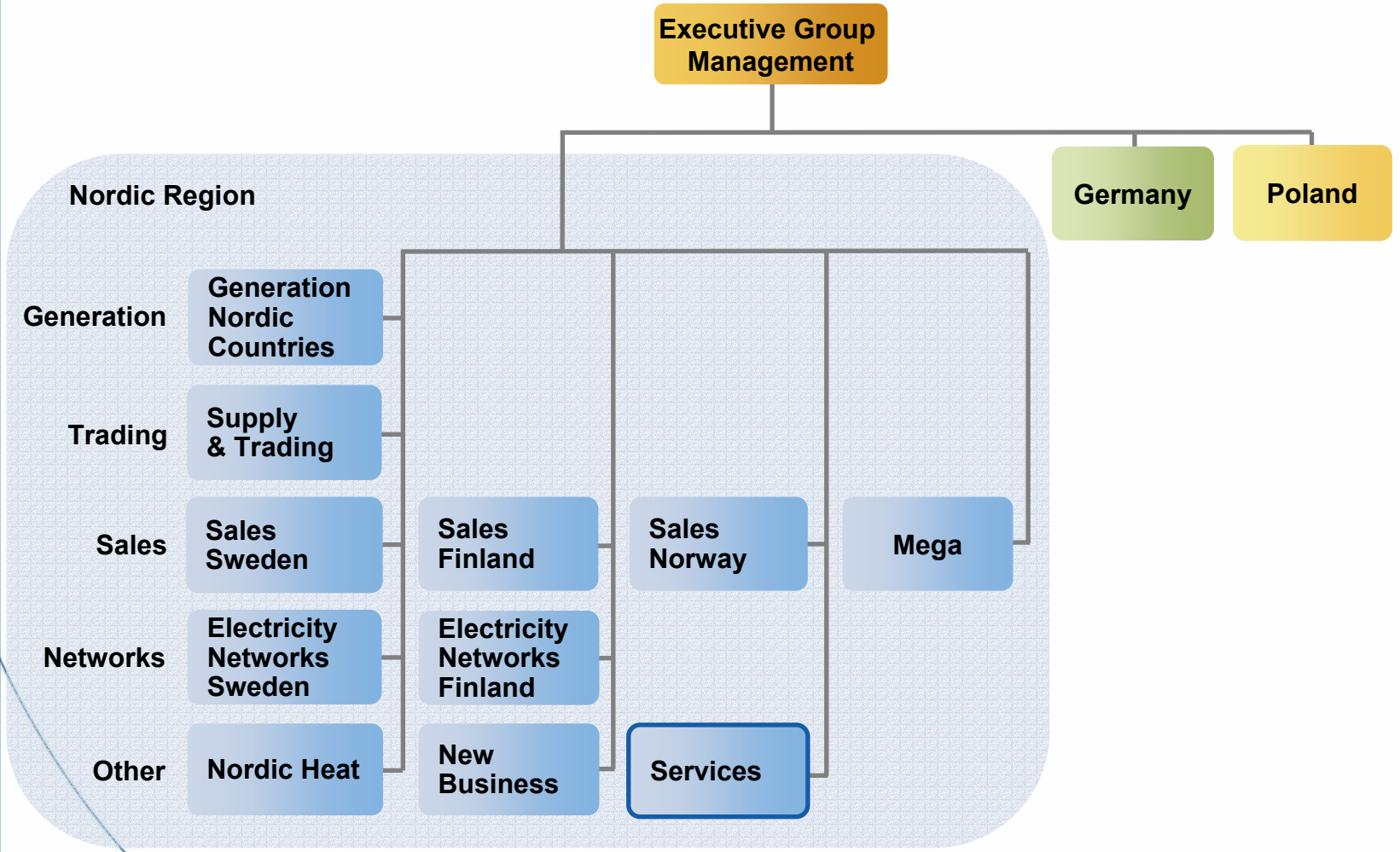
Has worked with communications in local control equipment and SCADA for hydro power plants and substations since 1991, and for wind power plants since 1998.

Project leader/convenor of IEC TC88 - Wind Turbine Systems, Project team 25 (PT25) - Communications for monitoring and control of wind power plants.

Vision

Vattenfall
– a leading European energy company

Vattenfall business areas



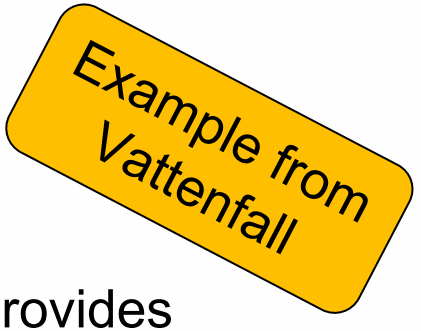
The Vattenfall Group

	2003	1999
Net sales (million $)	13 000	3 500
Balance sheet items (m $)	30 000	11 000
Sales of electricity (TWh)	180	87
Sales of heating (TWh)	> 30	5
Customers (million) approx.	6	2
Employees, approx.	40.000	8 000

Source: Facts from February 2001

Background to standardization of wind power plant communication

Many different proprietary solutions



Wind power control centre supervises 39 wind turbines from 9 different suppliers.

With the delivery of the turbine each supplier provides a diskett or CD for his own proprietary (hidden) communication solution.

Without integration 9 different programs on different machines (DOS, Windows 98 or NT, Unix) must be started to communicate with all turbines.

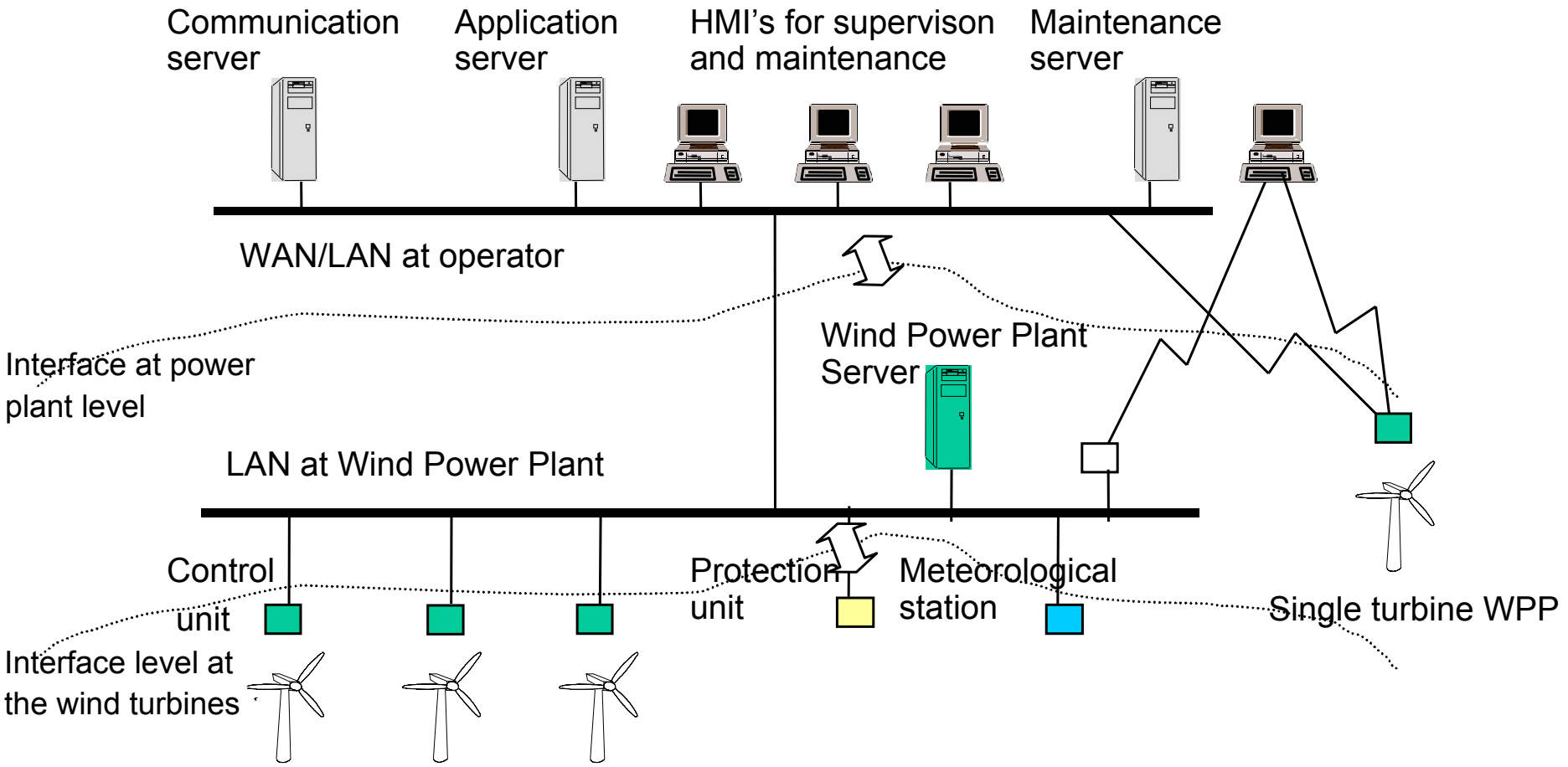
No benefits from joint use.

Integration require costly custom data-translation and data-mapping components.

Why do we need a standard for wind power plants?

- Many different proprietary communication solutions
  - No benefit from joint use
- Integration costs in general are high and increasing
  - Protocol converters
  - Translation of data
- Increasing need for wind power information exchange
  - More comprehensive information, for condition monitoring etc
  - Off-shore Wind farms
- New ways to operate wind power – new businesses
  - Ancillary services (power control), e.g. reactive power and delta control

Interface levels



Power plant functionality and associated data

Different needs for different actors.

- Monitoring
- Control
- Protection
- Event Management
- Fault diagnosis
- Automatic Dispatch
- Condition monitoring and diagnostics

Background to IEC TC88 PT25

Need for a common Swedish-Danish solution

- Vattenfall: 39 single wind turbine power plants at different locations monitored with 9 different proprietary communication solutions.
- SEAS & Elsam: Existing protocol (FDV) out-of-date and difficult to maintain. Need for new solution for 5 new off-shore wind farms.

Joint work

- Swedish utilities joined forces through Elforsk AB. Elforsk represented by Vattenfall Utveckling and Sycon.
- Energi-E2 represented by Seas Wind Energy Centre
- Elsam represented by Tech-wise.

Output from Swedish-Danish co-operation

Phase 1 - Requirements

Elforsk report (01:25) ”Functional Requirements on Communication System for Wind Turbine Applications”. Including list on communication protocols.

Phase 2 - Test projects for IEC 61850/UCA2 and OPC

Elforsk report (02:14) ”Wind power communication – Verification report and recommendation”. Results from tests and recommendation on the use of IEC61850/UCA2 and OPC.

Elforsk report (02:16) ”Wind power communication – Design and implementation of test environment for IEC61850/UCA2”. Description on test system and tests.

Test projects in Denmark & Sweden

OPC

SEAS Wind Energy Centre performs tests on an OPC installation at Nojsomheds odde wind farm in Denmark (sponsor: Energi E2)*

IEC 61850

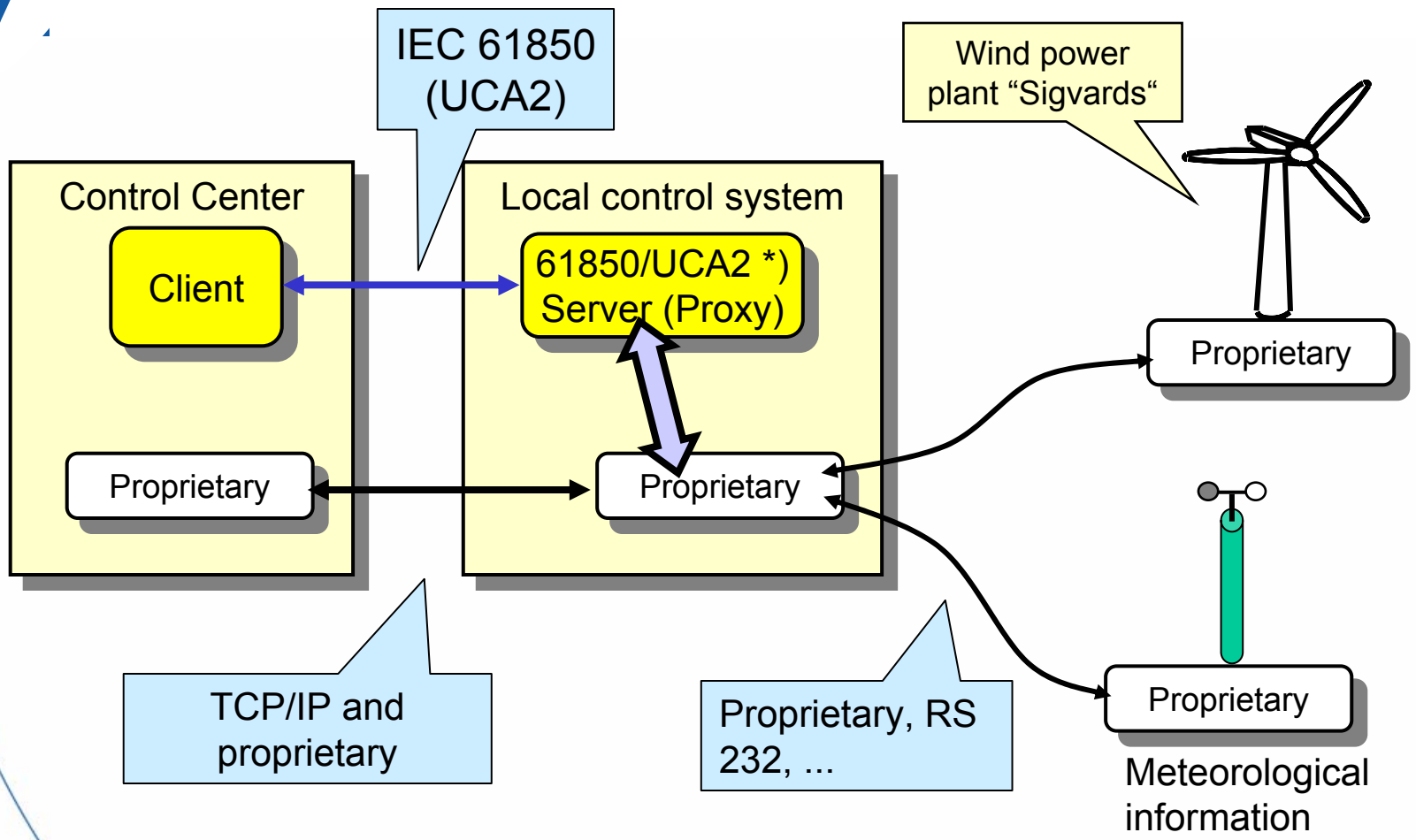
Vattenfall Utveckling, Sycon & Netted Automation implement and test IEC61850 software at one of Vattenfalls wind turbines at Gotland, Sweden (sponsor: Elforsk).

Test object: 1 MW turbine from Nordic Wind Power

IEC 61850 based communication between wind turbine and control centre.

* This presentation focus on IEC61850/UCA. For further information about the OPC tests contact Claus Bjerge at SEAS Wind Energy Centre.

Topology of the project



*) The server may also also be located inside each WPP or any other component.

Project Results

Practical tests

- The implementation fulfilled the requirements on start-up and configuration.
- Due to limitations in the implementation security issues could not be verified.
- The Tamarack server met all functional requirements, except for dynamic creations of data sets (implementation specific, supported by IEC 61850).
- Practical tests show that for the normal operation there are no performance problems. However the Visual Basic object must call the DLL often enough (every 100 ms or less).

International standardization

Swedish initiative to a new communication standard based on the previous Swedish-Danish work.

TECHNICAL COMMITTEE N° 88:
WIND TURBINE SYSTEMS

Project Team 25: Communications for Monitoring and Control of Wind Power Plants

Project leader: Anders Johnsson, Vattenfall Utveckling

Input to IEC 61400-25

IEC61850 was proposed as the basis for IEC61400-25.

Data Models produced in the project was reused in the first working draft of IEC61400-25

The approach is to define just the WPP specific information models and to re-use the common information (measurand, status, control, ...), the modelling methods, the SCADA services (poll data, etc), and the state-of-the-art communication networks (TCP/IP, Ethernet).

The re-use would accelerate the standardization, implementation, and use of standard compliant communication software.

Status IEC TC88 PT25

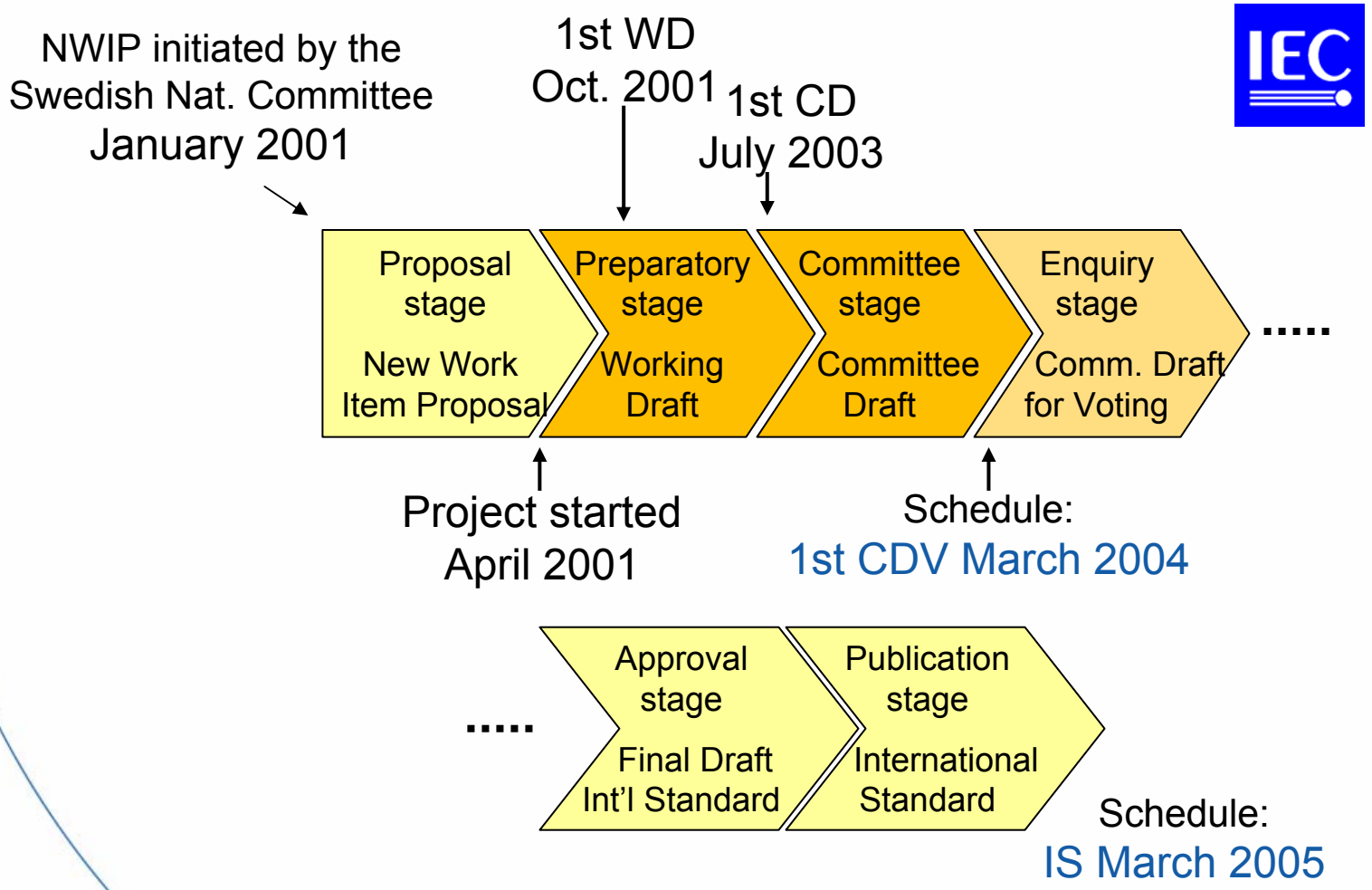
Project started April 2001

27 project members (utilities, vendors, consultants) from 11 countries

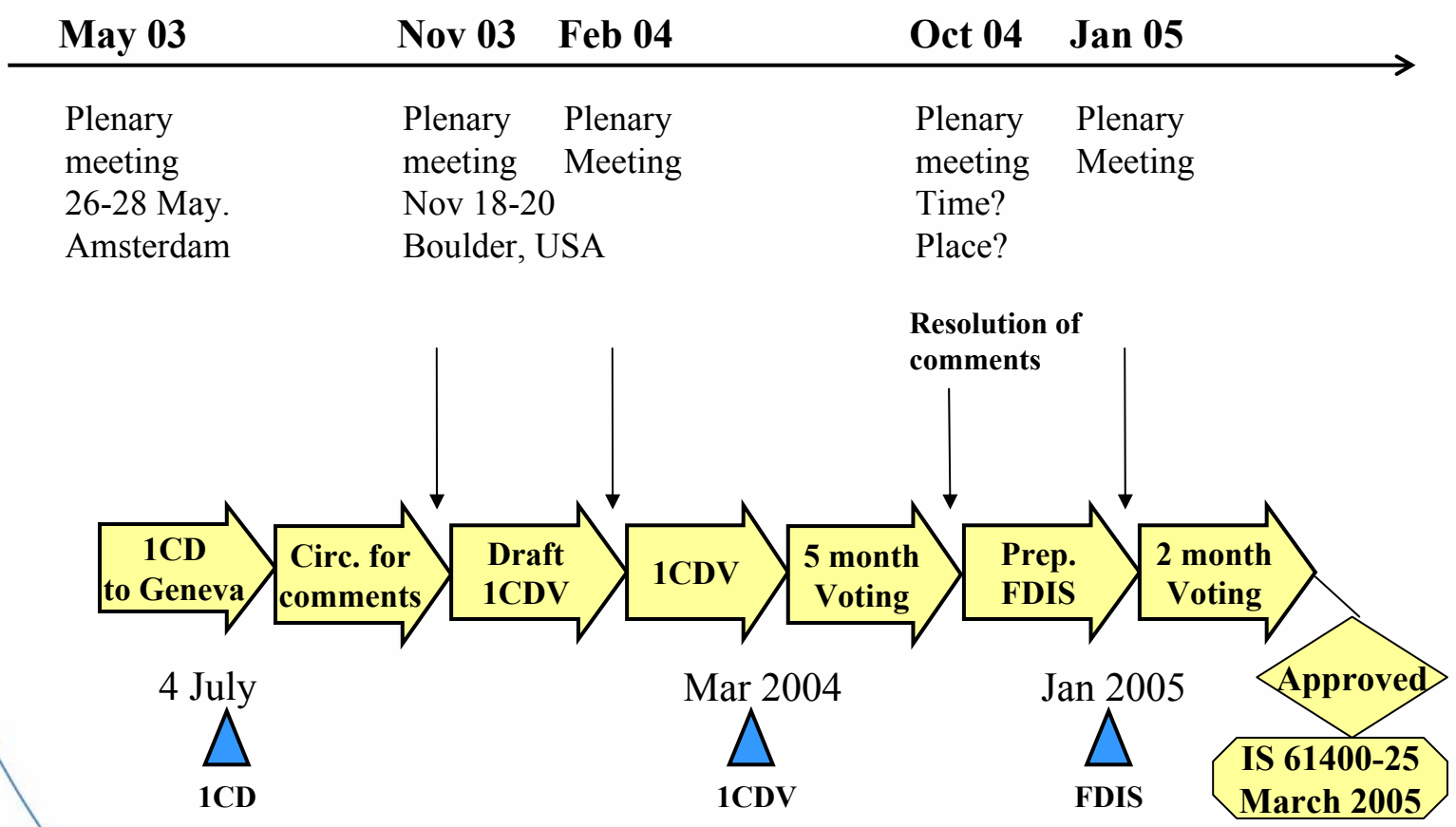
First committee draft of IEC 61400-25 distributed July 2003

Meeting in Boulder, Colorado, 18-20 November 2003.

International standardization



Time schedule for PT25



Members of IEC TC88 PT25 (Nov 2003)

Vattenfall Utveckling, Sweden, Project leader

Mitsubishi Heavy Industries, Japan
DanControl Engineering, Denmark
DeWind, Germany
General Electric Wind Energy, USA
KC Associates, USA
Statkraft SF, Norway
Second Wind Inc., USA
ECN Wind Energy, the Netherlands
Mita-Teknik, Denmark
NEG Micon Control Systems, Denmark
EFACEC - Sistemas de Electrónica, Portugal
Energi E2 (SEAS Wind Energy Centre), Denmark
Vestas Wind Systems (Cotas Computer Technology A/S), Denmark
Dept. of Information Engineering, **University of Ryukyus** 1 Senbaru, Japan

Vestas Wind Systems, Denmark
General Electric Wind Energy, Germany
Schwarz Consulting Company, Germany
Garrad Hassan and Partners Limited, UK
n@tcon 7, Germany
EnerNex Corp., USA
W2E Wind to Energy GmbH, Germany
Hydro Tasmania, Australia
kk-electronic a/s, Denmark
BONUS Energy A/S, Denmark

A north american DNP3 based solution from GE Wind Energy - Needs and requirements from a North American perspective

Gary Moore

Development of communication solutions

Erich Gunther

Scope and purpose of IEC 61400-25

Wind turbines –

Communications for monitoring and control of wind power plants

Scope

IEC 61400-25 defines

- wind power specific information,
- mechanisms for information exchange,
- mappings to communication protocols, and
- communication protocol stacks

for monitoring and control,

using a specific method for modelling the information and the information exchange.

The goal/purpose of IEC 61400-25

A new standard: For what?

To enable devices from different manufacturers to easily communicate with any other device, at any location, at any time for monitoring, control, ...

to easily integrate, engineer and configure devices and applications, ...

to easily re-use software (device models, …, Not APIs),

Application of IEC 61400-25

Actors/users

IEC 61400-25 addresses vendors (manufacturers, suppliers), operators, owners, planners, and designers of wind power plants as well as system integrators and utility companies operating in the wind energy market.

Application of IEC 61400-25, cont.

Functionality

The standard support functions for monitoring and control of wind power plants.

It supports also functions for secure access to data, diagnostics and maintenance of meta-data.

Wind power operational and management functions

Operational functions

- Authorisation
- Supervision / monitoring
- Logging and reporting
- Data retrieval of processed information
- Control

Management functions

- Diagnostics (self-monitoring)
- User / access management*
- Configuration*
- Time synchronisation*

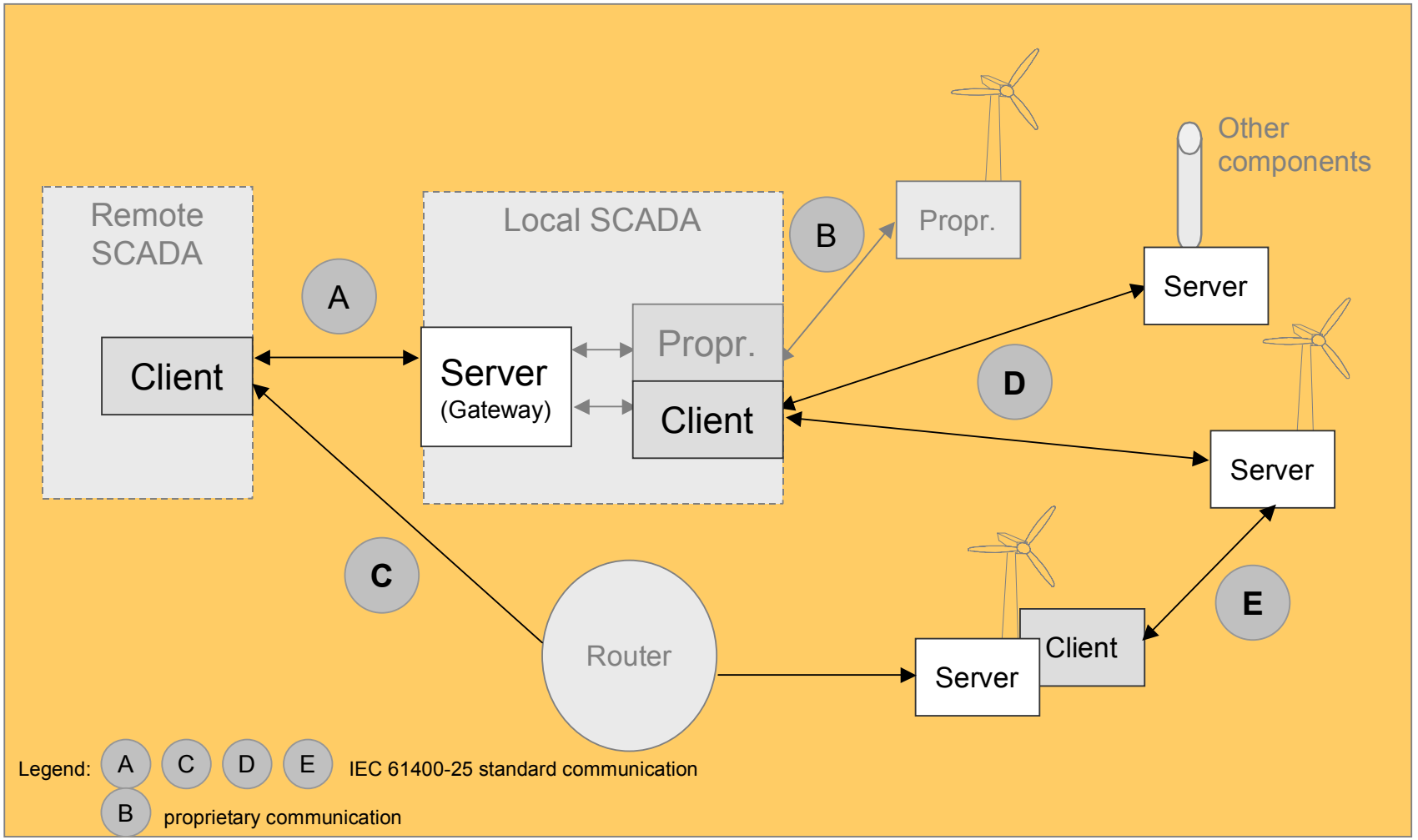
* System specific or SCSM specific (SCSM = Specific Communication Service mapping)

Application of IEC 61400-25, cont.

Interface

- The focus of the standard is the communication between wind power components, e.g. wind turbine, met mast and SCADA.
- Internal communication within the wind power components are not covered.

Alternative topologies



Application of IEC 61400-25, cont.

System/components

The application area of IEC 61400-25 covers all components required for the operation of wind power plants, i.e., not only the wind turbine, but also the meteorological system (reference wind mast), the electrical system, and the wind power plant management system.

The wind power plant specific information in IEC 61400-25 excludes information associated with feeders and substations. Substation communication is covered within the IEC 61850 series of standards.

The Standard IEC 61400-25

Information

Scope

- **The information defined in this standard comprises mainly wind power plant specific information like status, counters, measurands, and control information of various parts of a wind power plant, e.g., turbine, generator, gear, rotor, and grid.**
- **This standard defines also a profile of generic information specified in IEC 61850-7-4 and 61850-7-3 for the use in this standard.**

The Standard IEC 61400-25

Information description

Scope

The object oriented information description methods allow precise and complete specification of the information.

- **The methods use a table notation.**

The Standard IEC 61400-25

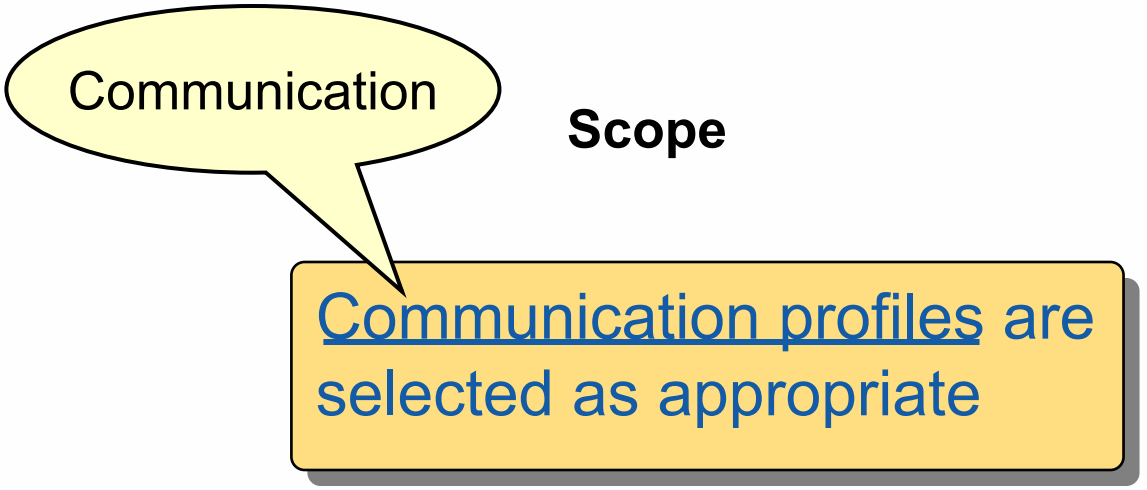
Information exchange

Scope

Information exchange methods:

- real-time data access and retrieval (polling),
- controlling devices,
- event/alarm reporting and logging (publisher/subscriber),
- self-description of devices (device data directory),
- data typing and discovery of data types, and
- file transfer

The Standard IEC 61400-25



Scope

(Modem 2400 Bit/s, ... 100 Mbit/s Ethernet, ...)

IEC 61400-25 a model for DE

The following IEC TCs seem to have similar requirements with regards to communications:

TC 57 - POWER SYSTEM CONTROL AND ASSOCIATED COMMUNICATIONS

TC 82 - SOLAR PHOTOVOLTAIC ENERGY SYSTEMS

TC 88 - WIND TURBINE SYSTEMS

TC 105 - FUEL CELL TECHNOLOGIES

IEC 61400-25 could be the base for the Distributed Energy market.

2 New Work Item Proposals

- Communications Systems for Distributed Energy Resources (DER) (Proposal from USA)
- Hydroelectric power plants – communication for monitoring and control (Proposal from Sweden)

Basic approach of IEC 61400-25

Erich Gunther

Wind power plant information and information exchange

Karlheinz Schwarz

Mappings to protocol stacks

Karlheinz Schwarz

Implementation of IEC 61400-25

Knud Johansen

Example/demonstration

Erich Gunther and Karlheinz Schwarz

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Summary

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Feedback to PT25?!

Questions and Answers

Contact information

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IEC TC88 PT25
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www.scc-online.de/std/61400