

The logo consists of a globe with a network of lines overlaid on it, with the text 'IEC 61850' in white. There are smaller, fainter versions of this globe logo to the right and below it.

IEC
61850

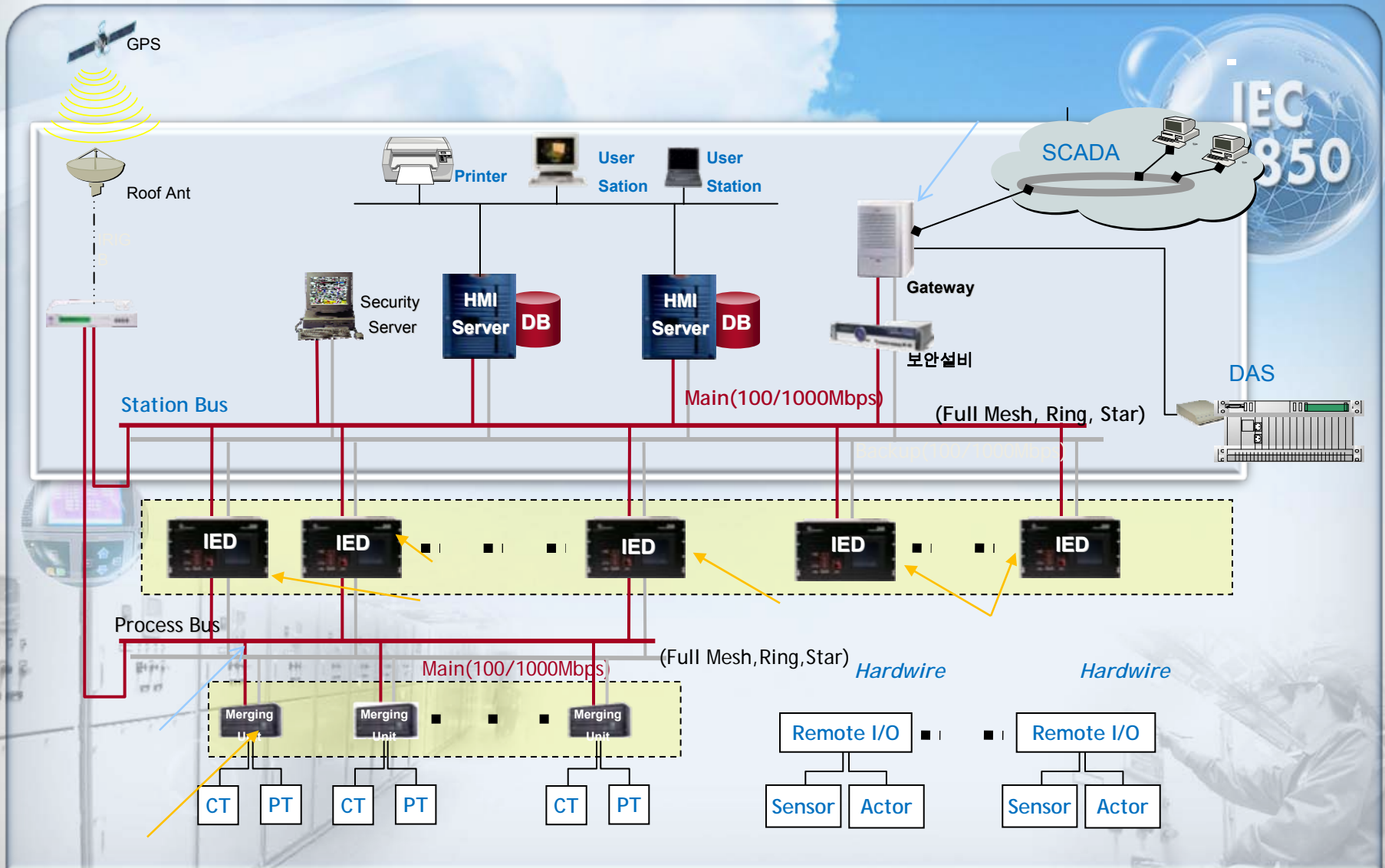
UCA 2010 in Paris

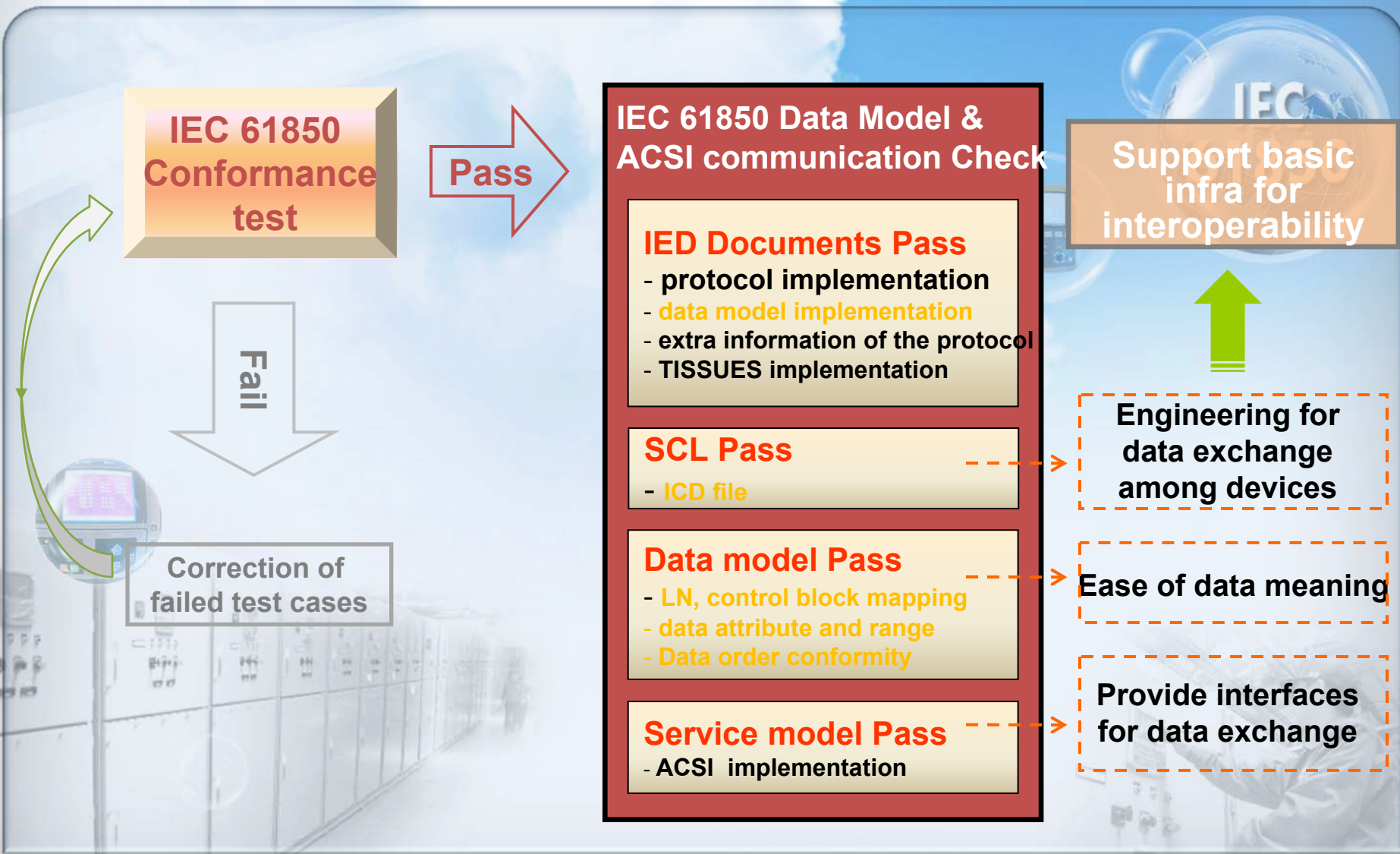
IEC 61850 Client Conformance Testing System

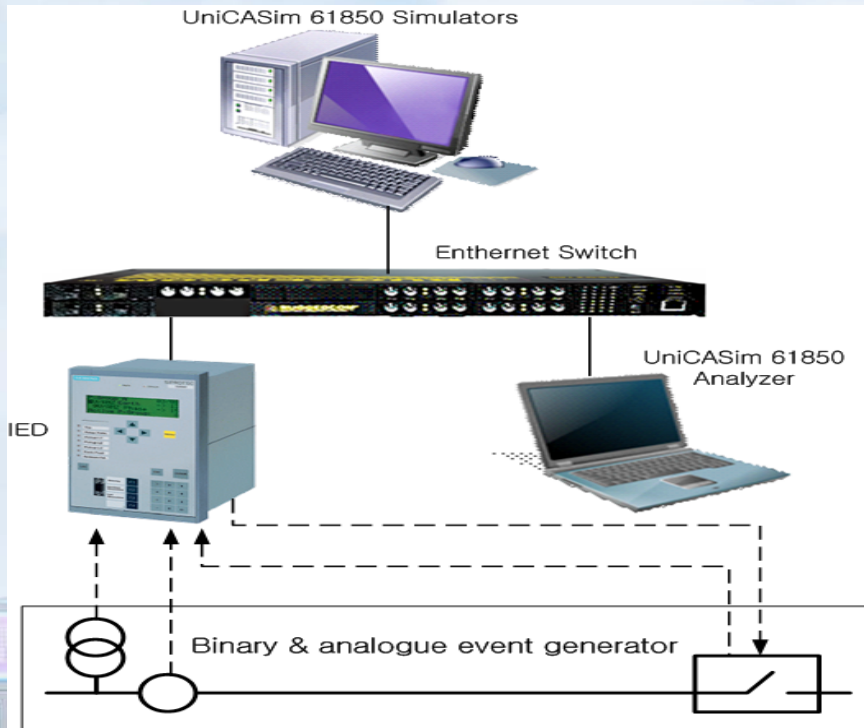
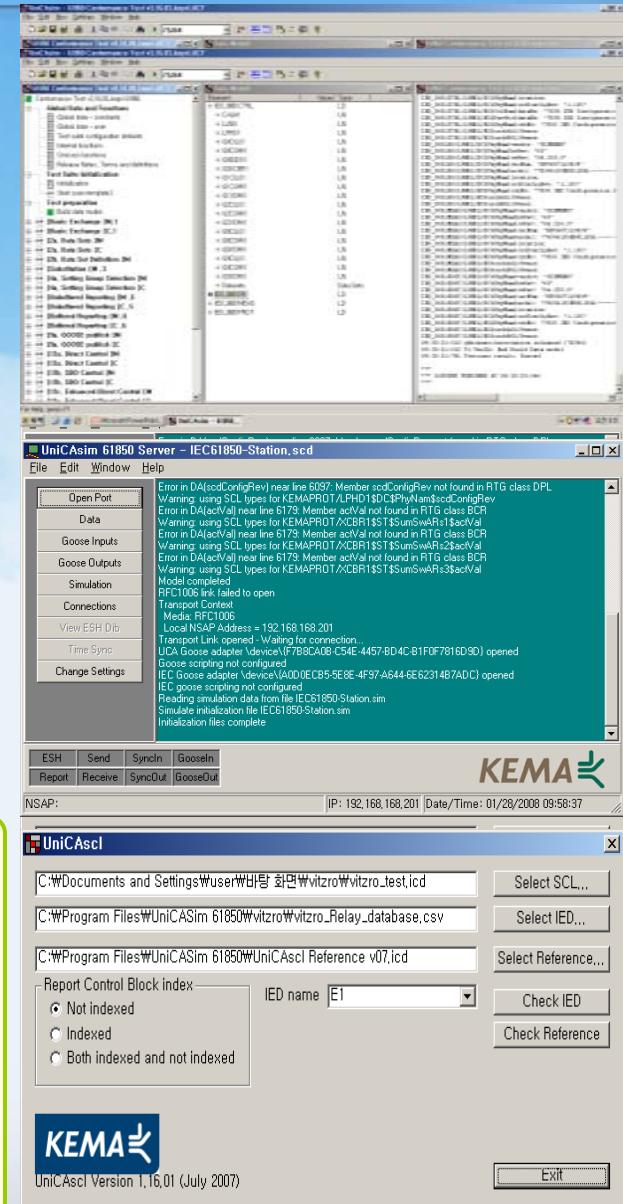
A faded, light-colored background image of a power plant or industrial facility with complex piping and structures.

Nam-Ho Lee
Korea Electric Power Corporation

IEC 61850 Substation Automation System





The screenshot shows the UniCASim 61850 Server software interface. The top window displays a list of components and their status. The main window shows the 'UniCASim 61850 Server - IEC61850-Station.scd' configuration file. The interface includes a menu bar (File, Edit, Window, Help), a toolbar with buttons for 'Open Port', 'Data', 'Goose Inputs', 'Goose Outputs', 'Simulation', 'Connections', 'View ESH Dib', 'Time Sync', and 'Change Settings'. The main display area shows a list of error messages and warnings, such as 'Error in DA(acVal) near line 6179: Member acVal not found in RTG class BCR' and 'Warning: using SCL types for KEMAPROT/CBRI1S1\$SunSWAr1\$acVal'. The bottom status bar shows 'NSAP: IP: 192.168.168.201 Date/Time: 01/28/2008 09:58:37'. The KEMA logo is visible in the bottom right corner.

◆ System Configuration

- UniCASim 61850 client
- UniCASim 61850 GOOSE
- UniCA 61850 analyzer
- UniCA SCL Checker

◆ System Utilization

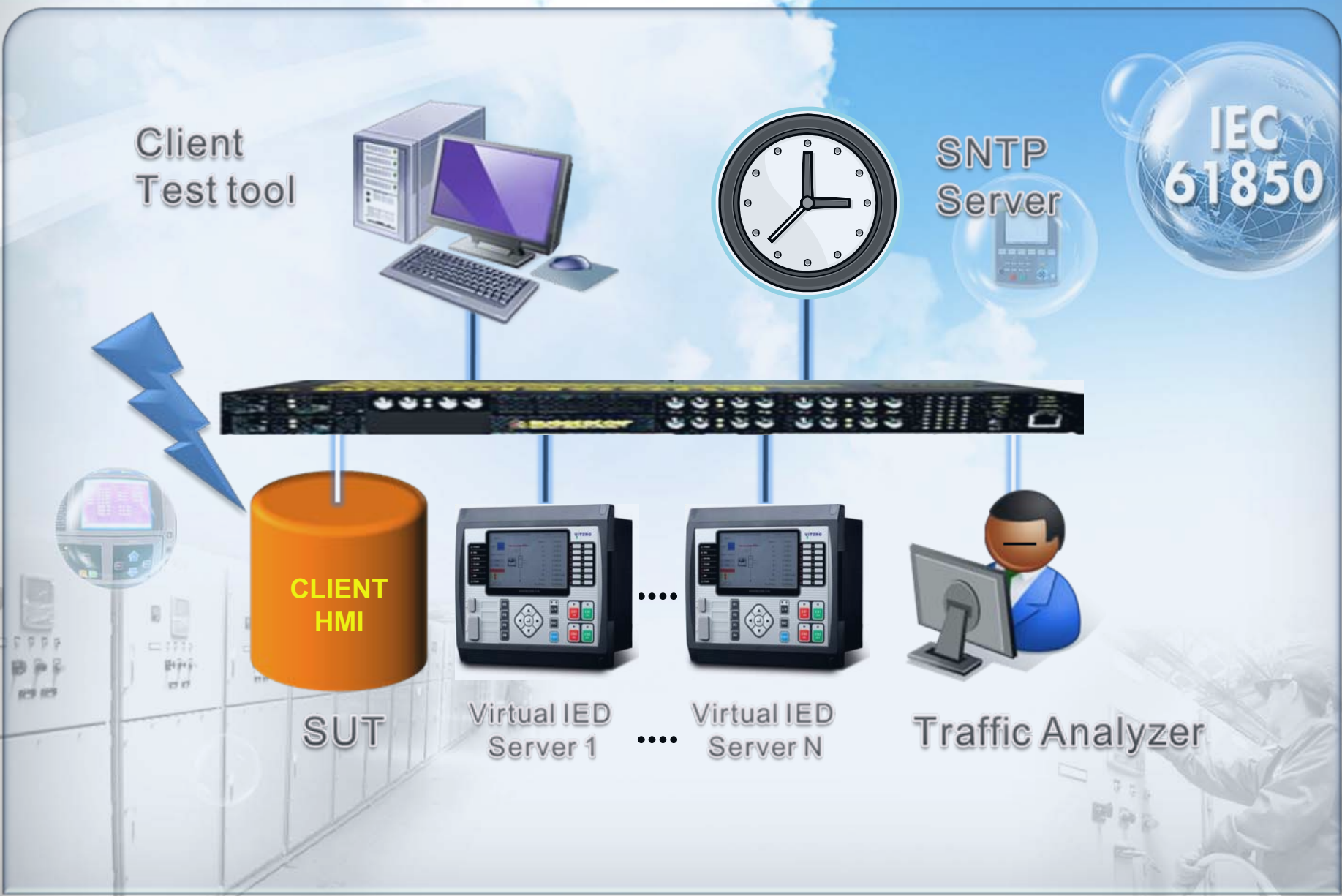
- IEC 61850-10 conformance test
- Analysis of EC 61850 communication messages
- Verification of SCL(Substation Configuration Language) file

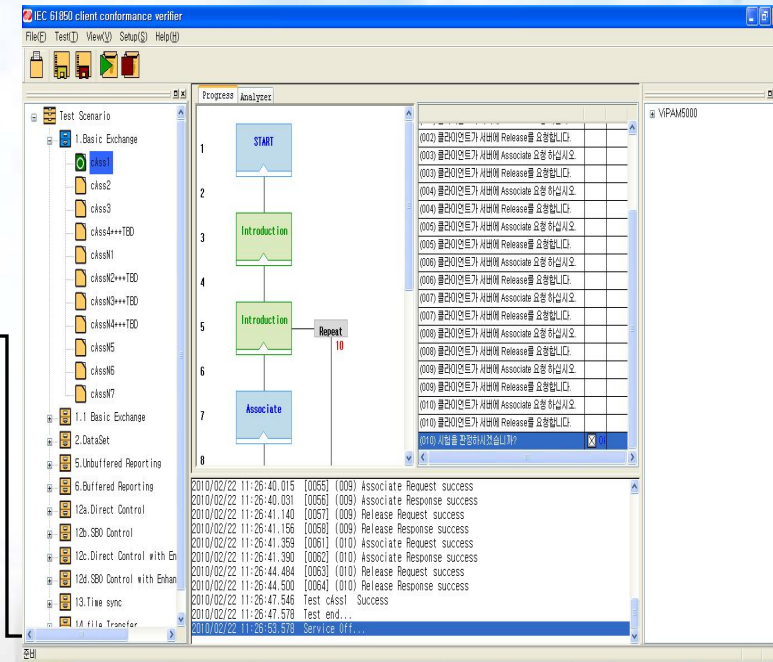
적합성 블록	Mandatory	Conditional
1: Basic Exchange (10/11)	cAss1,cAss2,cAss3,cAss4 cAssN1,cAssN4,cAssN5, cAssN6,Srv5, SrvN3	cAssN7,cSrv1,cSrv2, cSrv3,cSrv4,cSrv6,cSrv7 cSrN1, cSrvN2 SrvN4, SrvN5 cSrvN4
2: DataSets (3/4)	cDs1, cDs2, cDs1	cDs3, Ds4, DsN2, DsN3
2+:DataSet Definition (2/2)	cDs6D, cDsN4	cDs7, cDsN5
3: substitution (1/2)	cSub1	cSub2, cSub3
4: Setting Group Selection (2/2)	cSg2, cSgN1	cSg1, cSg3
4+: Setting Group Definition (2/0)	cSg3, cSg4	
5: Unbuffered Reporting (11/7)	cRp2, cRp3, cRp4, cRp5, cRp8, cRp9, cRp10 cRpN2, cRpN3, cRpN7 cRpN8	cRp1, cRpN1, cRp6, cRp7, cR pN4, cRpN5, cRpN6

적합성 블록	Mandatory	Conditional
6: Buffered Reporting (14/8)	cBr2, cBr3, cBr4, cBr5, cBr8, cBr9, cBr10, cBr11, cBr12, cBrN2, cBrN3, cBrN7, cBrN8, cBrN9	cBr1, cBr6, cBr7, cBr13, cBrN1, cBrN4, cBrN5, cBrN6
12a: Direct control (4/3)	cCtl4, cCtlN1, cDOns1 cDOns2	cCtl1, cCtl2, cCtl3
12b: SBO Control (5/4)	cCtl4, cCtlN1, cSBOns1, cSBOns2, cSBOns3	cCtl1, cCtl2, cCtl3 cSBOns4
12c: Enhanced Direct control (4/3)	cCtl4, cCtlN1, cDOes1, cDOes2	cCtl1, cCtl2, cCtl3
12d: Enhanced SBO control (5/4)	cCtl4, cCtlN1, cSBOes1, cSBOes2, cSBOes3	cCtl1, cCtl2, cCtl3 cSBOes4
13c: Time Sync (1/3)	cTm1	cTm2, cTmN1, cTmN2
12d: File transfer (5/3)	cFt2, cFt2, cFt3, cFtN1, cFt N2	cFt4, cFtN3, cFt5



Configuration of IEC 61850 Client Conformance Testing System





IEC 61850 Client Conformance Testing System(CCTS)

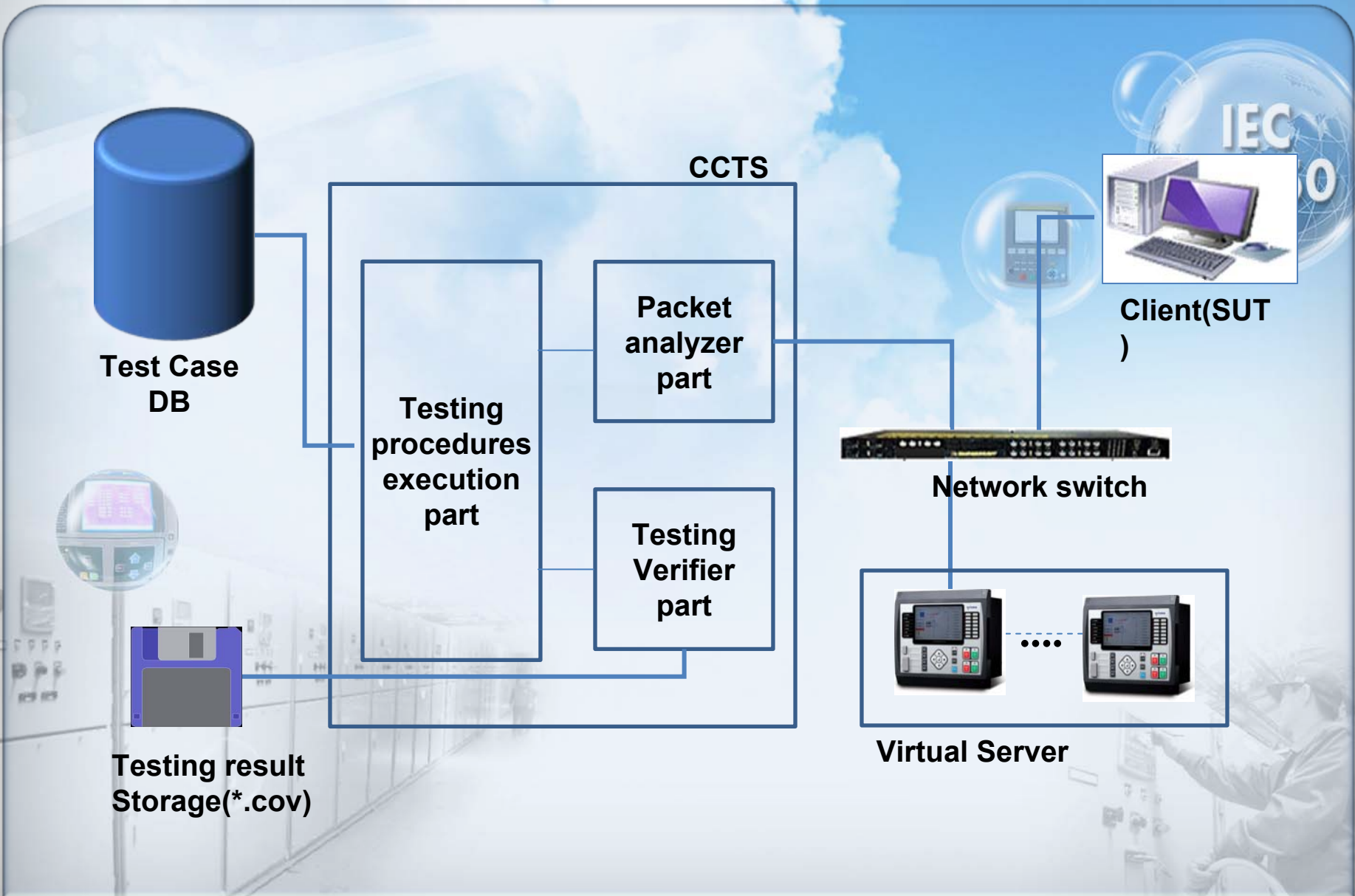
System Features

◆ IEC 61850 CCTS

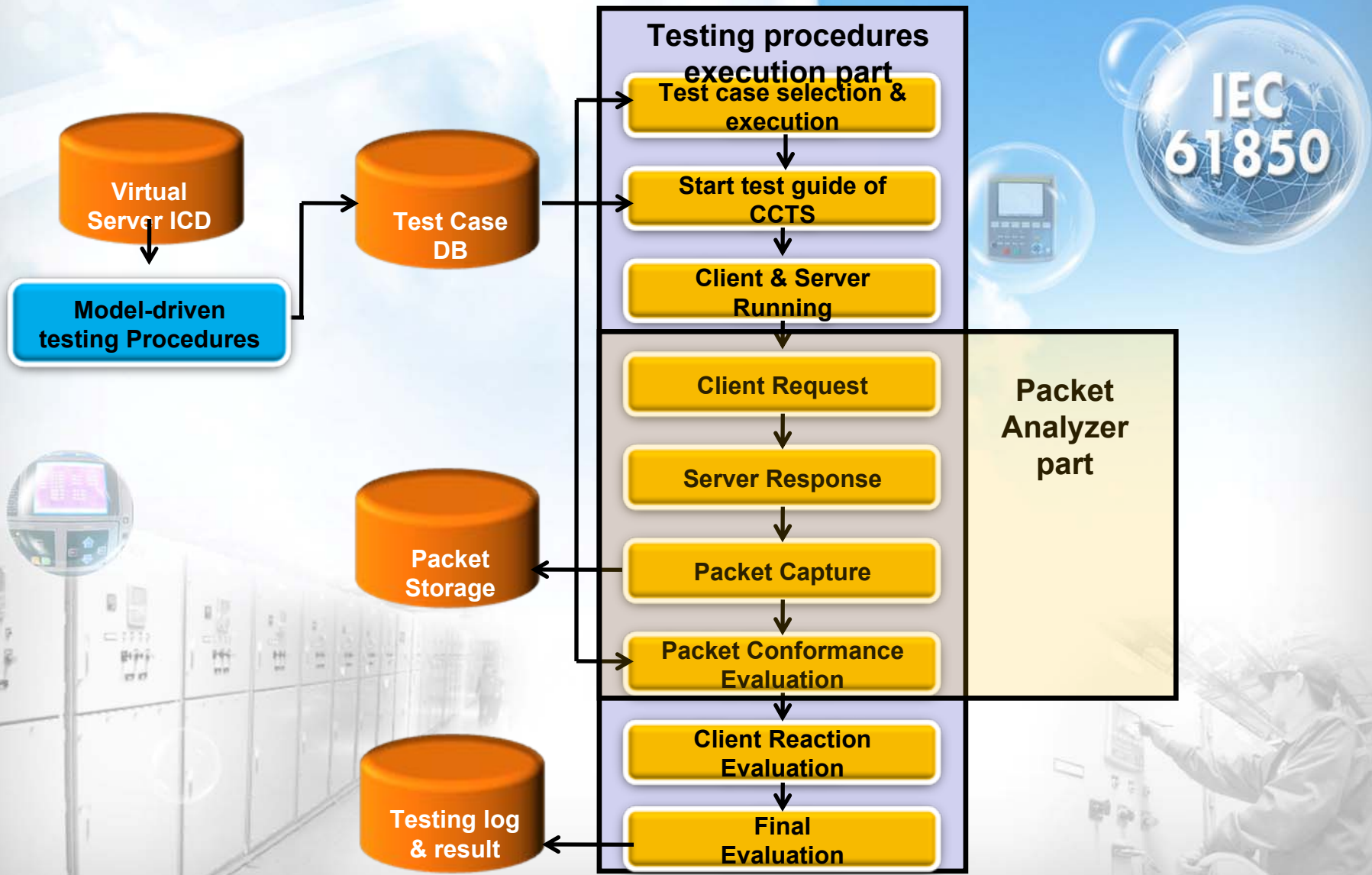
- Virtual Server System
 - Max running sever : 100
 - Include a virtual Circuit Breaker for Control Simulation
 - IEC 61850 Data Dynamic Simulator
 - Time Synchronization based on SNTP
 - Data(DA, Dataset, RCB, GoCB etc) Viewer
 - Verified by IEC 61850 conformance test
- CCTS
 - Implement Model driven UCA testing procedures
 - Analyze MMS & ACSI packet
 - Evaluate SUT
 - provide testing log & user guide UI

Virtual Server System

Overview of IEC 61850 Client Testing System



Action flow of IEC 61850 Client Testing System



- **IEC 61850 communication association :**

Associate, Abort, Release

- **Data read and write :**

GetServerDirectory, GetLogicalDeviceDirectory, GetDataValues, GetDataDirectory, GetDataDefinition, SetDataValues

- **Dataset:**

GetDatasetValues, SetDatasetValues

- **Report service :**

GetRCBValues, SetRCBValues

- **Control:**

Operate, Select, Cancel, SelectwithValue

- **File transfer :**

GetFile, GetFileAttributeValues, DeleteFile

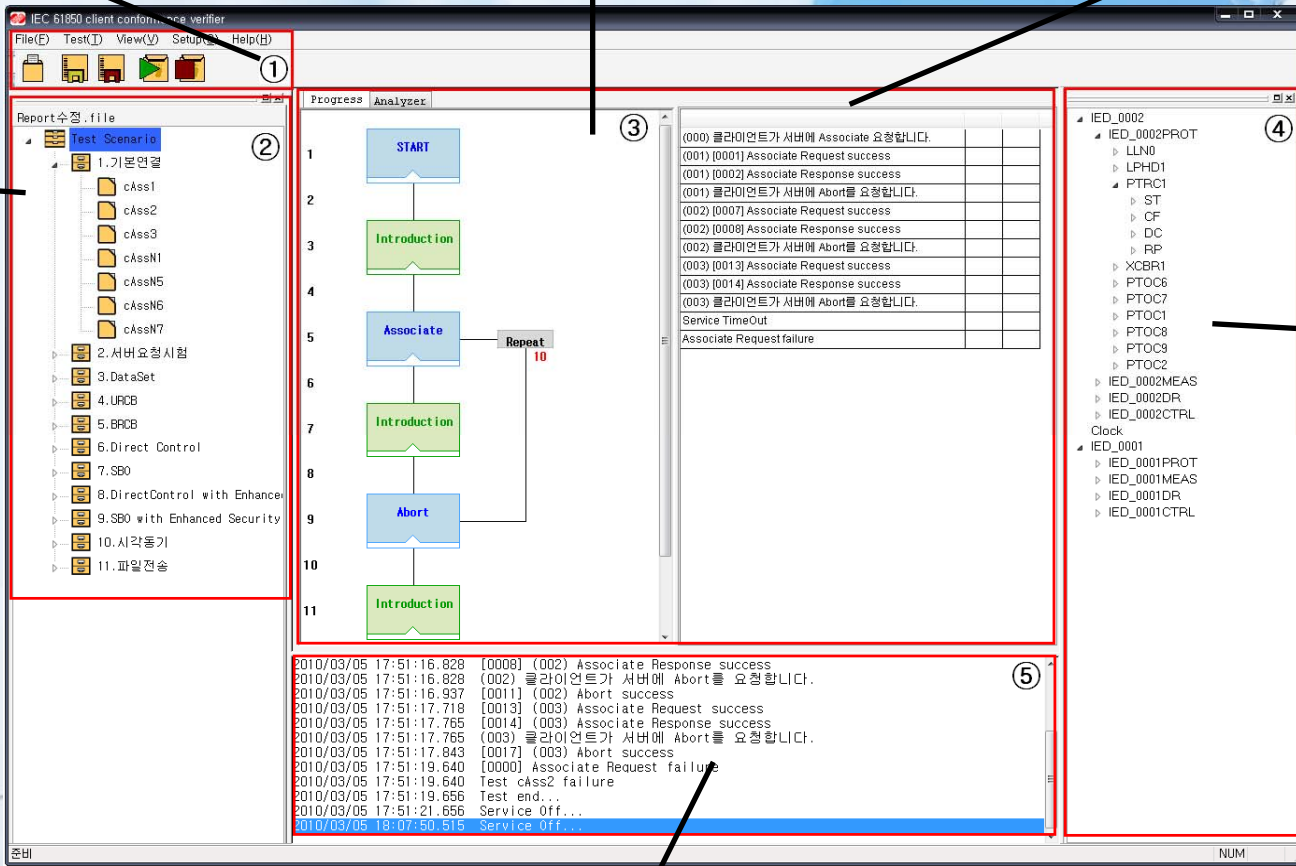
Tool bar

Test model

Test guide & evaluation

Test case Selection

IED Data Viewer



The screenshot shows the IEC 61850 client test system interface. It includes a menu bar (File, Test, View, Setup, Help), a toolbar (1), a test case selection tree (2), a test model flowchart (3) with steps like START, Introduction, Associate, Repeat (10), Abort, and Introduction, a test guide and evaluation table (4), and a test log window (5) showing test results with timestamps and status messages.

Test ID	Test Name	Status
(000)	클라이언트가 서버에 Associate 요청합니다.	
(001)	[0001] Associate Request success	
(001)	[0002] Associate Response success	
(001)	클라이언트가 서버에 Abort를 요청합니다.	
(002)	[0007] Associate Request success	
(002)	[0008] Associate Response success	
(002)	클라이언트가 서버에 Abort를 요청합니다.	
(003)	[0013] Associate Request success	
(003)	[0014] Associate Response success	
(003)	클라이언트가 서버에 Abort를 요청합니다.	
	Service TimeOut	
	Associate Request failure	

Test Log (5):

```
2010/03/05 17:51:16.828 [0008] (002) Associate Response success
2010/03/05 17:51:16.828 (002) 클라이언트가 서버에 Abort를 요청합니다.
2010/03/05 17:51:16.937 [0011] (002) Abort success
2010/03/05 17:51:17.718 [0013] (003) Associate Request success
2010/03/05 17:51:17.765 [0014] (003) Associate Response success
2010/03/05 17:51:17.765 (003) 클라이언트가 서버에 Abort를 요청합니다.
2010/03/05 17:51:17.843 [0017] (003) Abort success
2010/03/05 17:51:19.640 [0000] Associate Request failure
2010/03/05 17:51:19.640 Test cAss2 failure
2010/03/05 17:51:19.656 Test end...
2010/03/05 17:51:21.656 Service Off...
2010/03/05 18:07:50.515 Service Off...
```

Test log



Packet viewer

IEC 61850 client conformance verifier

File(F) Test(T) View(V) Setup(S) Help(H)

uca.jbt

- Test Scenario
 - 1.Basic Exchange
 - 1.1 Basic Exchange
 - 2.DataSet
 - 5.Unbuffered Reporting
 - 6.Buffered Reporting
 - 12a.Direct Control
 - 12b.SBO Control
 - 12c.Direct Control with En
 - 12d.SBO Control with Enhan
 - cCt11(SBOes)
 - cCt12(SBOes)
 - cCt13(SBOes)
 - cCt14(SBOes)
 - cCt1N1d(SBOes)
 - cCt1N2(SBOes)+++TBD
 - cSBOes1
 - cSBOes2**
 - cSBOes3
 - cSBOes4
 - 13.Time sync
 - 14.file Transfer

Progress Analyzer

RAW | LNK | NET | TRA | SES | PRE | **MMS** | **ACSI**

```

MMS
ACSI
  SelectWithValue
    Data Write Success
  [5] 09:15:52.312 192.168.0.32 -> 192.168.0.48, Operate, Request
  MMS
  ACSI
    Operate
      listOfVar : ViPAM5000CTL/BK1CSWI1$C0$Pos$Oper
      listOfData
      ctlVal = TRUE
      origin = _Originator
      orCat = remote-control
      orIdent =
      ctlNum = 0
      T = 2010-07-26 09:11:07.036249 q0a
      Test = FALSE
      Check = 00
  [6] 09:15:52.328 192.168.0.48 -> 192.168.0.32, Operate, Response
  MMS
  
```

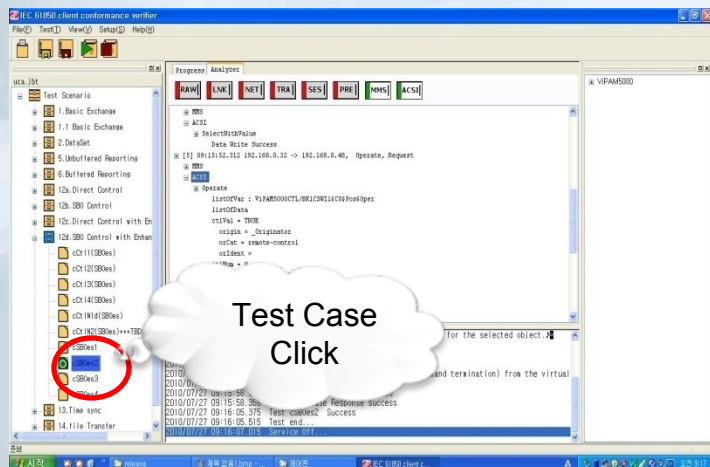
VIPAM5000

```

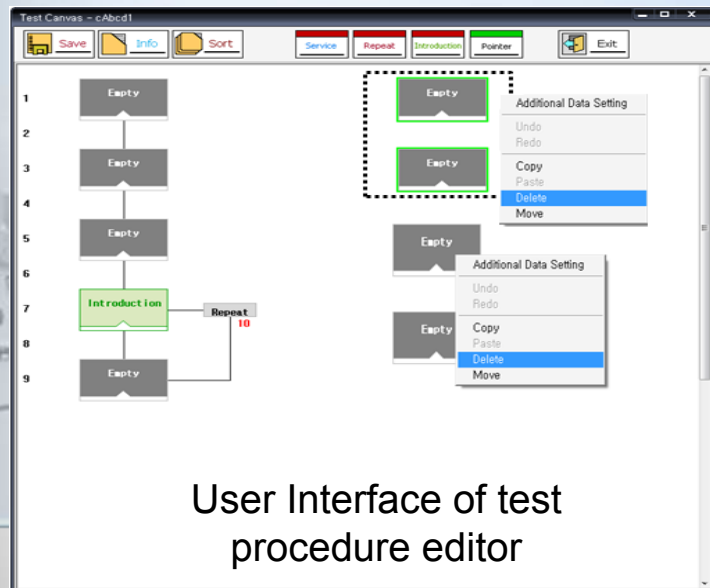
2010/07/27 09:15:40.000 Force the SUT to perform a operate request for the selected object.
2010/07/27 09:15:52.312 [0005] Oper Request success
2010/07/27 09:15:52.328 [0006] Oper Response success
2010/07/27 09:15:53.375 [0007] Oper success - CommandTermination
2010/07/27 09:15:53.390 check if SUT can receive a response(command termination) from the virtual
2010/07/27 09:15:53.406 SUT requests release.
2010/07/27 09:15:58.343 [0008] Release Request success
2010/07/27 09:15:58.359 [0009] Release Response success
2010/07/27 09:16:05.375 Test cSBOes2 Success
2010/07/27 09:16:05.515 Test end...
2010/07/27 09:16:07.015 Service Off...
  
```

준비

Model-driven test procedure editor(1)



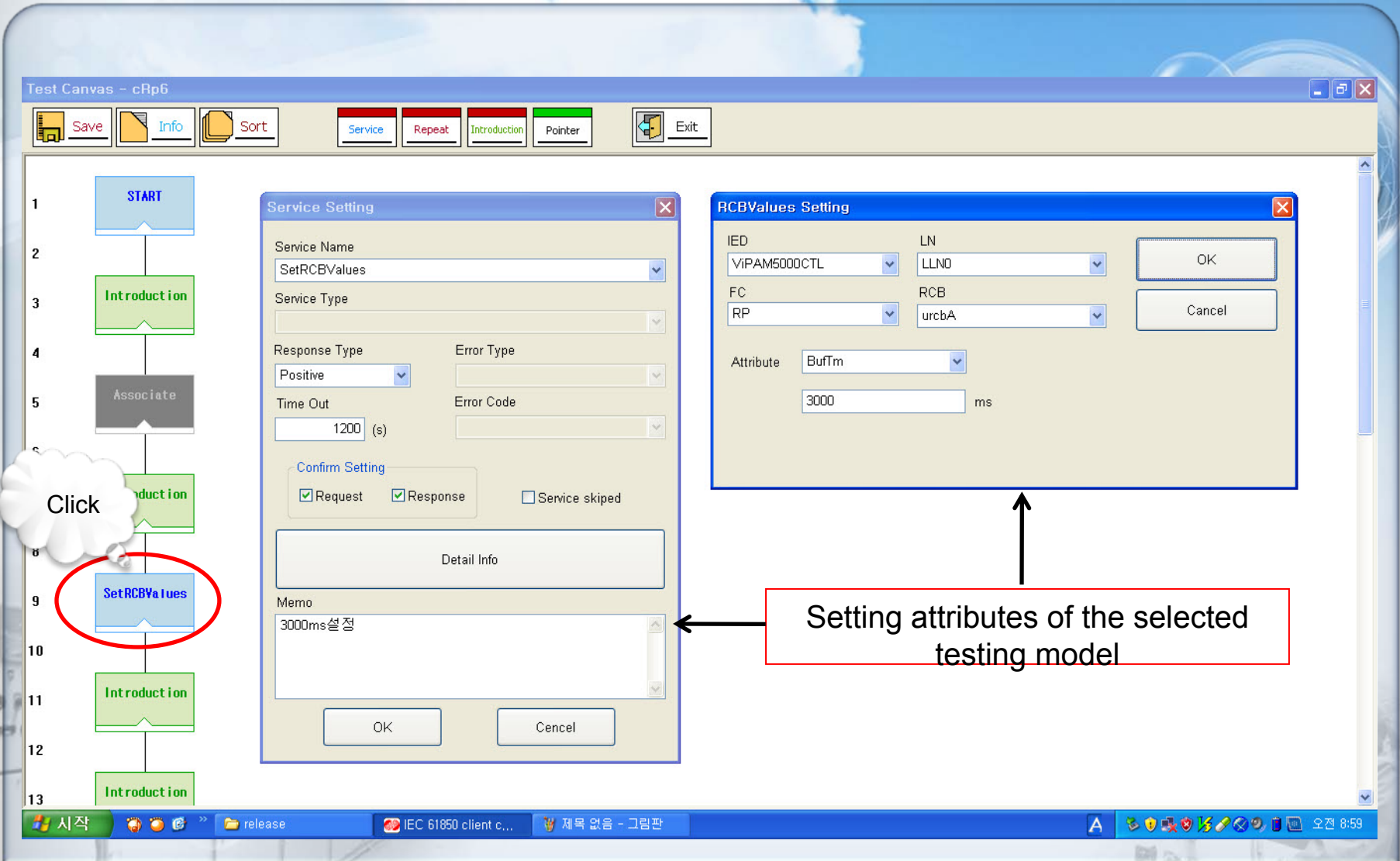
Test Case Click



User Interface of test procedure editor

- Save** : save of a test procedure
- Info** : information of the test model
- Sort** : sort of test models
- Service** : IEC 61850 service object
- Repeat** : repeat test process
- Introduction** : introduction of the test case
- Pointer** : selection of the test model
- Exit** : exit of the editor

Model-driven test procedure editor(2)



The screenshot displays the 'Test Canvas - cRp6' application window. On the left, a vertical flowchart shows a sequence of steps: 1. START, 2. Introduction, 3. Associate, 4. Introduction, 5. SetRCBValues (highlighted with a red circle and a 'Click' callout), 6. Introduction, 7. Introduction, 8. Introduction, 9. Introduction, 10. Introduction, 11. Introduction, 12. Introduction, 13. Introduction. Two dialog boxes are open: 'Service Setting' and 'RCBValues Setting'. The 'Service Setting' dialog has 'SetRCBValues' selected in the 'Service Name' dropdown, 'Positive' in 'Response Type', and '1200 (s)' in 'Time Out'. The 'RCBValues Setting' dialog has 'ViPAM5000CTL' in 'IED', 'LLNO' in 'LN', 'RP' in 'FC', 'urcbA' in 'RCB', and 'BufTm' in 'Attribute' with a value of '3000 ms'. A red box with the text 'Setting attributes of the selected testing model' has an arrow pointing to the 'RCBValues Setting' dialog. The Windows taskbar at the bottom shows the system tray with the time '오전 8:59'.



IEC 61850 communication association : Associate, Abort, Release

Data read and write :

GetServerDirectory, GetLogicalDeviceDirectory, GetDataValues, GetDataDirectory, GetDataDefinition, SetDataValues

Dataset for transmitting report and GOOSE: GetDatasetValues, SetDatasetValues

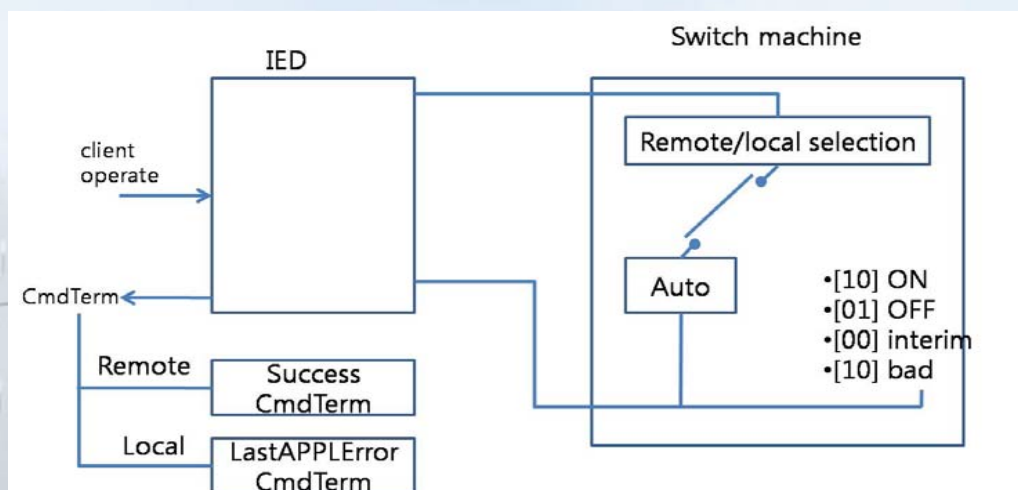
Report service : GetRCBValues, SetRCBValues

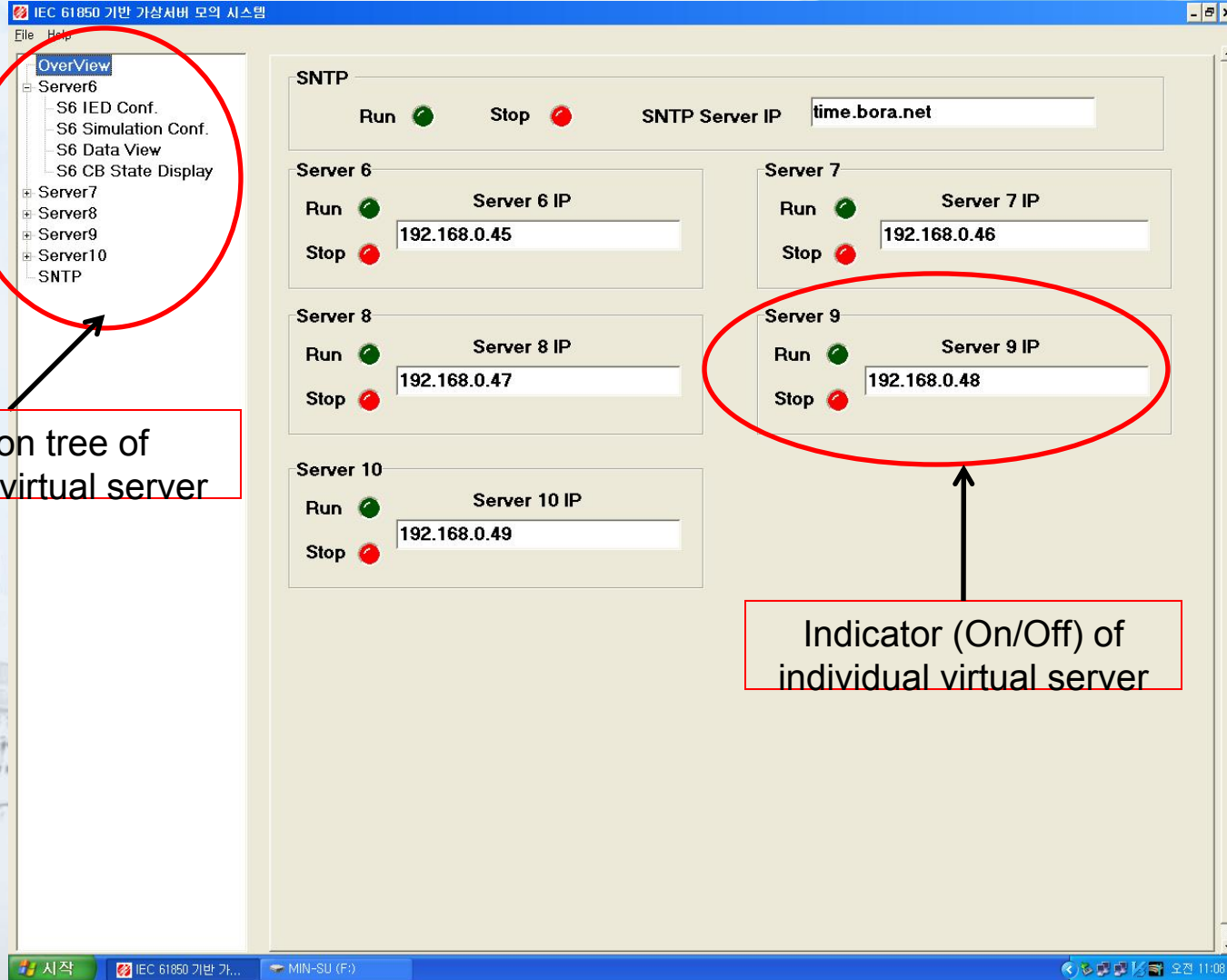
Control : Operate, Select, Cancel, SelectwithValue

File transfer : GetFile, GetFileAttributeValues, DeleteFile



- Network setting : IP, GOOSE, SNTP
- Support SNTP based time synchronization
- Install a number of virtual servers(over 100ea) in the H/W system
- View IEC 61850 data model of the virtual server by a user friendly interface :
 - Logical device, Logical Node, Data object, Data attribute, Control block, Dataset
- Support Read/Write command on IEC 61850 data model of the virtual server
- Simulate IEC 61850 data of the virtual server
- Include the virtual switch machine for IEC 61850 control test





IEC 61850 기반 가상서버 모의 시스템

File Help

- Overview
- Server6
 - S6 IED Conf.
 - S6 Simulation Conf.
 - S6 Data View
 - S6 CB State Display
- Server7
- Server8
- Server9
- Server10
- SNTP

SNTP Run Stop SNTP Server IP time.bora.net

Server 6 Run Server 6 IP 192.168.0.45 Stop

Server 7 Run Server 7 IP 192.168.0.46 Stop

Server 8 Run Server 8 IP 192.168.0.47 Stop

Server 9 Run Server 9 IP 192.168.0.48 Stop

Server 10 Run Server 10 IP 192.168.0.49 Stop

시작 IEC 61850 기반 가... MIN-SU (F) 오전 11:08

Function tree of individual virtual server

Indicator (On/Off) of individual virtual server

IEC
61850



KEPCO IEC 61850 Server Simulator

File Help

Overview

- Server6
- Server7
- Server8
 - S8 IED Conf.
 - S8 Simulation Conf.
 - S8 Data View
 - S8 CB State Display
- Server9
- Server10
- SNTPT

Server 8

Server 8 Data View

Server

- VIPAM5000ALM
 - LLN0
 - ST
 - CF
 - DC
 - BR
 - brcbA
 - RptID
 - RptEna
 - DetSet
 - ConfRev
 - OptFlds
 - BufTm
 - SqNum
 - TrgOps
 - IntgPd
 - GI
 - PurgeBuf
 - EntryID
 - TimeofEntry
 - brcbB
 - brcbC
 - RP
 - GO
 - Test_ALMDset1
 - Test_ALMDset2
 - Test_ALMDset3
 - Test_ALMDset4
 - Test_ALMDset5
 - Test_ALMDset6
 - Test_ALMDset7
 - Test_ALMDset8
 - LPHD1
 - CINGGIO1
 - COUTGGIO2
 - DIGGIO3
 - VIPAM5000CTL
 - VIPAM5000MET
 - VIPAM5000PRT

Data Read/Write

Reference Name
VIPAM5000ALM/LLN0\$BR\$brcbA\$RptID

Value
"VIPAM5000ALM/LLN0\$brcbA"

Read Write

DataSet

DataSet Name
VIPAM5000ALM/LLN0\$Test_ALMDset1

Request DataSet Items

DataSet Item List

Index	Value
1	VIPAM5000ALM/CINGGIO1\$ST\$Ind01\$stVal
2	VIPAM5000ALM/CINGGIO1\$ST\$Ind02\$stVal
3	VIPAM5000ALM/CINGGIO1\$ST\$Ind03\$stVal
4	VIPAM5000ALM/CINGGIO1\$ST\$Ind04\$stVal

Viewer of Server Data attributes

Viewer of Server DataSet

IEC 61850 기반 가상서버 모의 시스템

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- Server9
- Server10
- SNTF

Server 6

Server 6 Simulation Set

Index	Data Reference Name	Type	cycle(ms)	Data	Min	Max
1	E1Rly1/LLNO\$ST\$Mod\$origin\$orCat	integer	100		-127	127
2	E1Rly1/LLNO\$ST\$Mod\$sciNum	integer	100	1	0	255
3	E1Rly1/LLNO\$ST\$Mod\$stVal	integer	100	1	-127	127
4	E1Rly1/LLNO\$ST\$Mod\$eq	bitstring	100	[11111111111111]		
5	E1Rly1/LLNO\$ST\$Mod\$t	utcTime	100			
6	E1Rly1/LLNO\$ST\$Mod\$stSeld	boolean	100			
7	E1Rly1/LLNO\$ST\$Beh\$stVal	integer	100			
8	E1Rly1/LLNO\$ST\$Beh\$eq	bitstring	100	[11111111111111]		
9	E1Rly1/LLNO\$ST\$Beh\$t	utcTime	100			
10	E1Rly1/LLNO\$ST\$Health\$stVal	integer	100			
11	E1Rly1/LLNO\$ST\$Health\$eq	bitstring	100	[11111111111111]		
12	E1Rly1/LLNO\$ST\$Health\$t	utcTime	100			
13	E1Rly1/LLNO\$ST\$Loc\$stVal	boolean	100			
14	E1Rly1/LLNO\$ST\$Loc\$eq	bitstring	100	[11111111111111]		
15	E1Rly1/LLNO\$ST\$Loc\$t	utcTime	100			
16	E1Rly1/LLNO\$ST\$OpTmh\$stVal	integer	100	1	-2147483647	2147483647
17	E1Rly1/LLNO\$ST\$OpTmh\$eq	bitstring	100	[11111111111111]		
18	E1Rly1/LLNO\$ST\$OpTmh\$t	utcTime	100			
19	E1Rly1/LLNO\$ST\$Diag\$origin\$orCat	integer	100	1	-127	127
20	E1Rly1/LLNO\$ST\$Diag\$sciNum	integer	100	1	0	255
21	E1Rly1/LLNO\$ST\$Diag\$stVal	boolean	100			
22	E1Rly1/LLNO\$ST\$Diag\$eq	bitstring	100	[11111111111111]		
23	E1Rly1/LLNO\$ST\$Diag\$t	utcTime	100			

Report Information

URCBST DataSet Index: 1 ~ 30

BRCBST DataSet Index: 1 ~ 30

Simulation Setting

Index Num: **Set to Server**

All Data Sim

Simulation Cmd

Start **Stop**

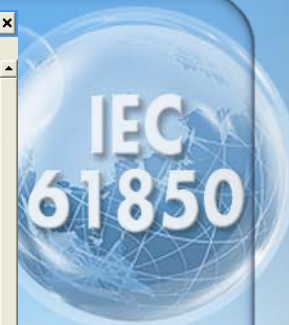
File Cmd

Save **Load**

Event cycle

Data value change

Simulation mode Setting as event cycle, data value change (Max&Min)



Simulation mode Setting as event cycle, data value change (Max&Min)

KEPCO IEC 61850 Server Simulator

File Help

- Overview
- Server6
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- Server8
 - S8 IED Conf.
 - S8 Simulation Conf.
 - S8 Data View
 - S8 CB State Display**
- Server9
- Server10
- SNTF

Server 8

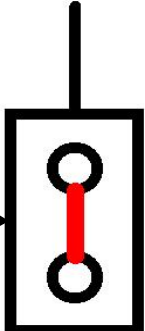
Server 8 CB Status Display

Control Select

Direct Control SBO Control

Circuit Break Data Reference Name	Value
VIPAM5000CTL/DS1XSWI1\$ST\$Pos\$stVal	[10]

ON State



XCBR\$ST\$Pos\$stVal

Control Option

normal

keep state

force [00]

force [11]

ON

OFF

Local/Remote Reference Name

Local/Remote Reference Name	Value
VIPAM5000CTL/LLN0\$ST\$Loc\$stVal	F

Local

Remote

Circuit Breaker Simulator

Demonstration of KEPCO IEC 61850 CCTS

