



华北电力大学

North China Electric Power University

NASPI North American
SynchroPhasor Initiative

WAMS Implementation in China

Pat I: Current status

Tianshu Bi

North China Electric Power University

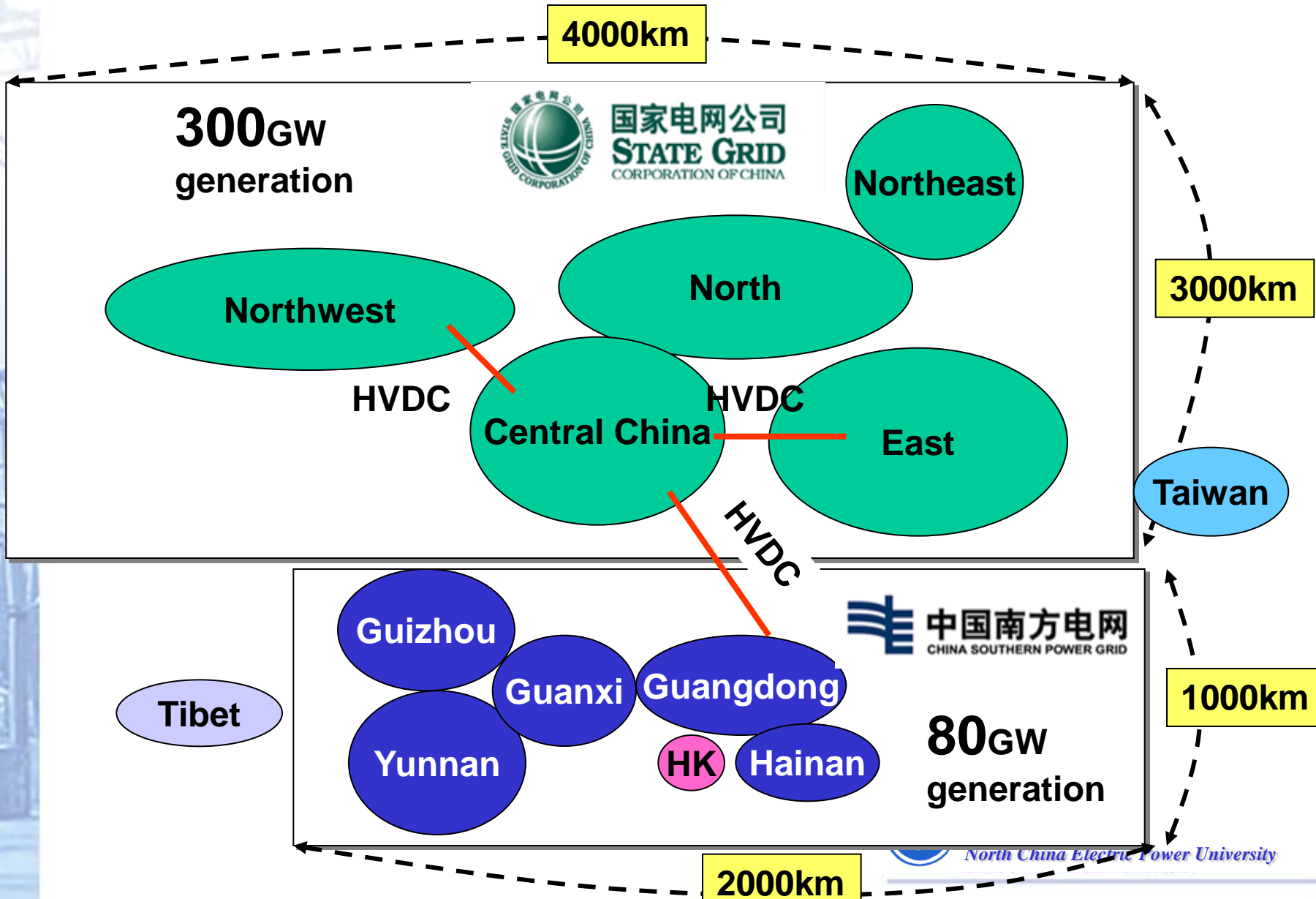
NASPI Meeting

Vancouver, BC, June 8, 2010

Outline

- WAMS implementations in China
- Features of WAMS Technology in China
- Applications of WAMS in China
- Conclusion

Chinese Power Grid

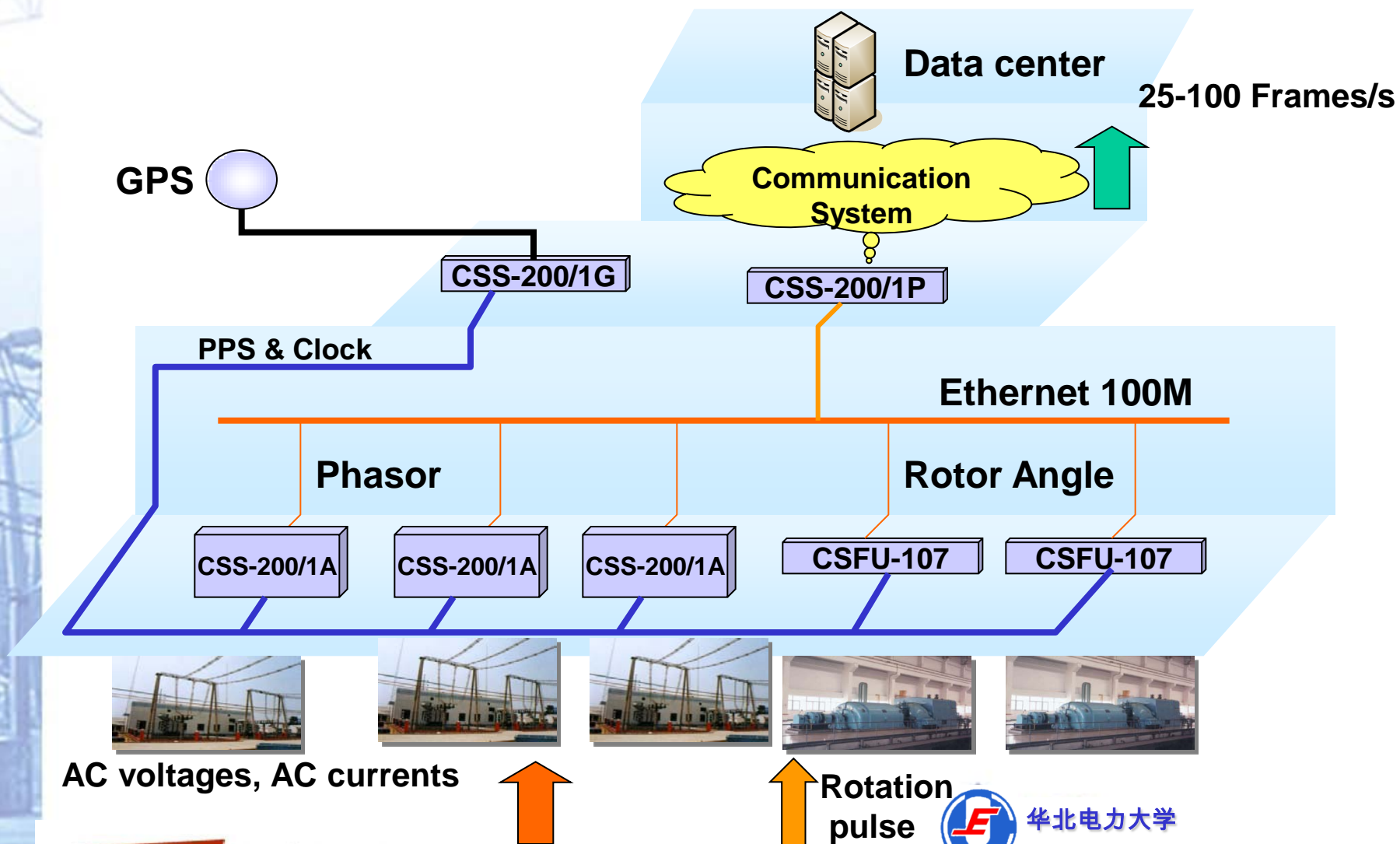


The developments of PMUs in China

- GPS has been introduced to Chinese power grid since **1993**.
- Synchronized Phasor Measurement Techniques have attracted increasingly interests since **the middle 1990s**.
- CEPRI attempts to introduce ADX3000 from Taiwan to China **during 1996-1998**.
- **Since 2002**, Chinese manufacturers have their own PMUs with intellectual properties.
- Chinese State Dispatching Center issues the steady state standard for PMU in **April 2005**.



Features of WAMS Technology in China

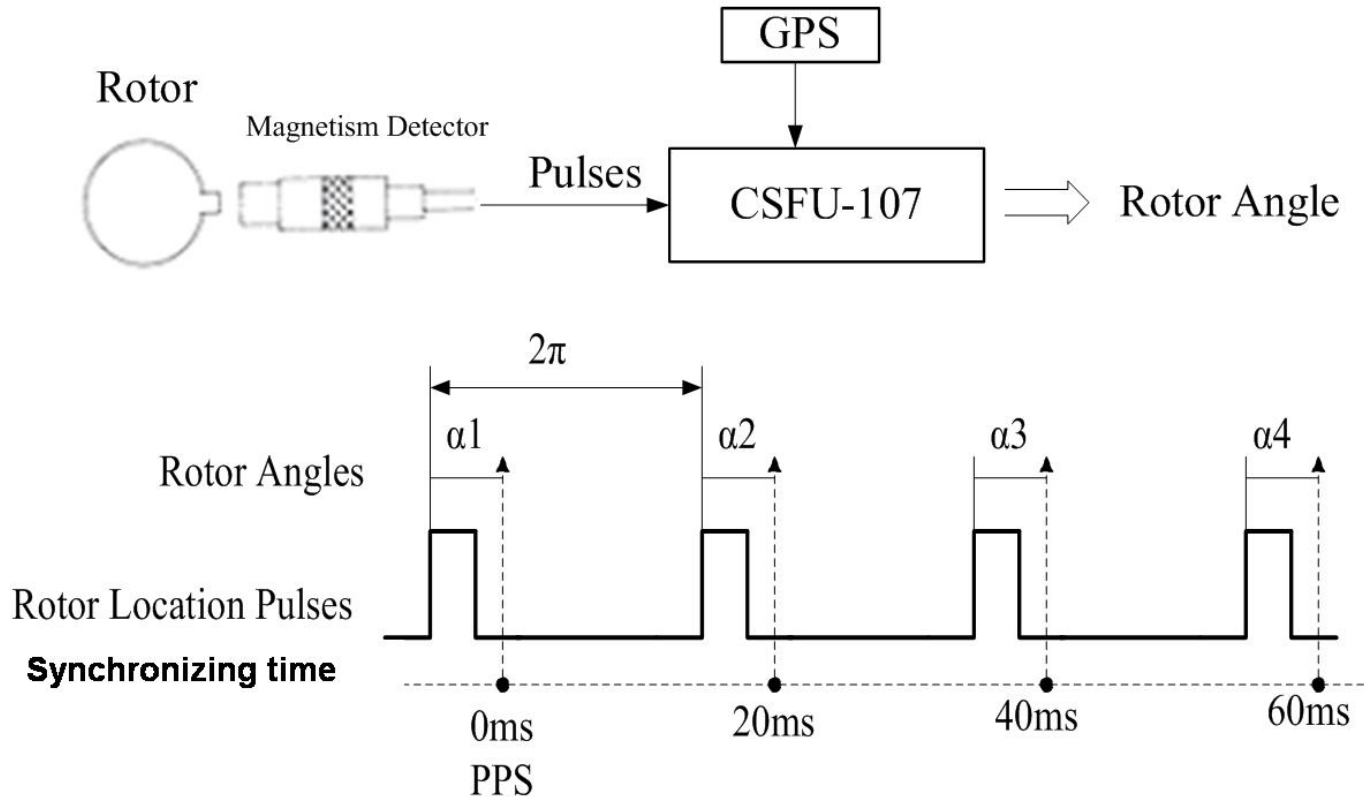


Features of WAMS Technology in China

- There are two types of PMUs in China
 - Phasor measurement
 - Rotor angle measurement

Item	Chinese PMU	Oversea PMU
A/D sampling rate	96-200/cycle	20-96/cycle
A/D bit	14/16 bit	12/16 bit
Accuracy of signal magnitude	0.2%	0.1-0.6%
Accuracy of phase angle	0.2 degree	0.1 degree
Accuracy of frequency	0.001	0.005
Accuracy of synchronization	1 μ s	1 μ s
Communication channel	Ethernet	Dial and Ethernet

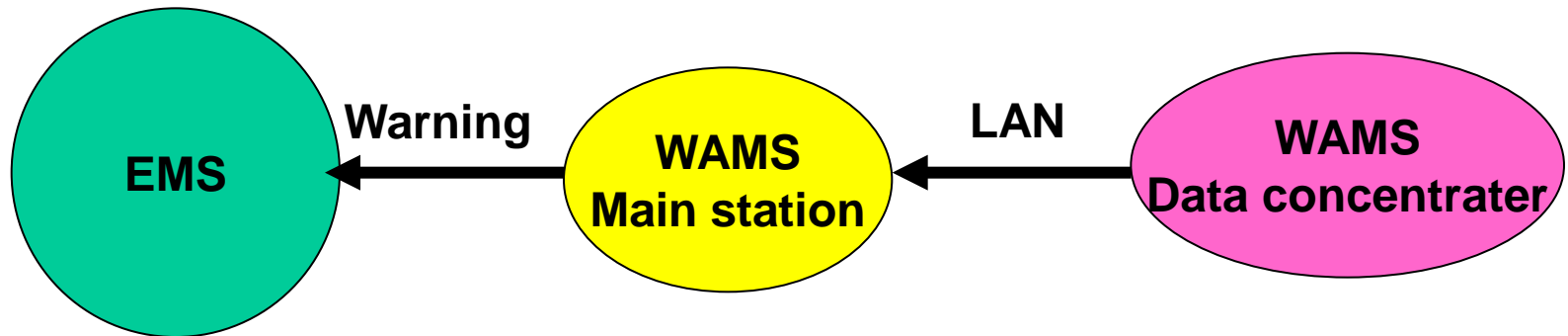
Rotor angle measurement



The latest PMU manufactured in 2006 can measure excitation voltage, excitation current, valve position, output of PSS.

Features of WAMS Technology in China

- Advanced application station retrieves data from data concentrator via LAN



Special designed Real time DB

to handle PMU data with timestamp refreshing 10-20ms

Special designed History DB

to handle Huge data more than 1000GB

High-speed storage and enquiry technology in DC is also a challenging work

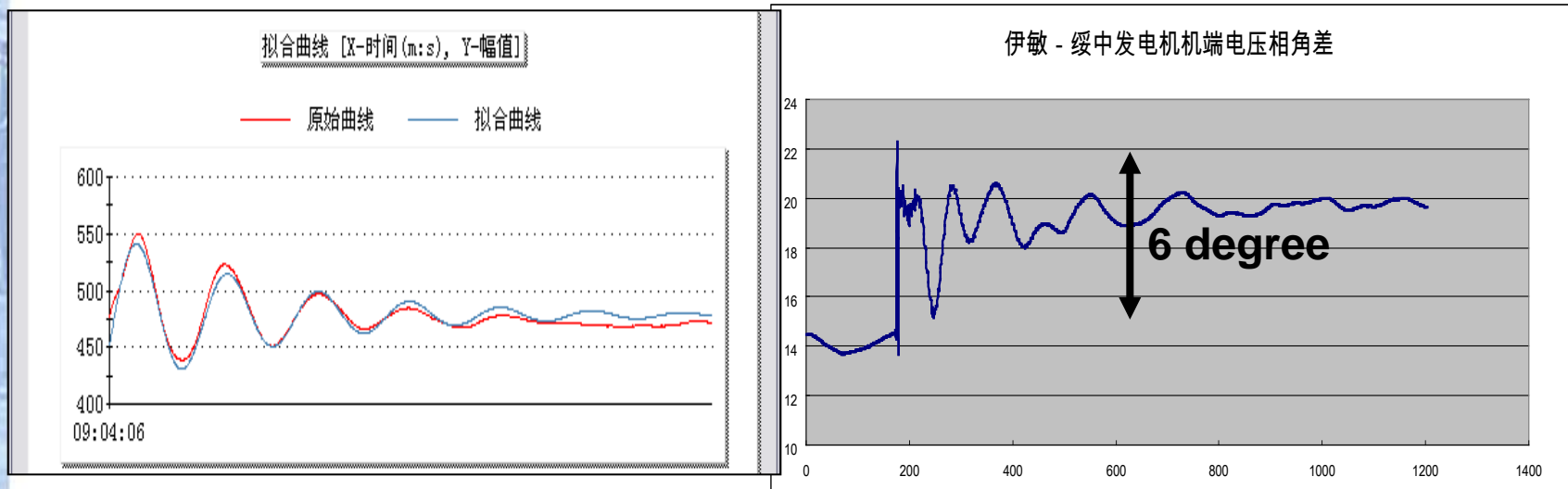
Applications of WAMS in China

- PMU test, evaluation and state estimator, especially under dynamic condition
 - PMU is a useful tool for power system dynamic monitoring and control
 - We need to know the exact behavior of PMU under dynamic condition
 - This is a Key Project under Chinese National Nature Science Foundation.

Applications of WAMS in China

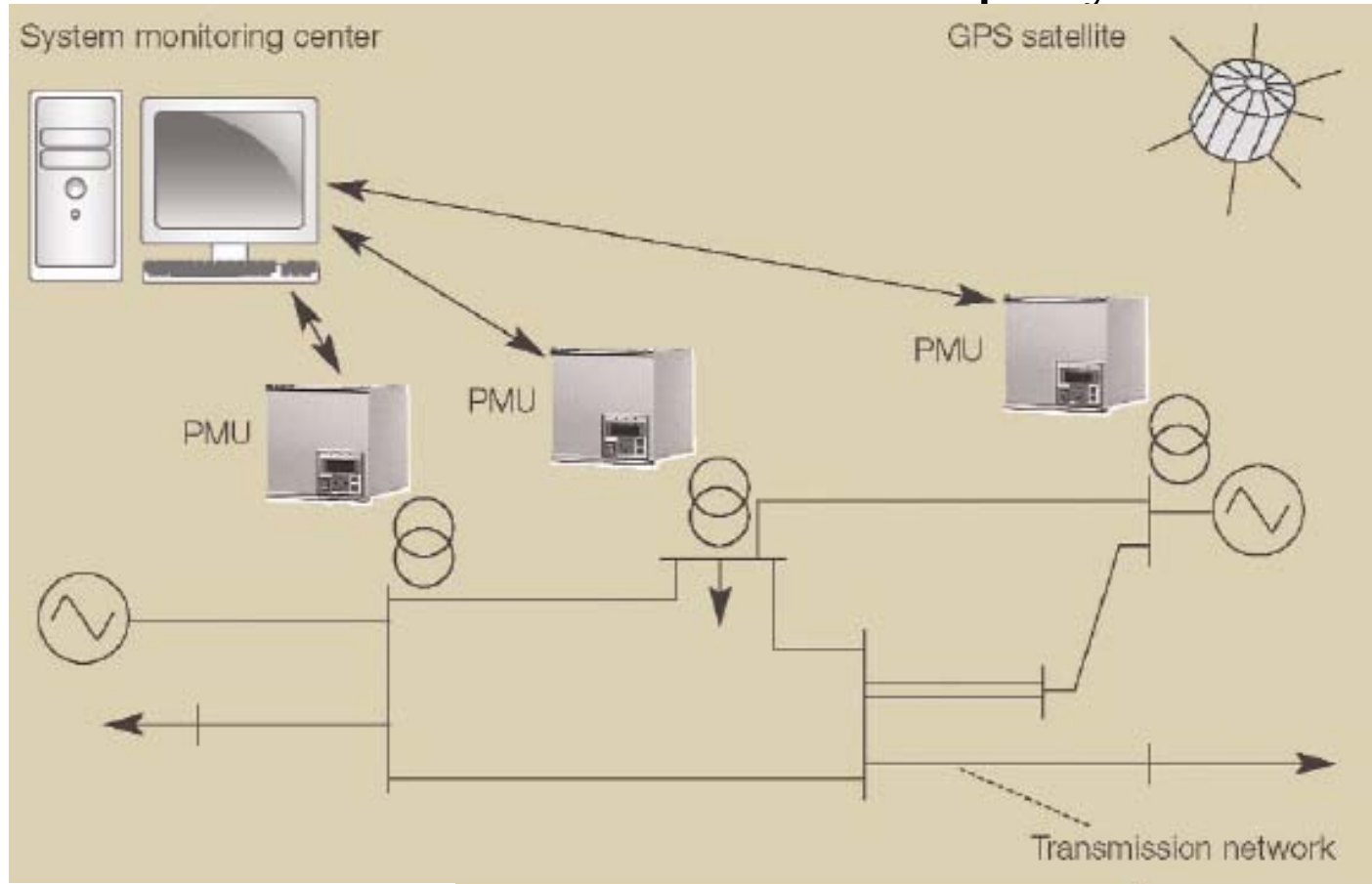
■ Dynamic modeling and simulation validation

- In 2004 and 2005, northeast grid 500kV transmission line three phase to ground to investigate the load model.
- In 2007, northwest grid 330kV transmission single line phase to ground, trip generators to testify new generation models and PSS performance.



Applications of WAMS in China

- Wide area back-up protection commissioned in Southern China Power Grid Company



Applications of WAMS in China

■ Feed back control

- Low frequency oscillation management.

Normal state

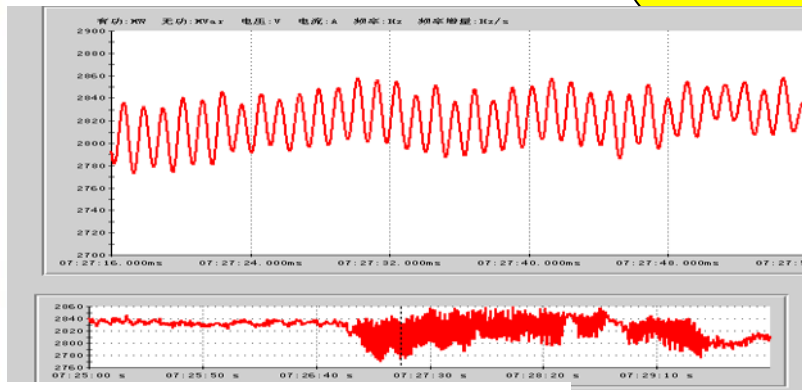
Assess osc. freq.
and damping

Under osc.

Intelligent warning

Under osc.

Wide area control

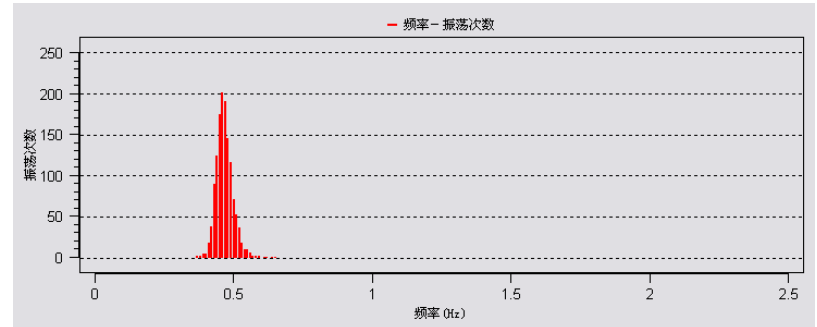


Power oscillation

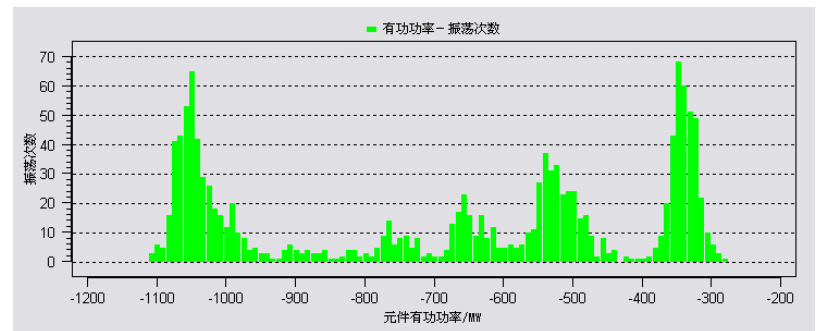
Assessment of oscillation

- Scan all transmitting power under normal state.
- If oscillation power $> 10\text{MW}$ and duration > 5 oscillating cycles, the event is registered.
- Statistics shows: oscillation with poor damping will have more events.
- The assessment successfully predicts dangerous oscillation event before its real occurrence.

Osc.events distribution



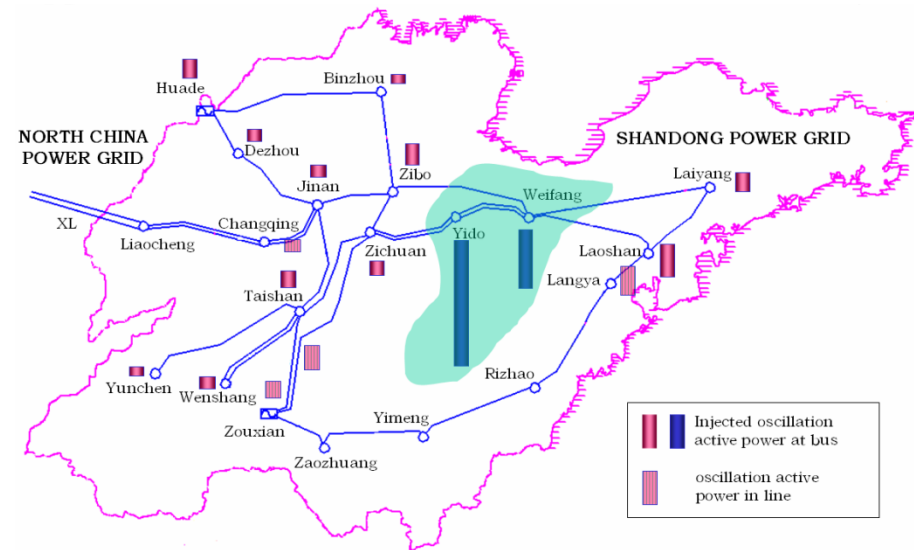
Freq. -- Event



Real power -- Event

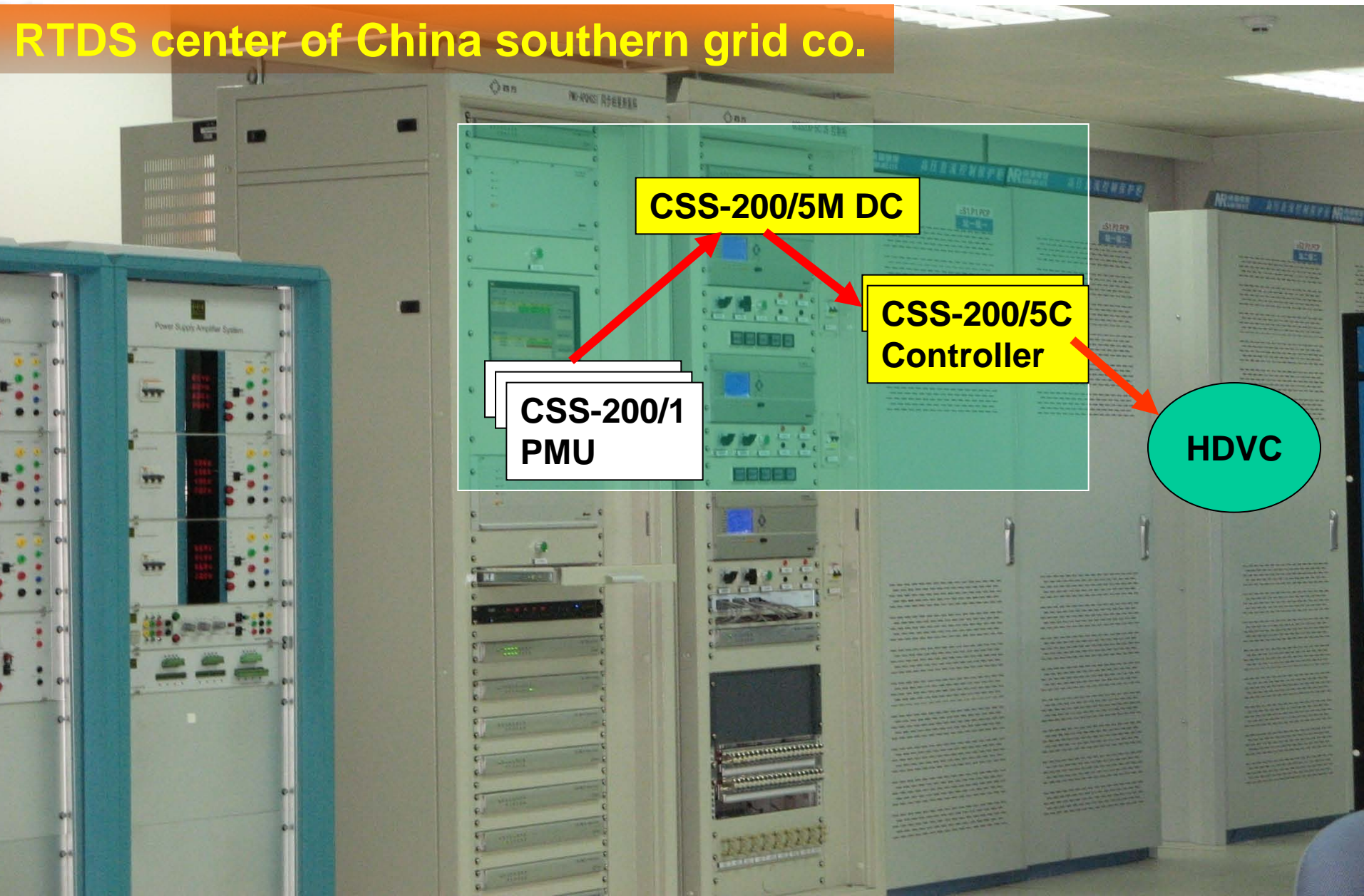
Intelligent warning during oscillation

- Group coherent bus and identify the oscillation interface.
- Sort contribution factors of bus injection power to indicate the dangerous bus or generator.
- Visualization of oscillation distribution.



WAMS based damping control

RTDS center of China southern grid co.



CSS-200/5M DC

CSS-200/5C
Controller

CSS-200/1
PMU

HDVC

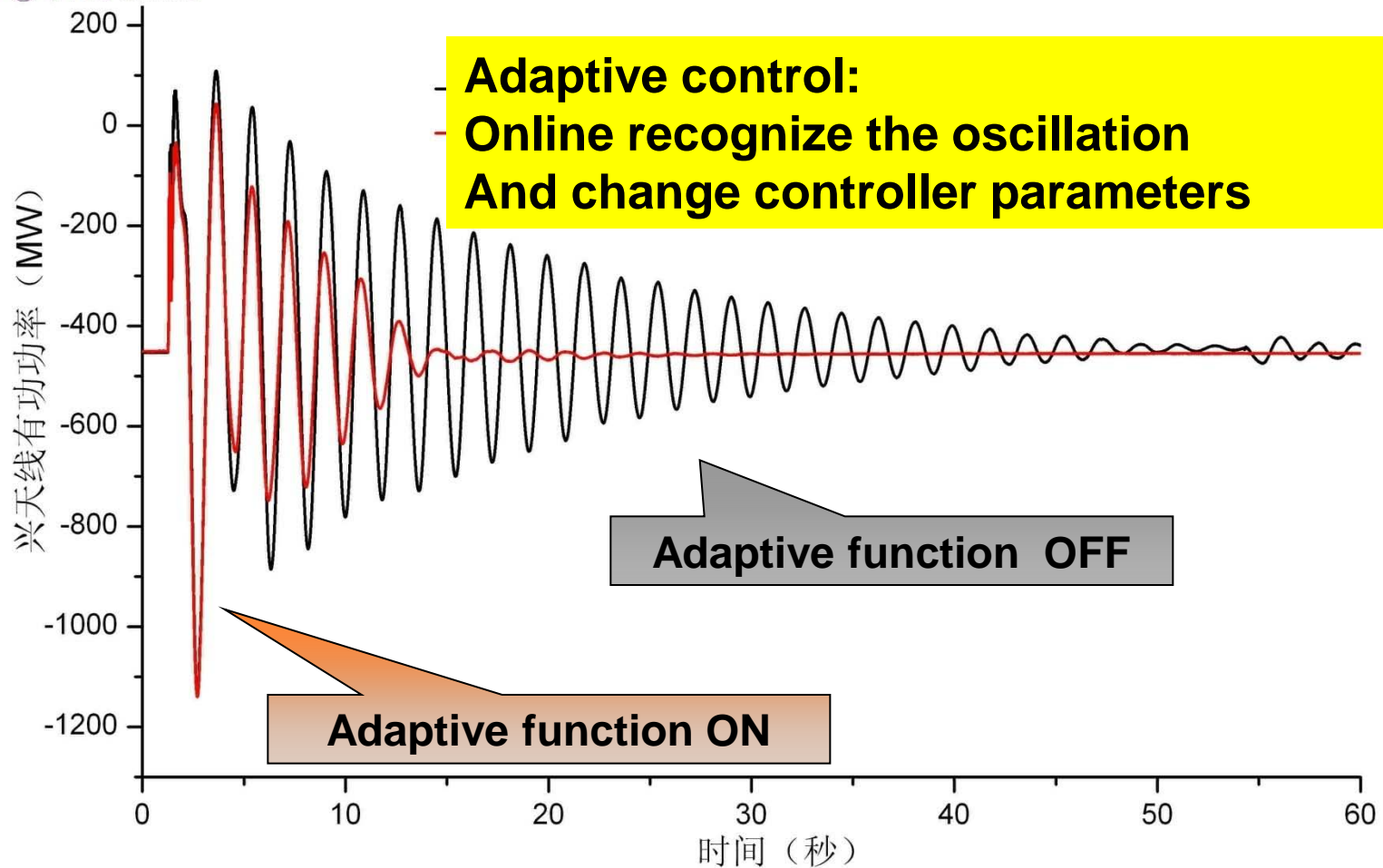
Simulation of HDVC supplement control

中国南方电网
电网技术研究中心
POWER SYSTEM TECHNOLOGY RESEARCH CENTER

四方
北京四方继保自动化股份有限公司
SINOHV BEIJING SIFANG AUTOMATION CO., LTD.

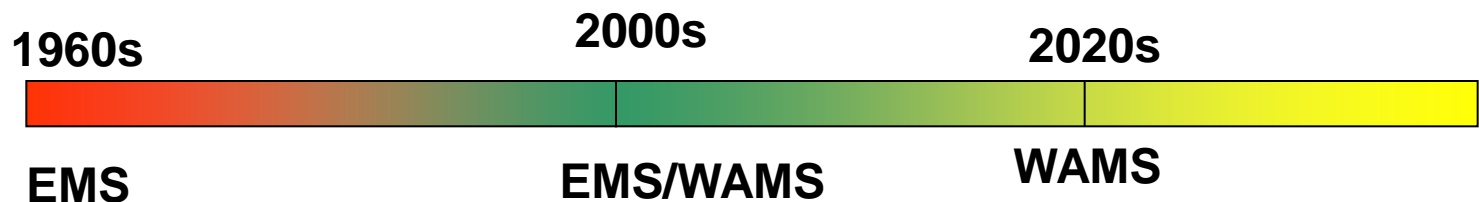
清华大学
Tsinghua University

兴天线投运时的自适应控制效果



Conclusion

- **WAMS is becoming one of the most important data sources of dispatching center.**
- **How to integrate phasor data to develop advanced applications to prevent bulk power systems against blackout still opens.**





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WAMS Implementation in China

Part II: Future research

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The Key Project: Natural Science Foundation

**TITLE: Wide Area Backup Protection
and Control Strategy to Prevent
Cascading Trips Caused by Flow
Transferring**

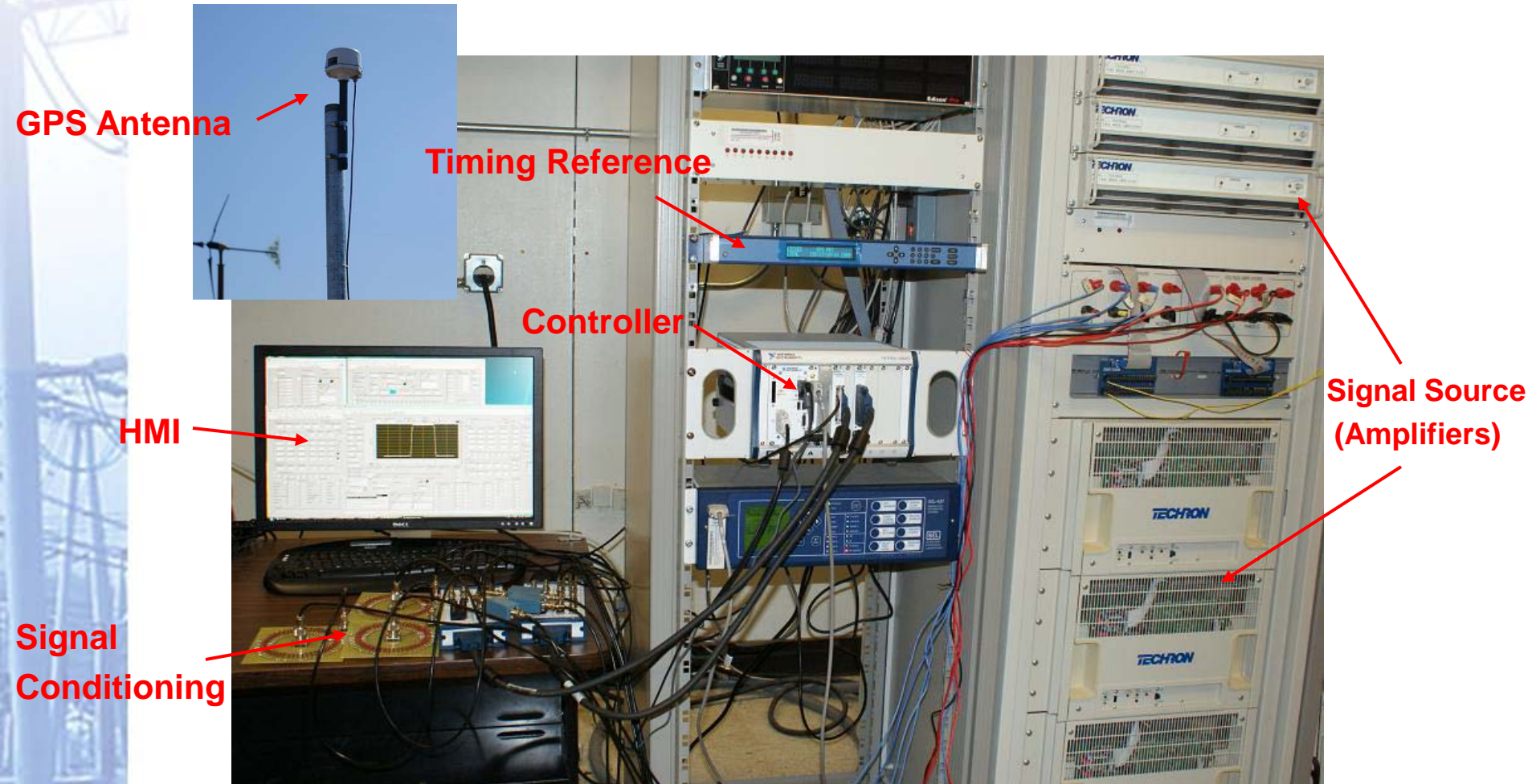
The Key Project: SCOPE

- Reveal the rule of dynamic behaviour of PMU
- The phasor testing and calibration method will be proposed, which provides technical support for the standard for dynamic phasor measurements.
- On-line assessment of WAMS system and the corresponding phasor trajectory estimation approach will be presented, which can give more accurate phasor trajectories for power system protection and control.

The Key Project: TASKS

- **Task I (2010-2012):**
 - **Static and dynamic PMU test method**
- **Task II (2011-2012)**
 - **The dynamic performance assessment method of PMU (phasors and samples) solutions**
- **Task III: (2012)**
 - **Tracking phasor trajectory for generator states**
- **Task IV (2013):**
 - **Final assessment and report production**

The Key Project: Testing of PMUs and PDCs



The Key Project: Symposium on PMU applications

- Will be hosted in China
- Share results from the project
- Learn about other experiences
- Visits to China grids and vendors
- Planned for fall 2011 or spring 2012

The Key Project: Natural Science Foundation

Q & A

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