REAL TIME WIDE DYNAMICS MONITORING SYSTEM (RTDMS)
HISTORY, PATENT, LICENSING

presentation to

NASPI Leadership Group

February 23, 2010

Vikram S. Budhraja

Electric Power Group

Outline

- EPG Principals Involvement in Reliability
- EPG Findings and Resulting Invention
- EPG Focus and Approach
- Patent – Content, Scope, Timing
- DOE Funding and Rights to Invention
- RTDMS© Use and Licensing
- EPG Synchrophasor Technology Adoption and Commercialization Efforts
- Summary
- Q & A

EPG Principals' Involvement in Reliability

Major role and contributions in developing understanding and actions for reliability

- 1996 – WECC Blackout Investigation
- 1996 – DOE established Secretary of Energy Advisory Board (SEAB)
- 1996 – NERC Reliability Compliance Team Report – led to Blue Ribbon Task Force and "new NERC"
- 1996-98 -- WECC Mandatory Reliability Standards – Contract Approach
- 1999 – CERTS formed
- 1999/2000 – EPG, LLC established and started operations
- 1999/2000 – Investigation of six reliability events in EI
- 2000/01 – Persistent generation deficiency in Eastern Interconnection lasting many hours . Took many months to identify root cause
- Aug 14, 2003 – Eastern Interconnection Blackout Investigation

EPG Findings and Resulting Invention

- Lack of grid visibility beyond control area footprint – no wide area view
- Lack of interconnection wide real time monitoring capability
- Lack of ability to diagnose emerging wide area grid problems and take preventative actions
- Analysis of reliability issues – time consuming, resource intensive and took months and years
- No tools for reliability monitoring and management beyond control area footprint
- Opportunity for Real -Time Performance Monitoring and Management System
- Researched and filed provisional application on **Aug 8, 2003** for patent now commonly referred to as Grid-3P: Real-Time **P**erformance Monitoring and **P**rediction **P**latform – U. S. Patent No. 7,233,843

EPG Focus and Approach

- Reliability management, research and consulting services
- Founding member of CERTS. Funding for CERTS comes from DOE and CEC
- Focused on real time grid monitoring and reliability management applications and tools research, development, testing and deployment
- Developed real time applications using the Grid-3P platform and other technologies
- Several NERC applications and RTDMS are built on the Grid-3P technology
- Several applications are being used by NERC and have been deemed "mission-critical," including Resource Adequacy, CPS-BAAL, AIE, Inadvertent, Intelligent Alarms, Frequency Monitoring Application
- **EPG obligation is to *commercialize* the technology**
- EPG approach – license applications with full installation support and on-going maintenance, license technology to third parties and end-users

Patent – Content, Scope, and Timing

- U. S. Patent No. 7,233,843
- Title: Real-Time Performance Monitoring and Management System
- Inventors : Vikram Budhraja, Jim Dyer, Carlos Martinez Morales
- Assignee: Electric Power Group, LLC
- Provisional Patent Application Filed: Aug 8, 2003
- Date of Award: June 19, 2007

Patent

(12) **United States Patent**
Budhraja et al.

(10) **Patent No.: US 7,233,843 B2**
(45) **Date of Patent: Jun. 19, 2007**

(54) **REAL-TIME PERFORMANCE MONITORING AND MANAGEMENT SYSTEM**

(75) Inventors: **Vikram S. Budhraja**, Los Angeles, CA (US); **James D. Dyer**, La Mirada, CA (US); **Carlos A. Martinez Morales**, Upland, CA (US)

(73) Assignee: **Electric Power Group, LLC**, Pasadena, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **10/914,789**

(22) Filed: **Aug. 9, 2004**

(65) **Prior Publication Data**

US 2005/0033481 A1 Feb. 10, 2005

Related U.S. Application Data

(60) Provisional application No. 60/527,099, filed on Dec. 3, 2003, provisional application No. 60/493,526, filed on Aug. 8, 2003.

(51) **Int. Cl.**
G06F 19/00 (2006.01)
G06F 15/173 (2006.01)

(52) **U.S. Cl.** **700/291**; 709/224

(58) **Field of Classification Search** 709/217–219, 709/223–225, 249; 700/83, 286, 291, 297; 702/60–62, 179–185; 703/18; 715/965, 715/969
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,681,154 B2 * 1/2004 Nierlich et al. 700/286
6,728,601 B2 * 4/2004 Garcia et al. 700/286
6,732,019 B2 * 5/2004 Spool et al. 700/291
6,751,562 B1 6/2004 Blackett et al.
6,771,058 B2 * 8/2004 Lapinksi et al. ..... 324/117 R
6,778,882 B2 * 8/2004 Spool et al. 700/295
6,801,940 B1 * 10/2004 Moran et al. 709/224
6,912,889 B2 * 7/2005 Staphanos et al. 73/23.31

(Continued)

OTHER PUBLICATIONS

Power World Corporation, "Power Systems, Transmission Systems, Analysis, Visualization and Expertise." (Product Brochure), no date.

(Continued)

Primary Examiner—M. N. Von Buhr
(74) *Attorney, Agent, or Firm*—Christie, Parker & Hale, LLP.

(57) **ABSTRACT**

A real-time performance monitoring system for monitoring an electric power grid. The electric power grid has a plurality of grid portions, each grid portion corresponding to one of a plurality of control areas. The real-time performance monitoring system includes a monitor computer for monitoring at least one of reliability metrics, generation metrics, transmission metrics, suppliers metrics, grid infrastructure security metrics, and markets metrics for the electric power grid. The data for metrics being monitored by the monitor computer are stored in a data base, and a visualization of the metrics is displayed on at least one display computer having monitor. The at least one display computer in a grid

Patent – Excerpt

REAL-TIME PERFORMANCE MONITORING AND MANAGEMENT SYSTEM

CROSS-REFERENCE TO RELATED APPLICATION(S)

This application claims priority to and the benefit of U.S. Provisional Patent Application No. 60/493,526 filed Aug. 8, 2003 and U.S. Provisional Patent Application No. 60/527,099 filed Dec. 3, 2003, the entire contents of both of which are incorporated herein by reference.

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

This invention was made partially with government support under Department of Energy Contract # DE-AC03-76SF00098, Subcontract # 6508899. The Government has certain rights in this invention.

FIELD OF THE INVENTION

The present invention relates generally to a monitoring and management platform, and more particularly to a real-time performance monitoring and prediction system that has wide applicability to various industries and processes.

BACKGROUND

In various industries, the ability to monitor, track, predict and/or act in real-time is desirable. These industries include

(CAs) in the United States for monitoring and control of generation, transmission and distribution of electricity. While all these different entities at various different levels are involved in generation, transmission and distribution of electricity as well as monitoring and control in a power grid, there is no single integrated system that can be used to monitor and manage the electric power grid in real-time across all of the different elements of the power system. For example, there is no information management system for the power grid, which is integrated across multiple business systems, companies and Control Areas to manage the secu- timeliness, accuracy or accessibility of information for operations, reliability, market operations and system rity. Analogous issues may be apparent in other indus-

SUMMARY

n an exemplary embodiment according to the present invention, a real-time performance monitoring, management and prediction platform is provided. Systems based on the platform may be used to manage processes in various industries, based on current monitoring tools as well as tools that are under development, for example, in smart, switchable networks. Systems based on the platform preferably include visualization features that enable managers and operators in various industries to: measure key system operating and market metrics; monitor and graphically represent system performance, including proximity to potential system faults; track, identify and save data on abnormal operating patterns; and predict system response in near

Patent Fig 2B - Integration of Real Time Wide Area Monitoring for Reliability Management

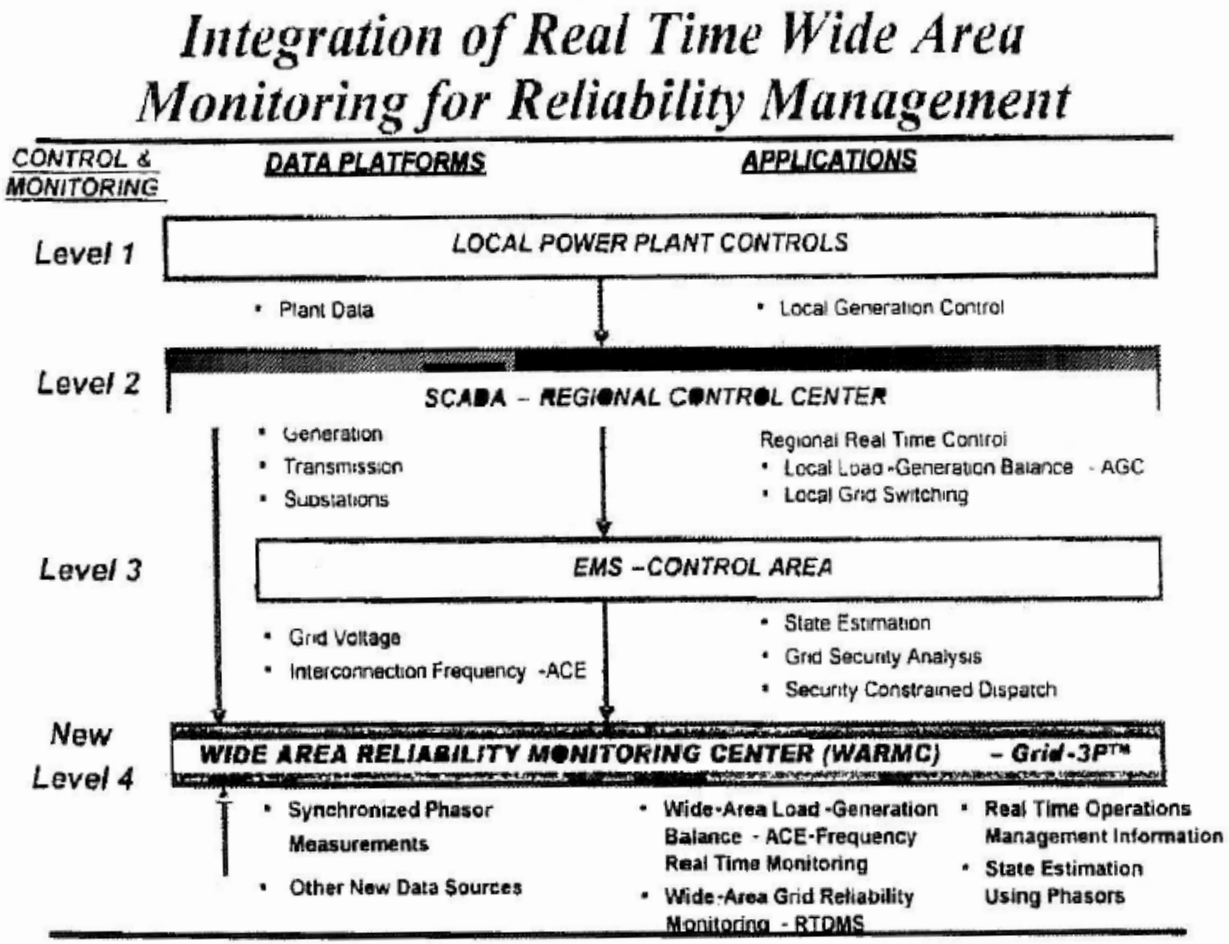

FIG. 2B

U.S. Patent Jun. 19, 2007 Sheet 4 of 41 US 7,233,843 B2

Patent Fig 4 - Real Time Wide Area Monitoring for Reliability Management

Grid-3P for Real Time Performance Monitoring

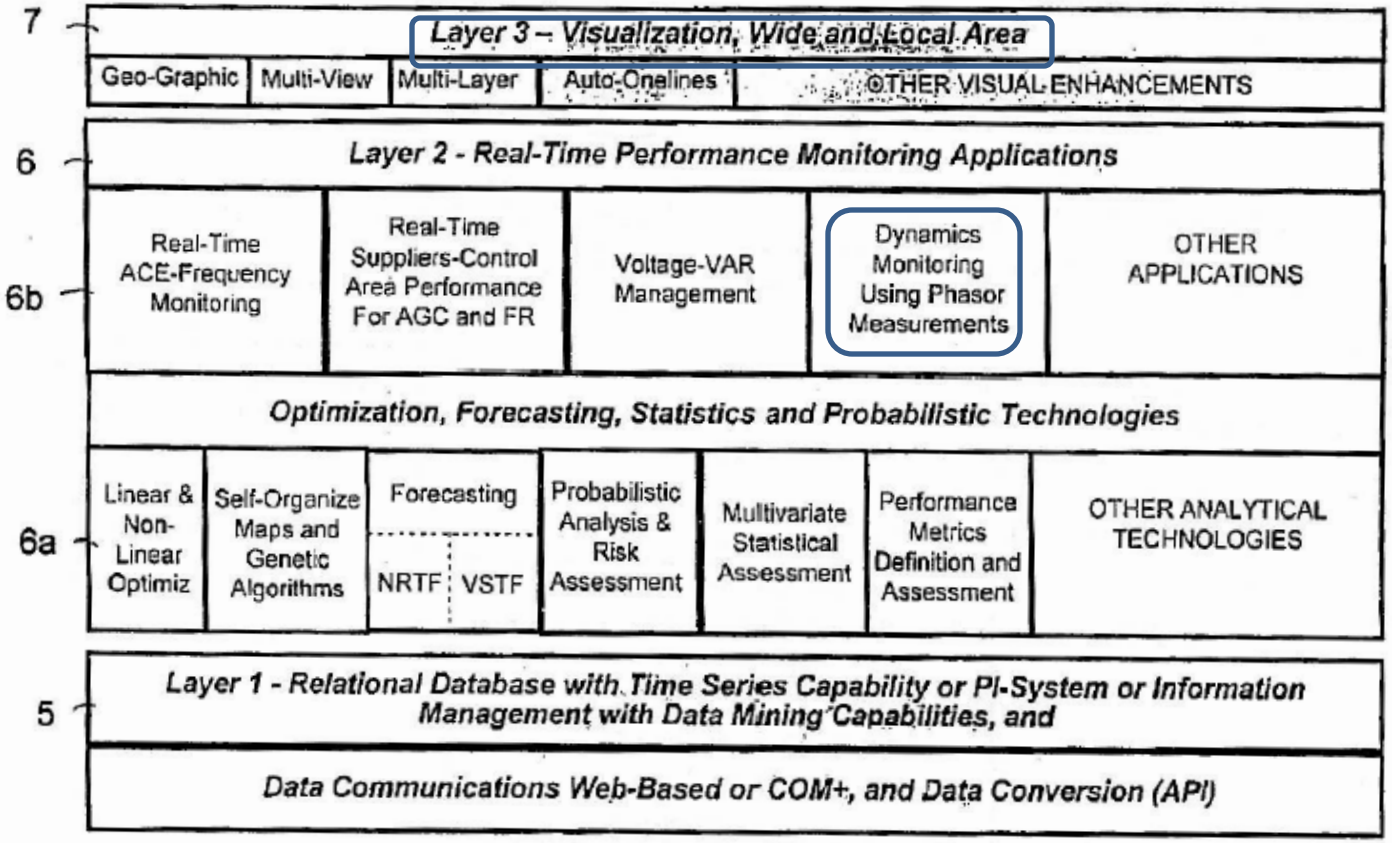

FIG. 4

Patent – Fig 5

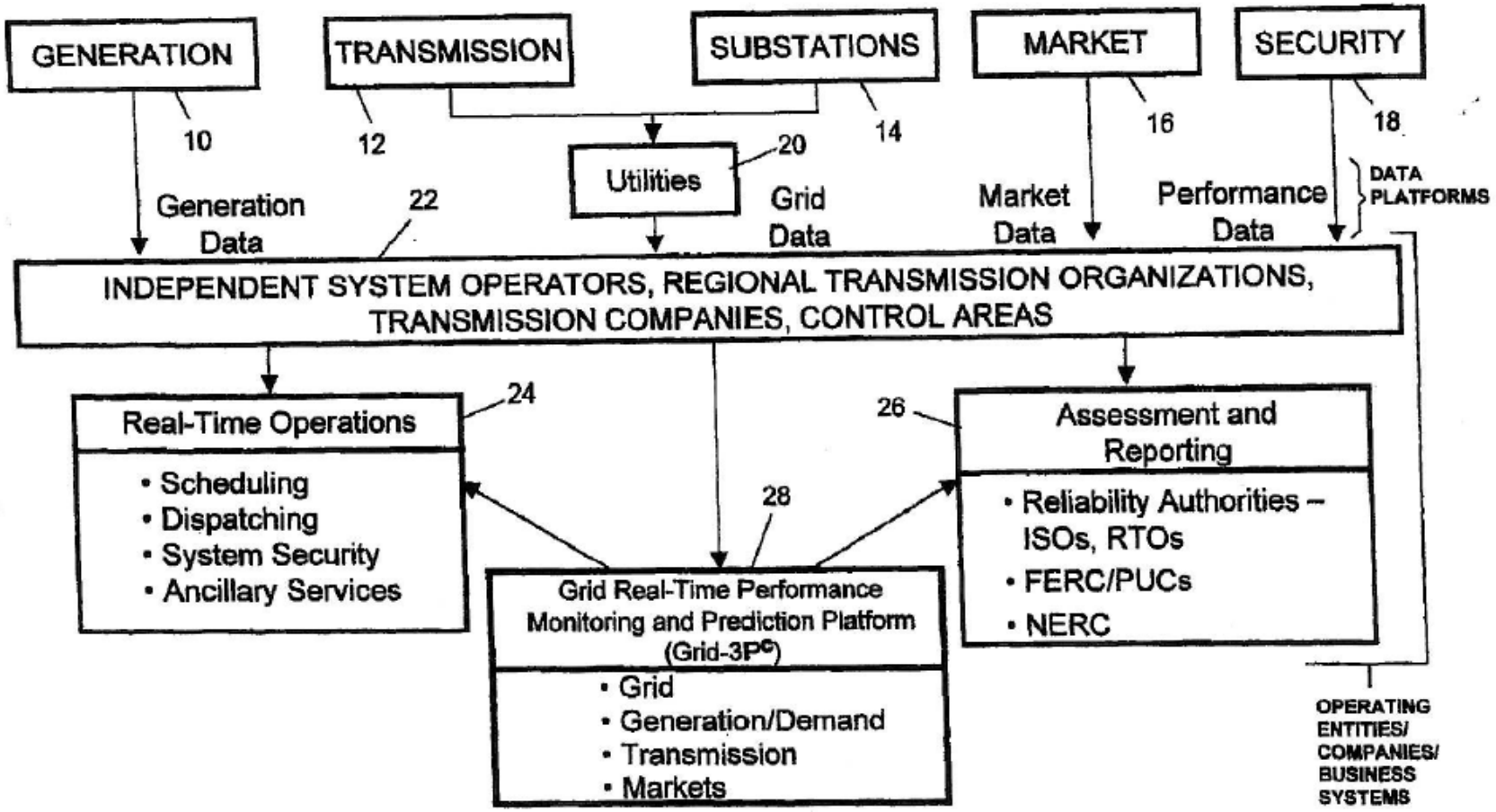

FIG. 5

DOE Funding and Rights to Invention

- DOE partial funding of EPG invention disclosed in the Patent "This invention was made partially with government support under Department of Energy Contract # DE-AC03-76SF00098, Subcontract # 6508899."
- DOE granted EPG permission to assert copyright on May 7, 2004
- DOE approval and continuing approval for copyright is based on:
  - "The standard that the work is still commercially available and the market demand is being met or, if the foregoing is not the case, that the Contractor is diligently pursuing commercial activities pertaining to the work."
  - The Contractor agreeing to grant a broader license to Government if Contractor abandons commercialization activities pertaining to the work to which the Contractor has been given permission to assert copyright.

RTDMS Use and Licensing

- EPG obligation pursuant to DOE grant of copyright: "Work is still commercially available and market demand is being met" or "Contractor is diligently pursuing commercial activities"
- EPG providing applications through grant of a "license" to end-users while retaining all property rights in IP of the software, as well as the technology (Grid-3P)
- EPG has offered to license technology (Grid-3P) to third parties and end users – informal discussions for several years with a variety of solution providers, letter sent to electric industry leaders and vendors in Dec 2009. The parties can develop their own solutions and products using the patented technology.
- For U.S. companies participating in NASPI, EPG currently waiving the license fee for one RTDMS server installation and RTDMS client. Licensee pays for installation and ongoing annual support and maintenance
- RTDMS server installed at TVA for the Eastern Interconnection and 50 plus clients have been distributed. RTDMS server also installed at CAISO and several other utilities and ISOs
- RTDMS users, during client download process, acknowledge and accept EPG's license
- EPG is collaborating with the research community for testing new research algorithms and applications which then are incorporated (example oscillation detection). No cost to research community

EPG Synchrophasor Technology Adoption & Commercialization Efforts

- CERTS Founding member – advocating industry adoption of synchrophasor technology
- Helped launch EIPP and NASPI – promoting technology adoption, knowledge sharing, research results, application demonstrations
- Supporting NASPI task teams and NASPI community with webcasts, training, technology issues
- Provided no cost trial licenses to SEL, Quanta, universities, users, and others
- Adopted industry standard protocols and integrated EPG applications with FNET, OPC
- Continuing to invest in research, development and enhancement of applications to meet industry needs for production quality applications

Summary

- EPG principals have a long history and interest in promoting reliability
- EPG committed its own resources to research and invest to create its patented technology
- EPG research efforts were, in part, funded by DOE and this was acknowledged and disclosed in the patent
- EPG owns the IP and has indicated its willingness to license the use of EPG technology by third parties and/or license the use of EPG applications directly to end users
- License provides for use of technology. EPG retains all property rights to the IP

THANK YOU

Electric Power Group
201 S. Lake Ave., Ste 400
Pasadena, CA 91101
626-685-2015