TigerGraph

Case Study: Energy

Delivering a Faster Than Real-Time Energy Management System

THE CUSTOMER

STATE GRID CORPORATION OF CHINA

State Grid Corporation of China (SGCC) is the largest electric utility company in the world with $363 billion USD annual revenue for 2017. With 927,839 employees, State Grid has over 1.1 billion customers and is world's second largest company by revenue as of 2018.

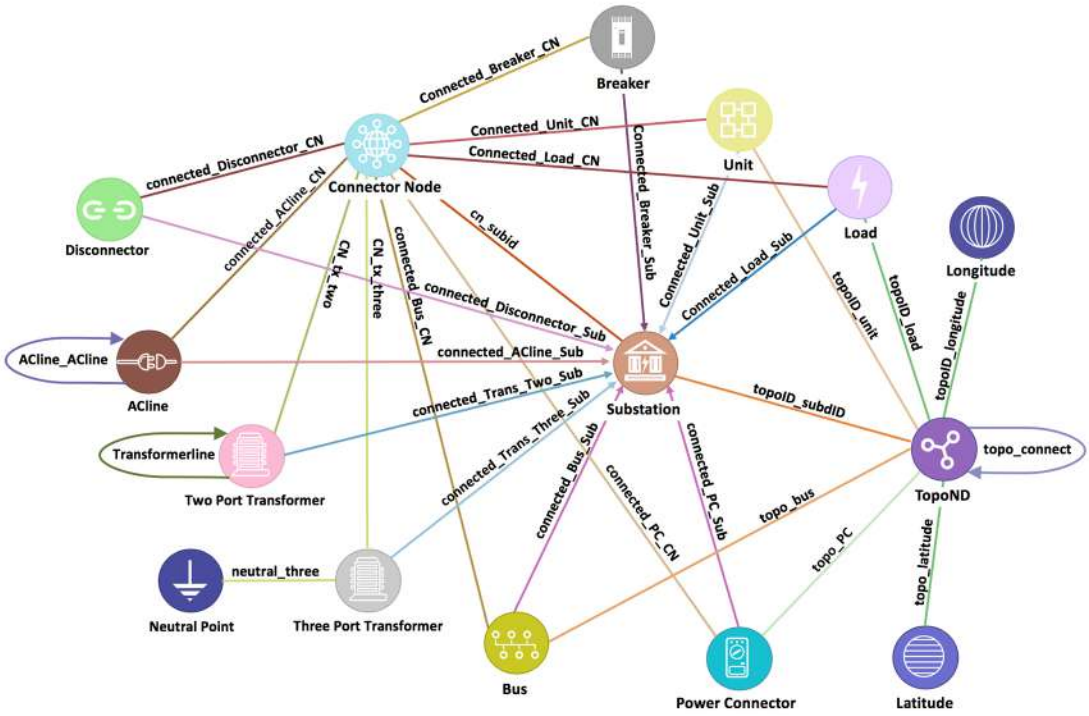
Global Energy Interconnection Research Institute North America (GEIRI North America or GEIRINA), acts as a collaboration platform for the State Grid of China. GEIRINA works with universities, research institutes, laboratories, firms and local startups to jointly discover solutions for complex problems and challenges the electric power industry faces.

GEIRINA has teamed up with TigerGraph to build the next generation energy management solution.

THE CHALLENGE

Creating a faster-than-real-time Energy Management System (EMS) has been the holy grail for the power industry. Such a system must be able to identify mismatches between power demand and supply, lower power consumption for non-critical parts of the grid, divert power to higher priority areas for industrial output and national security, and be able to accomplish all of this in a few seconds.

A faster-than-real time EMS must be capable of completing execution within a Supervisory Control and Data Acquisition (SCADA) sample cycle, typically 5 seconds. The Team at GEIRINA set out to achieve the seemingly impossible task that has eluded power system engineers for the past decade.



Using TigerGraph's graph database and computing platform, GEIRINA has achieved a faster-than-real-time Energy Management System.

THE SOLUTION

Power system engineers have investigated multiple parallel computing approaches based on the relational database structure to improve the EMS application computing efficiency, but until now have been unable to achieve a faster-than-real-time EMS.

Conventionally, power systems are modeled using relational databases in a collection of interlinked tables. As different components of power systems are stored in separate tables, they need to be linked together using shared key values to model the connectivity and topology of the power system. Connecting or linking across separate tables (database joins) typically takes about 25% of the processing time for power flow calculation and 35% for power grid state estimation.

The standard approach for solving large-scale linear equations for power management requires bulky, time-intensive matrix operations. Modeling a power system as a graph (instead of a matrix) represents connections and topology more naturally. **No data preparation is needed, cutting 25-35% of the generally required time for power flow calculation and state estimation.**

Bus ordering and admittance graph formation are performed with all graph nodes processing in parallel. Core calculations are all conducted on graph, and solved values are stored as attributes of vertices and edges of the graph - rather than unknown variables in the vector or matrix. Using TigerGraph, solved values are stored as attributes of vertices and edges on a graph - forgoing the need for a mapping process. **Output visualization takes about 70% of total time for power flow calculation, and 28% for state estimation when using the conventional approach. Using TigerGraph's graph database and graph computing, that portion of the time is eliminated.**

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THE RESULTS

The massively-parallel graph-based solution, providing a faster-than-real-time EMS, was deployed in one province's actual power bus system. The table below compares its performance to that of D5000, the widely used commercial EMS covering most control centers in China and many other countries.

Test System	State Estimation	Power Flow	Contingency Analysis	Total Time
Commercial EMS	4488 ms	3817 ms	18000 ms	26.3s
TigerGraph Based EMS Prototype	172 ms	79 ms	772 ms	1.02s

The total execution time of the three major EMS applications - State Estimation, Power Flow, and Contingency Analysis - is a little above 1 second combined, which is much less than the SCADA sample cycle standard of 5 seconds. **With the help of TigerGraph, the team at GEIRINA has achieved the first viable faster-than-real-time EMS solution for commercial use.**

CUSTOMER QUOTES

"TigerGraph's speed, scalability and graph model have enabled many applications for us that we previously thought were overly challenging."

- Jack Xie, Head of Data at Wish.com

"We chose TigerGraph for three reasons: its realtime high performance computational power, its scalability to process large graphs and its flexible and powerful SDK which enables my teams to develop vertical applications quickly and efficiently."

- Guangyi Liu, PhD, CTO of GEIRI North America, State Grid Corporation China

CUSTOMERS AND USE CASES

TigerGraph's real-time analytics on giant graphs is the engine behind fraud prevention at the world's largest e-commerce provider, recommendations at the world's largest mobile e-commerce company, and network management at the world's largest electric grid company.

ANTI-FRAUD & MONEY LAUNDERING:

TigerGraph's deep link analytics and big graph capabilities uncovers hard-to-find patterns and connections. Financial crimes teams can investigate specific transactions, high-risk customers or counterparty relationships using a graph modeling approach, in real-time.

MASSIVE-SCALE TRANSACTION PROCESSING:

One of the world's largest e-payment companies uses TigerGraph to handle a graph with 100B+ vertices and 2B+ real-time updates/day. 20-node cluster, 2+ years in production, full ACID.

SUPPLY CHAIN INTELLIGENCE:

Provides real-time visibility and analytics into key supply chain operations including order management, shipment status and other logistics.

CUSTOMER INTELLIGENCE:

Empowers organizations to quickly deploy powerful relationship analysis capabilities. Real-time capabilities allow retailers to quickly synthesize and make sense of customer behavior and activities, smartly clustering products and making real-time, personalized recommendations.

SMART GRID:

Working closely with leading energy and utility companies, TigerGraph has pioneered Native Parallel Graph approaches that help companies monitor and analyze power flows, detect bottlenecks, and alert personnel about grid performance issues.

About TigerGraph

TigerGraph is the world's fastest graph analytics platform designed to unleash the power of interconnected data for deeper insights and better outcomes. TigerGraph fulfills the true promise and benefits of the graph platform by tackling the toughest data challenges in real time, no matter how large or complex the dataset. TigerGraph supports applications such as IoT, AI and machine learning to make sense of ever-changing big data. For more information, follow the company on Twitter @TigerGraphDB or visit www.tigergraph.com.

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