Exploring the
future of computing
where analytics and
knowledge generation
are performed at the
source of the data.

Edge Computing

Edge Computing is pushing the frontier of computing applications, data, and services away from centralized nodes to the logical extremes of a network. It enables analytics and knowledge generation to occur *at the source of the data*. This approach requires leveraging resources that may not be continuously connected to a network such as laptops, smartphones, tablets and sensors.

Edge Computing covers a wide range of technologies including wireless sensor networks, mobile data acquisition, mobile signature analysis, cooperative distributed peer-to-peer ad hoc networking and processing known as Local Cloud/Fog Computing and Grid/Mesh Computing, distributed data storage and retrieval, autonomic self-healing networks, virtual cloudlets, remote cloud services, augmented reality, and more.
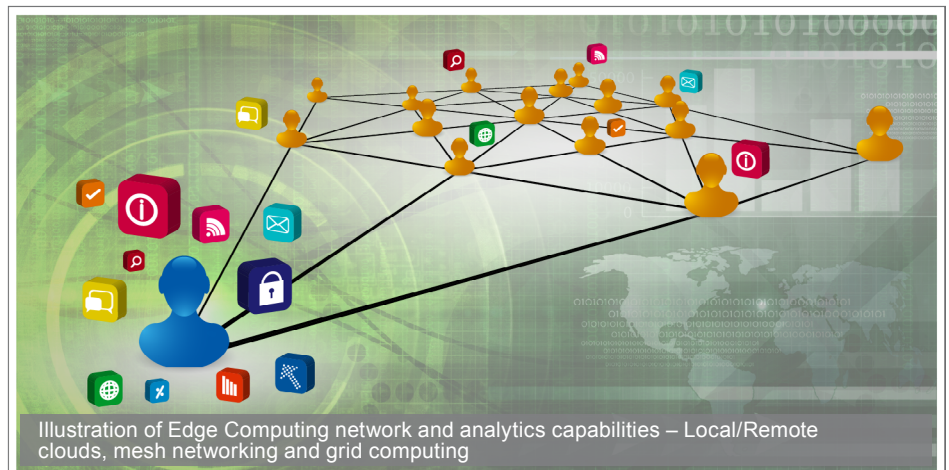
WHY EDGE COMPUTING?

Edge Computing represents the future of computing. In 2011, vendors shipped more smartphones than PCs for the first time in history. It is predicted that mobile devices soon will become the dominant computing platform worldwide. Today's mobile devices are computationally equivalent to laptops from only a few years ago, while combining excellent battery life, storage capacity, networking, and a multitude of internal and external sensors in a single platform.

As our clients continue to look for more in-depth decision support, PNNL researchers need to develop more innovative solutions to meet those analytic needs. The growth of technology has been away from the standard computing model and increasing numbers of PNNL clients are looking to drastically different solutions to meet their needs. For example, the US Army Joint Battle Command-Platform has declared its official Mobile/Handheld Computing Environment platform to be Google Android.

The expertise is present at PNNL to meet those needs, and those capabilities are distributed across a wide customer base. The proposed Center for Edge Computing (CEC) and the broader aims of Edge Computing research seek to bring together researchers to develop creative approaches for tackling current and future client needs.

Major clients are already moving to mobile platforms for all of their future critical analytics and support needs. Clients from a number of areas have expressed interest in pushing their analytic capabilities out to an Edge Computing solution (mobile, local clouds, distributed storage). Ultimately, PNNL researchers need to be able to adapt to those changes, and provide the services, technology, and software necessary to support the dynamic analytic environment faced by PNNL clients. Edge Computing allows researchers to provide users in the field powerful, real-time analytics without constraining users to cumbersome power, weight, or mobile restrictions.

Illustration of Edge Computing network and analytics capabilities – Local/Remote clouds, mesh networking and grid computing

EDGE COMPUTING AIMS TO ADDRESS THREE MAIN AREAS

Consolidation of capabilities

Consolidation of capabilities will be accomplished through the establishment of a CEC at PNNL. The CEC will focus on Edge Computing research, development and promotion that will give both internal researchers and external clients a centralized location for talent, software, hardware, and publication opportunities.

Research area leadership

The CEC will work to provide research area leadership by working closely with DOE, academia, industry, intelligence and defense agencies to develop customer-driven research solutions to "on the ground" challenges. An important component to the success of this leadership is to provide essential training to the next generation of Edge Computing experts.

Facilitation of internal and external collaboration

It is vitally important that Edge Computing research is enabled through the facilitation of internal and external collaboration. The CEC will support an externally facing website, intended to be the central location for external public relations, whitepapers, and testimonials and an internally facing website, intended to be the central location for internal research collaboration, technical library, concept papers, and proposals.

A multitude of researchers all over the world are tackling a variety of Edge Computing problems. PNNL does not plan to re-invent the research that's already been completed in this domain. Rather, PNNL is in a unique position with its diversity of clients and deep understanding of its clients' problems and how to both apply existing tools and techniques and invent new solutions to solve these problems.

PNNL has developed a number of close collaborations with both industry and academia that are researching these problems. By applying basic research being conducted by both research partners and the community at large, PNNL can help drive innovation that will meet client needs.

CURRENT CAPABILITIES

An Edge Computing reference platform named Kaval, running on the Android operating system, has been developed at PNNL to help provide Edge Computing solutions. Kaval is a common platform for clients who need the ability to collect and analyze data on a mobile device, while potentially sharing that data with others devices in the field.

The Kaval platform is a state-of-the-art peer-to-peer ad hoc wireless sensor network providing such features as mobile data acquisition and analysis, autonomic "self-healing" networking and cooperative distributed data storage, mesh networking, and analysis. Kaval also provides a common interface for sensors of all types—including imaging, audio, and radiation detectors—to acquire and perform analysis on the data. The data and analysis results can then be shared with other devices tasked with the same mission, who are either within the same geographic region (local cloud) or geographical distant (remote cloud)—agnostic of the particular type of data or analysis actually being performed. This approach allows for new sensors and analysis methods to be readily deployed—"plug-n-play"—to suit a particular client need.

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ABOUT PNNL

Interdisciplinary teams at Pacific Northwest National Laboratory address many of America's most pressing issues in energy, the environment and national security through advances in basic and applied science. PNNL employs 4,600 staff, has an annual budget of nearly $1 billion, and has been managed for the U.S. Department of Energy by Ohio-based Battelle since the laboratory's inception in 1965.

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