Research@Intel 2011
Presented by Intel Labs

Technology Zone and Demo Guide

June 2011

Computer History Museum

Mountain View, CA

Cloud Zone

Each year cloud computing, powered by massive datacenters, plays a larger role in our everyday lives. The cloud connects us through social media, provides us with new ways to shop, houses a wealth data, and provides the backend horsepower for many mobile apps. See examples of how Intel researchers are working to make cloud computers and networks more automated, flexible, and efficient as well as take better advantage of the clients they serve. Make sure to also visit the Energy and Security zones to see more related research.

Perceptive Edge Zone

Intelligent sensors may one day provide the ability to create an unobstructed path to cloud computing.   Research indicates that when low power Wi-Fi radios with embedded processors are connected directly to the cloud, data moves faster, the sensor system is more reliable and the cost of ownership may be lowered.   The Perceptive Edge Zone will introduce various environments in which these intelligent sensor technologies have been tested.   Researchers will provide examples on ways to analyze the use of everyday objects in homes, clinics, and outdoor settings.

Personal Energy Zone

The Personal Energy Zone showcases research into the future to control and reduce energy consumption by empowering the individual or organization with tools and information needed to make intelligent energy choices and by developing infrastructure components to help integrate systems to achieve greater energy improvements.   In this zone you will see how Intel is making energy personal and extending research to address energy challenges on a global scale.

Platform Innovations Zone

Intel processors and technologies form the basis of platforms that span the computing continuum, from mobile and embedded devices to high-performance workstations and servers. This zone features platform innovations in extreme scale systems, clever techniques to reduce platform power consumption across the continuum and operate at lower supply voltages and innovations in radios – a critical component of efficient SoC designs.

Security Zone

As sophistication and number of cyber-attacks continue to rise, fast, proactive and effective security countermeasures are needed. These countermeasures must provide balance of security and computing experience.   In the security zone, you will experience technologies that aim at improving both user experience and security. You will see innovative approaches for accelerating cryptography while reducing computing overhead. You will experience authentication of the future where   a user's authentication security and experience online is enhanced.

User Experience Zone

The User Experience Zone showcases research projects that aim to make technology easier to use and more helpful to people, and create richer, more intuitive technology experiences that users will love.   In this zone we showcase environments such as the classroom, the home and the car, and the benefits that these new experiences will deliver to people in the future.

Visual Zone

In this zone you can see how Intel is adding a "visual" aspect to the daily life of the future with minimal costs and eco system changes. Research technologies developed at Intel and with our university partners will improve daily user experiences ranging from shopping in a mall to the viewing experience of digital content on consumer electronic devices. In this zone, we also take virtual environments to the next level by integrating and coordinating numerous real-time technologies like emotions, 3D, gesture detection etc., resulting in more immersive user experiences.

Cloud Zone

Faster Web Apps with Data-Parallel JavaScript

In a world where the web browser is the user's window into cloud computing, browser applications must leverage all available computing resources. Data-parallel JavaScript research aims to put the computing power of multi-core client systems into the hands of web developers while staying within the secure boundaries of a familiar programming paradigm.

Cloud-based Ray Tracing on Handheld Devices

We demonstrate the capability to bring more realistic visuals to portable devices beyond what is possible today. A cloud using Intel Many Integrated Core (MIC) processors renders complex effects using ray tracing, which can then be streamed to a variety of Intel clients, including small handheld devices. See www.wolfrt.de for more information.

Many-core Applications Research Community

We highlight promising research results from some of the 80+ institutions worldwide using the Single-chip Cloud Computer (SCC). This 48-core concept processor developed at Intel Labs recently won the German Innovation Prize for Climate and the Environment for its energy-efficient architecture. We will show the SCC running applications on each core and will discuss the first technical papers from the MARC program.

Work or Play Online with a Cast of Thousands

Virtual environments have applications from gaming to disaster response training. However, today's approach typically limits each environment to running on only one server. Intel researchers have developed a new software architecture that breaks the environment into separately executable components, which, when combined with a cloud computing model, allows applications to scale user experiences far beyond existing limits.

Wireless Infrastructure on Intel Architecture

This research is to improve Intel Architecture (IA) efficiency for wireless processing, enabling wider adoption of IA in the wireless infrastructure market.   With software-based wireless processing on IA and virtualization techniques, cellular base stations are centralized and shared.   Wireless services could become more intelligent, flexible, efficient, and easier to develop.   Multiple standards such as GSM, 3G and LTE could be supported by the same base station equipment. All these greatly reduce the wireless network capital and operational costs for telecommunication operators and support better services for end users.

Silicon Photonics

As the amount of digital information grows, new interconnects will be required to move data farther and faster around billions of connected systems. Silicon Photonics research aims to enable faster data communication over longer distances. Its potential for low cost and scalability could alleviate data bottlenecks and enable new architectures in consumer electronics, data centers and high performance computers. We show our 50G Silicon Photonics link; the first end-to-end silicon photonics link with integrated lasers. The wide range of potential applications of the technology will be highlighted, from high-definition video transfer in the home to novel memory configurations to enhance server performance.

The Dependable Cloud

Intel is researching technologies to increase dependability in the automated clouds of the future. Machine-readable service level agreements can allow service levels to be personalized, automatically negotiated, aggregated, and continuously assured. This is one of several research vectors Intel Labs Europe is pursuing towards the Dependable Cloud.

Perceptive Edge Zone

Perceptive Household

Ambient sensing of daily activities may help older people live independently in the homes of their choice while easing the burden on healthcare costs.   We will demonstrate a suite of low powered Wi-Fi radio sensors that detects activities in the home such as meal preparation, social interaction and night wandering. A touch screen display presents questions to complement the system, improving accuracy.   Information communicated directly to the cloud allows external support resources to understand what is happening in older people's homes providing the best support possible.   Home trials were conducted indicating the effectiveness of the technology and ease of use.

Perceptive Environment

With low power Wi-Fi we can now connect sensors directly to the cloud using inexpensive and off the shelf technology. This enables large scale processing for enormous mixed sensor arrays in extreme and geographically diverse environments. Research trials are underway sensing structural movement of offshore oil-rigs and weather conditions in seaports. Goals include the ability to connect from remote locations, reliability, low cost and scalability.   This demo shows individual environmental sensors and explains how the cloud can bring thousands of them together to show a bigger picture.

Living Lab for Aging in Place Technologies

The well-documented aging of the population world-wide represents a daunting challenge to our society and points to an undeniable need to reshape our models of care before the demand overwhelms its capacity and resources to deliver. In response to this challenge, Intel helped establish the Oregon Center for Aging and Technology (ORCATECH) in 2004 and is extensively using the unique asset of its Living Laboratory to discover, study, and answer critical aging questions. The ORCATECH Living Laboratory is a population of community-dwelling seniors participating in ongoing technology-based health monitoring, interventions, and support of independent living. In this demo, we will characterize the "day in the life" of typical Living Laboratory, demonstrate the wide variety of sensor technologies installed in their homes, and describe how these data are being used to accelerate the innovation of new technologies, solutions, and models of health and eldercare.

Body Worn Sensors Applied to Gait Analysis

In the health domain, there has been growing interest in the use of body worn technologies to enable protocol innovation for applications such as Gait Analysis. Current technologies are based on pressure sensitivity floor sensors or camera/optical marker systems which are expensive, immobile and require specialized facilities. This demonstration presents a body worn sensor system approach to real time gait analysis using SHIMMER® body worn kinematic sensors to capture the temporal and spatial parameters of gait. This data is streamed wirelessly in real-time via Bluetooth to a BioMOBIUS™ software application for processing and displayed.

Intelligent Advertising Framework

We implemented an Intelligent Advertising Framework (IAF) that integrates Anonymous Video Analytics (AVA) and data mining technologies to achieve targeted and interactive Advertising. It relates AVA viewership information with point-of-sale (POS) data and learns advertising models. Using these models, IAF is able to intelligently identify and show the most appropriate advertisement to the audience in real time. The audience can also interact and easily find interesting ad content based on IAF recommendations.   IAF will help to improve the effect and utility of advertising and maximize the ROI of advertisers and retailers.

Personal Energy Zone

Clouds, DC & Grids

Clouds above wreak havoc with Photovoltaic (PV) energy production; the Grid is limited to 20-30% from variable sources. At the same time, cloud data centers are the fastest growing application of data centers, with data centers comprising more than two percent of US electrical demand. What if you could mitigate PV variability, have more usable energy, make data centers more efficient, and get extra revenue too? This research shows utility-scale variable generation connected to a Cloud Data Center with a DC microgrid. It creates more usable energy, reduces variability, is more efficient, and provides Demand-Response payments.

Emerging Market Microgrids

Power crisis in emerging markets (BRIC, Africa) is leading to the rapid development of distributed energy resources or microgrids. Intel Labs is working on low-cost sustainable microgrid technologies to bring power to millions of off-grid consumers in developing countries. We showcase two low-cost green power generation technologies: One, a novel low-cost biomechanical energy generator using a bike to generate electricity and second, an innovative low-cost direct methanol fuel cell.

Renewable Data Communications

The current terrestrial internet services one third of the world's population and less than 5% of the planet's surface. While internet access over satellite may be an option in some circumstances it is cost prohibitive in most. As part of a European Union funded research project N4C, Intel Labs Europe developed and deployed a trial solar powered delay and disruption tolerant network to remote communities in northern Sweden enabling internet like services for the distribution of educational content, communications, environmental monitoring etc.

Sustaining Legacy Data Centers

The ever increasing digitalization of modern life, coupled with legacy inefficiencies, has seen data centers become the fastest growing contributor to the ICT carbon footprint. Intel is focused on addressing these trends by delivering more while consuming less. However, often within legacy data centers, the issue is not a lack of technological options but rather a problem in deciding what choices will have the greatest impact. The demo introduces an improvement methodology which complements a sustainable ethos. The methodology was used to integrate existing techniques and technologies within one data center resulting in significant energy savings.

Making Energy Personal

The Intel Labs Wireless Energy Sensing Technology (WEST) is an easy-to-use plug-in device that monitors the energy usage of electrical devices in the home. Once plugged in, it establishes a secure wireless link to a home network to allow convenient access to the energy data from a laptop, smartphone or television. WEST recognizes the unique signatures of major electrical devices and by utilizing this information can provide a detailed energy consumption profile to the user. This demonstration showcases the prototype sensor devices, easy setup, load recognition and a glimpse of our current in-home trials.

Eco-Sense Buildings: Reimagined IT

The Eco-Sense Buildings project redefines the role of IT to maximize energy efficiency of buildings, while improving comfort and safety of their occupants. It does so by adding pervasive sensing of ambient conditions, energy, and people and using that input to drive coordinated power behaviors of building control systems, including office IT equipment as a collection, pluggable loads, lighting, heating and cooling. We are working with eco-system partners worldwide towards meeting the most aggressive energy target, net-positive energy buildings. The demo includes ambient and energy sensors (hardware and software), distributed sensor database, and visualization via end-user eco-feedback application, POEM, with innovative UI.

Platform Innovations Zone

A 550GOPS/W Near-Threshold Voltage Register File

One of the best ways to reduce power and improve energy-efficiency in microprocessors is to lower the supply voltage. Register files are performance-critical memories within microprocessors and are key limiters to voltage scalability. This demo presents a novel register file technology capable of scaling to ultra-low power supply voltages, while tolerating process parameter variations. The design is fabricated in a 32nm high-K/Metal-gate CMOS technology and silicon measurements demonstrate near-threshold voltage operation down to 340mV with an industry-leading peak energy-efficiency of 550GOPS/W. Silicon data also demonstrates wide dynamic operating voltage range scalable up to 1.0V with peak throughput of 8.3GHz.

Automatic Device Driver Synthesis

A device driver is the part of the operating system (OS) that is responsible for controlling an input/output (I/O) device. Currently, drivers are a primary source of bugs and driver development is a major bottleneck for platform validation and time-to-market. Jointly with NICTA, we propose to improve the driver development process by automatically synthesizing drivers from formal OS and device specifications. This approach improves driver reliability by reducing manual intervention, avoiding misinterpretation of device documents by driver writers. Moreover, given a device specification, drivers can be generated automatically for all supported OS, thereby eliminating the costs associated with porting drivers.

Variation Aware Dynamic Adaptation - V-ADAPT

The relentless pursuit of Moore's Law has enabled the era of many-core processors, but device scaling has led to greater on-die variability which results in increased frequency and leakage variations amongst identical cores on the same die. Our proposed Variation Aware Dynamic Adaptation (V-ADAPT) technology exploits these variations and enables higher performance in the same power envelope or increased energy efficiency for a given performance. This demonstration will show the benefits of V-ADAPT on Intel Lab's Single Chip Cloud Computer running industry standard benchmarks.

Extreme-Scale System Software

Extrapolation of supercomputing trends from tera- and peta-scale to exa-scale (a million trillion operations/sec) highlights the challenges of current technology for programming complexity, energy efficiency, and overall performance.   "Runnemede" is an Intel Labs project funded in part by DARPA and executed with academic and industrial partners. Our research is exploring fine-grained event-driven execution models to exploit very-high-core-count systems. Using introspective observation and adaptation, our system dynamically schedules tiny "codelets" to cores according to control and data dependencies. The result is extreme-scale performance with low power consumption and high reliability.

QoS & Heterogeneous Systems

As core counts continue to rise to provide additional platform performance, both shared platform resources and fixed power envelopes begin to limit scaling. This series of demonstrations examines potential methods to expand platform scaling beyond traditional barriers, including mechanisms related to shared execution resources and forward-looking heterogeneous and adaptable architectures.

32nm RF Transceiver

Demonstrates the world's first RF enabled 32nm process that will enable the integration of an applications processor with a WiFi radio that includes major RF components like the power amplifier, low noise amplifier and RF switch. The co-optimization of circuit design and process advancements for high performance wireless components integrated on SOCs will manage complexity, power, and costs.

Security Zone

Authentication of the Future

Today's user authentication mechanisms have inherent weaknesses that can lead to online fraud. According to a recent report, 73% of people reuse their passwords and share them across sensitive web sites such as banks and other non-sensitive web sites. Online service providers rely on various infrastructure protections as they are unable to trust the client to behave and execute correctly. This demo shows how a trusted client is able to use advanced authentication and user presence techniques to locally authenticate the user and then assert the user's identity to a remote service provider, improving both the security and user experience.

Unleashing the Potential of Intel® Processor Graphics

Due to the increasing number and sophistication of cyber attacks, the need for fast and effective security countermeasures has increased significantly. The availability of on-die processor graphics in the 2nd Generation Intel® Core™ processors increases the total computational capabilities of Intel platforms. In this research, we show how the Intel® processor graphics engine can be used to accelerate crypto operations such as RSA and TLS (Transport Layer Security). We present best-in-class results for RSA and TLS, allowing Intel platforms to be used in a cost and power efficient manner.

Intel Science and Technology Center for Secure Computing

Earlier this year, Intel announced a $100 million investment in academic research to launch a series of Intel Science and Technology Centers (ISTCs) at major U.S. universities. The ISTC for Secure Computing, announced today, will be centered at U.C. Berkeley and will drive collaborative research with Intel and four other leading universities. Learn more about the ISTC program and how this new center will work to protect our digital information for years to come.

User Experience Zone

Personal Smart Spaces

A fundamental component of pervasive computing is the efficient management and use of context information. In this demo we will showcase PERSIST, a smart space middleware framework developed by Intel Labs Europe that improves management and use of context information. PERSIST's context model was designed to support personal smart spaces and manage context across all the personal devices of a user. The context engine can derive high-level context information based on the raw sensor data and/or context history of all personal devices. In addition, it has a "user intent" system that discovers and manages models of user behavior. While a user preference normally specifies one action to perform when a context situation is met, PERSIST's user intent system specifies sequences of actions to perform based on past and current user behavior. The demo will showcase this technology as an information and visualization tool for disaster relief workers, a navigation system that learns user behavior based on previous events suggesting re-routes, and a personalized smart workspace for intelligent conference/meeting management.

Steerable Sound

This demo showcases spherical loudspeakers that not only give best-in-class sound reproduction, but also dynamic, steerable sound analogous to traditional acoustic musical instruments. This sound quality is made possible by the spherical nature of the speakers plus the signal processing enabled by parallel processing. A range of applications will be demonstrated including interactive sound installations, musical uses, and those involving room acoustic measurements.

Automatic Classroom Collaboration

This demo shows how students can form collaborative groups automatically using Intel's Classmate PCs. Today, teachers create student groups manually. Our Proximity Detection technology finds classmate PCs near a student and helps to form a group automatically with students who are in the vicinity. With a click of a button students can form groups, start collaborating on a project, take a quiz together, or compete with each other. In addition, a student can automatically form a group with a teacher if he needs help.

Smart Vehicle Research: Car, Cloud and Phone Working Together

See new user experiences for Internet-connected cars and the benefits of combining Intel in-car platforms, cloud-based services, and smart phones. Observe an innovative one-touch pairing technique using NFC touch or barcode to securely pair and provision a previously unpaired smart phone with a car and cloud services. Once paired, the phone's application provides the user a virtual key fob, remote video surveillance, car alarm notification, and other compelling capabilities. A lab-bench version of the demo can be seen in the Technology Showcase, and integration into a real car is demonstrated outside the Museum.

Me, Us, Here, Now

Facebook, Twitter and mobile phones are arguably as influential psychological tools as any form of psychotherapy. They allow unprecedented connection and expression. But developers have barely begun to explore how these platforms can meaningfully support wellbeing. In this demo, we share ethnographic research and several novel applications that apply psychological principles for personal awareness and change. The applications are "Affect Check" for Twitter (a dynamic Facebook visualization of "social capital" to help people stick to resolutions), and an iPhone app that displays moods as a function of time and place. These apps illustrate possibilities for more emotionally and socially intelligent computing.

Private Video Conferencing

This demo of a "workspace of the future" shows an always-on video conference application. The application uses a RGB+Z (depth camera) for gaze detection. In this application, the video stream is highly blurred until gaze is detected. With attention on the video conference monitor, the full resolution image is then shown on the remote end. When both parties are detected to be gazing at the video conference monitors, the audio portion of the conference is then transmitted. The application does not require calibration, uses industry standard transport and is intended to be device and OS independent.

Visual Computing Zone

High-End Visualization on Mobile Devices

We revisited a traditional volume rendering technique to provide excellent realism on platforms with high end CPUs and integrated graphics. We demonstrate a mobile device using our advanced volume rendering technique to display streamed data. Such a use could enable visualization on the new era of mobile devices and hence new usage scenarios. For example, end users in the medical field can now use their smartphones to view tomography data in an operating theater.

Transparent 3D Internet

Today, the Web is lacking non-proprietary mechanisms to model dynamic 3D scenes, render them in standard browsers and to interact with the content. In this demonstration we added extensions to Firefox and Chromium to arbitrarily modify 3D scenes described by the XML3D HTML extension without the need to retransmit the scene itself. With this technology users can immerse themselves in a fully interactive 3D Web on any browser platform.

High-Fidelity Planet Viewer

Rendering planetary scale objects is challenging due to geometric complexity and the need for managing huge amounts of data (terabytes or higher). We are showing how our application can enable real-time graphics rendering on the fly without having to purchase additional expensive hardware. Currently, much work in this field focuses on exploiting costly high-end discrete graphics hardware. But Intel developed a novel, full-scale planetary rendering solution that delivers realistic visuals on a less costly solution using a 2nd Generation Intel Core processor.

Technologies for Immersive Virtual Environments

Immersive virtual environments require integration and coordination of numerous real-time technologies including human-recognition (face, emotion, and gesture detection), 3D (capture, model generation, rendering), virtual-physical reality integration, real-time networking, sensor and data-flow management. Intel Labs is funding research at the University of Illinois on an integrated framework of such components to support development and evolution of immersive applications. This demonstration will showcase standalone and integrated components of the framework based on recent research including: robust 3D non-rigid face tracking for hands-free gaming and 3D human tracking for game and avatar control.

Improved Perception of Digital Content

This is the first ever demonstration of temporal up-sampling for 3D scenes that has traditionally been used in consumer devices for 2D video only. Here, we use temporal up-sampling with specially computed intermediate images to significantly improve visual user experience of 3D scenes and for perceptual enhancements on moving 2D images on modern TV sets with high refresh rate. When combining the computing power of Intel processors with the high-refresh displays that are quickly becoming mainstream, far better perceptual quality in daily used applications can be achieved.

Magic Mirror

The Magic Mirror project aims to provide a new shopping experience which provides a realistic avatar of the consumer dressed in the latest fashions. This demo shows our research in body tracking and our parametric human body model. We will show a 3D avatar that tracks your movements in real time. You will be able change the dimensions of the body using gestures.

Research within Intel's Academic Centers

Intel launched the Intel Science and Technology Center (ISTC) program to establish collaborative research centers within academia to drive the state of the art in specific technical areas. The first of these Centers, The Intel Science and Technology Center for Visual Computing (ISTC-VC) was launched as a complement to the Intel Visual Computing Institute that was launched at Saarland University in Germany. Together, these Centers engage 50+ researchers and 80 graduate students to pursue a broad research portfolio. Besides providing ISTC program overview we will present examples of this research and the impact it will have in the future.

Photo-Realistic Rendering

We present an interactive Monte Carlo ray tracing engine. It generates photo-realistic images of complex models within seconds, and it is capable of displaying previews in real-time. This technology is used for virtual prototyping, architectural visualization, movie production, online car configurators and many other applications. Our highly-optimized implementation on Intel Architecture allows people to generate photo-realistic images of virtual objects faster than previously possible.

Lobby

Platform Innovations

User Experience

Security

Visual Computing

Personal Energy

Perceptive Edge

Briefing Room 2

Briefing Room 1

Cloud