News Fact Sheet

Innovation Front and Center at Research at Intel Event 2013

June 25, 2013 — For over two decades, researchers at Intel Corporation's R&D Labs have produced groundbreaking technologies that enrich everyday life and reinvent the ways that people experience computing.

Under Justin Rattner's leadership as chief technology officer at Intel, Intel Labs has established a comprehensive network of collaborative research centers worldwide that bring the resources of Intel, academia and governments together to work toward fundamental breakthroughs in some of the most difficult and vexing areas of computing technology.

This year's Research@Intel Event will showcase the latest, most innovative research conducted by Intel Labs researchers, as well as Intel's collaborations with academic institutions around the world. Twenty innovative research demonstrations will be presented at this year's event, including technologies aimed to enrich lives, create smarter cities, homes and offices, and revolutionize the way people shop, communicate and drive. Below are brief summaries of each demo.

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Enriching Lives

Be Meaningful   *Stores that help you shop*

How many times have you looked for a product at a store, only to get flustered by one too many sizes, options and features? Shelf-Edge Technology (SET) from Intel Labs can detect your presence with sensors as you walk through a store to help you find what you want, and avoid what you don't. If you're cooking salmon for dinner, SET can recommend the best wine to pair based on your preferences. In terms of your personal health, SET can also warn you to avoid foods that could cause an allergic reaction.

Be Expressive   *Pictures worth a million words*

The future of displays will enable new ways for you to engage and express yourself through immersive experiences that go far beyond pictures. When images contain metadata about the

moment, our pictures can tell a richer story. A photo might play sound from the moment in time the photo was taken, provide the ability to zoom in on a detail, or pan to a different angle. Applying data derived from a given moment allows us to share an actual experience that's worth more than a thousand words.

Be Free   *Lighten the load*

Have you wished your phone touch display could scale based on the apps you're using or sharing so it's easier to view? Have you wished you didn't have to bring your laptop on vacation, but did anyway in case you needed it? Imagine the ability to display and interact on any surface with any device. You will no longer have to worry about which applications, devices and displays to bring … you will have access to all of them.

Be Understood   *Designating drivers with science*

Intel Labs is exploring ways to reduce the threats of distracted driving. Evolving technologies and methods may allow us to assess and alert a driver in a questionable state *before* they cause an accident. Technologies are being developed that can track where a driver is looking and measure brain activity characteristics and oxygen levels related to the ability to drive safely. Intel Labs, with university collaborators, is conducting research spanning neuroscience and cognitive engineering, continuing its work on the user experience in transportation.

Intelligent Everything

Connected Vehicle Safety   *Cars that look out for each other*

With a little warning, many traffic accidents can be avoided altogether. Enabling cars and scooters to communicate and work together may be the first step to avoid collisions and other incidents. To do this, fast and reliable communication amongst vehicles is critical, even on crowded city streets. Intel Labs, through the Intel Collaborative Research Institute for Connected Context Computing, is exploring visible light from tail lights to support high-speed data transmission over the short distances between vehicles. The technology uses direct modulation of LED tail lights to encode data in the visible spectrum, while maintaining a constant ambient lighting state. At almost no extra cost, the technology could save lives by giving vehicles the power to talk to each other.

Smart Homes   *Home is where the app is*

Our homes have more and more connected devices -- PCs, phones, TVs, entertainment systems, cameras and lights to name a few. And, in the future, they may all behave just the way we like, programmed to our family preferences and regular activities, such as knowing when the kids enter the front door after school, or the dog needs to be walked. Intel Labs is developing a graphical user interface with reusable modules that lets people coordinate devices with sensors and other cues that occur in the home. The new model for programming a home will help anyone use devices and coordinate patterns and sensor analysis to make a smarter home behave just the way they want.

Enhanced Collaboration *Connecting the dots for us*

For truly productive collaboration, we need to stay connected to, and updated by, our primary work device without being disrupted. Intel Labs is working on smart environments and sensors that people can set and forget. An eBadge is a secure wearable device that carries personal information identifying and authenticating the wearer, and also harvests energy to sustain itself. The eBadge can also team up with a smart phone to display useful information like your calendar, reminders or text messages.

The Internet of Displays from the Intel Visual Computing Institute (a collaboration between Intel Labs, and U.S. and German universities) eliminates the need for physical cables when you want to display video content. Whether it's for home entertainment, retail environments or global projects, Intel Labs research allows all connected devices to display the same content, connect any number of devices to any number of displays, and locate them anywhere, without the need for long cables.

Sustainable Connected Cities *Better city living through data*

With over 50 percent of the world's population living in cities[i], and the United Nations projecting that number to rise to 70 percent by 2050[ii], developing infrastructure to adapt and respond to that growth is critical. The livability and prosperity of our future cities will depend on it. Intel Labs demonstrates how smart infrastructure can capture, manage, fuse and analyze data about a city to help make it more livable.

The Intel Collaborative Research Institute in London is developing fixed and mobile sensors to harness real-time user and city infrastructure data to provide practical solutions to problems ranging from droughts and long commute times to wasteful use of energy. A sensor network could be used to monitor traffic flows and predict the effects of extreme weather conditions on water supplies, resulting in the delivery of near real-time information to citizens through citywide displays and mobile applications.

The Data Society

Discovering Relationships *Connecting data rapidly, not exactly*

The next phase of big data lies in exploring relationships among vast and diverse datasets. Intel Labs and university collaborators have developed tools that reveal surprising connections between people, things, or events leading actionable intelligence for work and personal use.

In one example, software developed by Intel (Graph Builder), the Intel Science and Technology Center for Cloud Computing at CMU (GraphLab), and an Intel strategic research alliance, is used to discover interesting connections between any two Wikipedia entries, even while those entries are being edited. The predictive analytics tool rapidly finds the correlation between two elements within a few degrees of separation. Another example, is the collaboration with the Intel Science and Technology Center for big data, showing how "approximate" analysis techniques

can rapidly poll the full text of hundreds of millions of recent tweets, and find those most related, from anywhere in the world. Such approximate analytics match at a 90 percent rate, while accomplishing the task 10 times faster than traditional analysis.

Vibrant Data Communities   *Data by the people, for the people*

Intel Labs envisions a new "data economy" in which personal and public data are exchanged to work for you. In a world beyond apps, you will download vibrant data agents that actively exchange and analyze data to connect you to the people and resources you need most. Tired of resorting to gift cards for co-workers? By applying context-aware algorithms to shared personal data, vibrant data could help a group of colleagues share their available data, which would then be coordinated to pick just the right present. Worried about an allergy attack during your morning jog? Using air quality sensors deployed around you neighborhood, shared vibrant data could help you steer clear of pollen hotspots in real time.

Visualizing Big Data   *See the really big pictures, faster*

Viewing incredibly detailed images such as medical scans, relief maps or scientific simulations helps experts discover hidden insights and solve real-world problems. But the time it takes to render them, especially on mobile devices, can be prohibitively slow. Intel Labs demonstrates technologies from the Intel Visual Computing Institute that use hybrid client/cloud processing to render massive images on devices ranging from smartphones, to a multi-screen display wall. The hybrid solution of different rendering systems makes it possible -- and more affordable -- for groups of people to evaluate critical visual data such as NASA images of the planet, 3-D volumetric CT scans and even a 4-yottabyte fractal image (equivalent to 4 trillion trillion bytes of data).

Privacy and Big Data   *Identification not required*

Removing sensitive information from a set of records is known as anonymization or de-identification. A capability that will only grow in importance, anonymization makes it possible to reap the benefits of cloud computing and big data without worrying about who might see personal information. In the enterprise environment, data privacy is an equally important and unique issue to manage. Intel Labs demonstrates how enterprise data can be anonymized and analyzed effectively while delivering an even better end user experience.

<u>Tech Essentials</u>

Protecting Sensor Data   *Safe data starts here*

Sensors such as cameras, microphones and position-locating solutions are being used to improve our interaction with electronic devices and the world around us. But if not protected, sensor data could also be used for malicious purposes like compromising identity, passwords and financial information. Intel Labs demonstrates a research prototype that combines Intel hardware and software to protect sensor data from different types of software-based attacks, such as API hooking, kernel based rootkits and rogue hypervisors.

Quality Video Streaming   *Fast forward with video streaming*

Intel Labs is exploring the best way to improve the video streaming experience by using MPEG Dynamic Adaptive Streaming over HTTP (DASH) protocol. By combining new techniques such as server-assisted feedback and quality-driven rate adaptation, the Intel team can stream higher quality video with fewer playback stalls or bitrate saving distortion. This demonstration presents end-to-end DASH streaming solutions in which the streaming servers and the streaming clients are sharing streaming statistics. With the help of a new component, the DASH manager, a high-quality, robust and smart video streaming solution is achieved.

Scalable Energy Efficient I/O   *More performance, less power*

High-performance computing for servers and datacenters demands aggressive chip-to-chip I/O performance. As I/O performance increases, so does its demand for power, resulting in lower power efficiency. Intel Labs demonstrates a dense 64-lane per-port I/O system that is remarkably scalable while still sipping power. And, the system is still able to deliver an aggregate bandwidth up to 5x better than existing methods. Aggressive power supply scaling from 0.6 to 1.08V enables non-linear power efficiency scaling of 0.8-2.6pJ/bit as per-lane data rate scales from 2 to 16Gb/s. By adjusting the bandwidth to match the applications, additional energy savings are achieved through co-optimizing the interconnect and circuits.

Direct Compressed Execution   *Honey, I shrunk the memory again*

Wearable technologies and many other embedded solution designs, including systems-on-a-chip, can take up a fair amount of "real estate" on the processors that drive them. While Intel's X86 ISA is known to have good "native" density, with compiled binaries sizes among the smallest for commercial CPUs, the future will need the powerful processors that require even less real estate. Intel Labs demonstrates technology improving this even further, allowing considerable code memory footprint reduction at fixed cost for many embedded and mobile applications.

Personal Analytics   *Devices that really know you*

Intel Labs showcases how a person can be helped by a digital assistant in both proactive and reactive ways. In both modes, back end servers deliver analytics that not only recognize the person, but are also able to infer – using machine learning algorithms -- what they may need or want based on the context of the situation and environment.

In the reactive mode, a semantic life-log database is used to provide contextual responses for user queries through a user's mobile device. Voluntary prompts through the user's device provide information of interest and reminders to the user based on the current context and life-log knowledge. For example, if the daily medication is forgotten, the technology will alert the user.

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[i] World Health Organization, *Global Health Observatory World Population Growth,* published 2013*,* access here

[ii] Food and Agriculture Organization of the United Nations, *How to Feed the World in 2050,* published 2009*,* access here