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### Bluetooth Technology

Imagine using **Bluetooth** enabled smartphones to access and control a range of services, applications and devices in close proximity to the user – everything from opening doors to paying bills to keeping tabs on a patient's health. At Rutgers University's Distributed Computing Laboratory (Disco Lab), researchers in the field of distributed embedded systems and pervasive computing are looking at innovative use cases like these, and more.

Liviu Iftode, associate professor and head of Disco Lab, began research in 2004 after receiving a \$1.5 million National Science Foundation Information Technology Research grant. His project, dubbed SMILES (SMartphones for Interacting with Local Embedded Systems), is a pioneer in ubiquitous computing research. And according to Iftode, "Bluetooth, a short-range wireless connectivity standard, has been a key feature for our ideas."

Using **Bluetooth** technology, a smartphone can become a short-range service-discovery and interaction tool. First, it locates nearby services and devices. Then, using 3G Web-based technology, the phone downloads software that lets users interact with services or devices via a wireless connection.

## Do You Compute?

*At Rutgers University's Disco Lab, researchers are working toward the day when everyone can connect with anything, anywhere, at any time – seamlessly, effortlessly and ubiquitously.*

At the core of the research is the Service Discovery, Interaction and Payment Protocol (SDIPP), which uses the **Bluetooth** Service Discovery Protocol (SDP) and other protocols.

So what can users expect? Disco Lab's developmental prototypes include a "smart door" system that allows someone with a **Bluetooth** enabled smartphone to unlock doors. Other practical applications that have been successfully tested in the Disco Lab include:

- Exchanging personal profiles with other smartphone users within range.
- Paying bills via a smartphone using electronic scrip.
- Locating people within a building using camera phones and a building-image database.


The research is promising. "We believe that pervasive computing will first materialize by extending the 'computing coverage' to smartphones and cars," Iftode explains. "With these two fields conquered, plus the home and office areas already equipped with computers, computing – along with connectivity – will be available to users anytime and anywhere."

At Disco Lab, **Bluetooth** enabled smartphones are seen as ideal for ubiquitous computing. "We believe that smartphones remain the immediate solution to building the first generation of pervasive computing applications, to create an appetite for them and, at the same time, to perform useful user studies," Iftode says. "**Bluetooth** is still an attractive choice for connecting smartphones to other smartphones, as well as other devices, to extend its capabilities."

Disco Lab's ongoing research means the SDIPP architecture is evolving to take advantage of other technologies. Researchers are developing software that will allow smartphones to apply GPS data to enhance SDIPP's capabilities within the local service area.

In one research application, GPS can provide the position of a user's car to a smartphone via **Bluetooth** technology, which could then make it available to a variety of services via 3G. The services use the information to determine where the car is relative to traffic jams, road construction and other impassable areas, then send a report back to the user. A prototype of this TrafficView system has been developed and is in testing.

In the future, Disco Lab researchers plan to use **Bluetooth** technology to compile sensor data. With ultra low power **Bluetooth** technology, sensors like those that monitor vital signs will become more commonplace, and smartphones will analyze data. When a vital sign reaches a critical state, the smartphone can alert the patient and selected health-care providers.

That's pervasive computing at its very best. 

**David Geer** is a technician turned freelance writer who covers the wireless space for publications such as IEEE Computer Magazine, Byte.com and Computerworld.