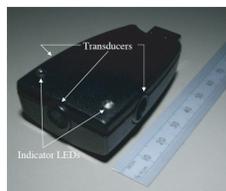




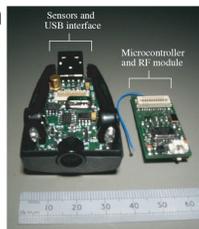
# SPATIAL SENSING TO SUPPORT INTERACTION ACROSS DEVICES

## THE RELATE DONGLES

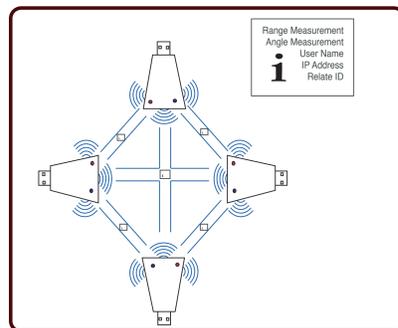


The Relate Dongles provide fine-grained relative position information to co-located devices on the basis of peer-to-peer sensing, to directly establish their spatial relationships, without need for infrastructure in their environment.

The dongles are based on wireless sensor devices implemented as USB peripherals that can be readily used to extend mobile computers with peer-to-peer sensing. The dongles are designed to perform best when the devices are positioned approximately in the same plane.



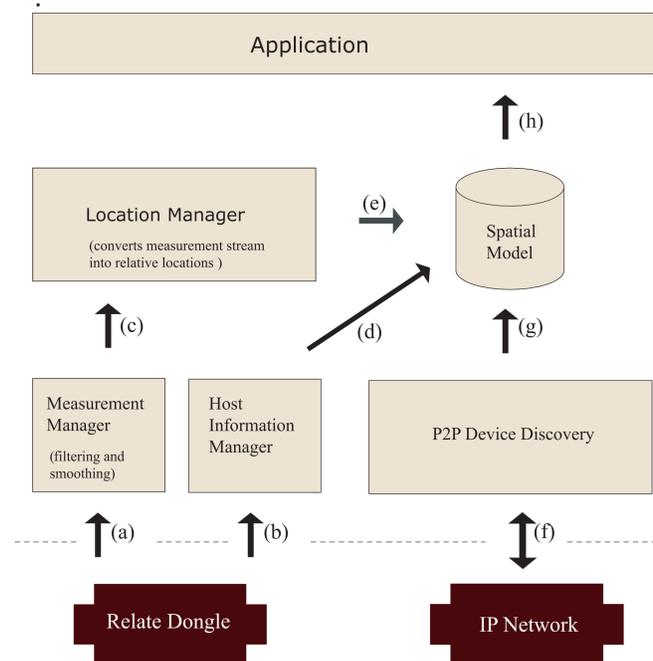
The Relate network is used to coordinate and collect range and angle-of-arrival measurements using ultrasonic signals between the dongles, and also to share information such as host and user names and IP address, when the mobile computer is connected to a network.



[Mike Hazas, Christian Kray, Hans Gellersen, Henoc Agbota, Gerd Kortuem, and Albert Krohn. "A Relative Positioning System for Co-Located Mobile Devices". 3rd International Conference on Mobile Systems, Applications, and Services (MobiSys) 2005, June 6-8, Seattle, USA.]

## THE RELATE TOOLKIT ARCHITECTURE

The range and angle-of-arrival measurements are aggregated into a spatial model of the co-located devices. This spatial information is encapsulated in a set of widgets we call the Relate toolkit, enabling the use of spatial information for different applications. For example, the device map (a Relate toolkit widget) shows an abstract representation of the co-located devices in their relative spatial arrangement.



[Gerd Kortuem, Christian Kray, Hans Gellersen. "Sensing and visualizing spatial relations of mobile devices. In Proceedings Eighteenth Annual ACM Symposium on User Interface Software and Technology (UIST 2005), Seattle, Washington, USA, 2005.]

## INTERACTION BY SPATIAL REFERENCE

We use spatial information to enable transparent interaction across spontaneously co-located devices. The Relate Dongle constantly acquires measurements, which are aggregated into the local spatial model. Any movement of the devices can be observed in the device map widget as a movement of the abstract device icon.

### DATA ACCESS

The Relate Dongles exchange host details such as Relate ID, IP Address, device type and user name over the Relate node RF network. However, there are limits for the amount of non-measurement information that can be exchanged. Instead, we implement exchange of further information by wireless IP network.

For example, we have implemented a scenario where the user can exchange virtual business cards of other users in VCard format just by knowing the device's relative location.

### FILE EXCHANGE

The Relate toolkit's implementation of transparent IP network access allows users to send files to remote mobile devices by dragging and dropping the file on their abstract graphical representation.

