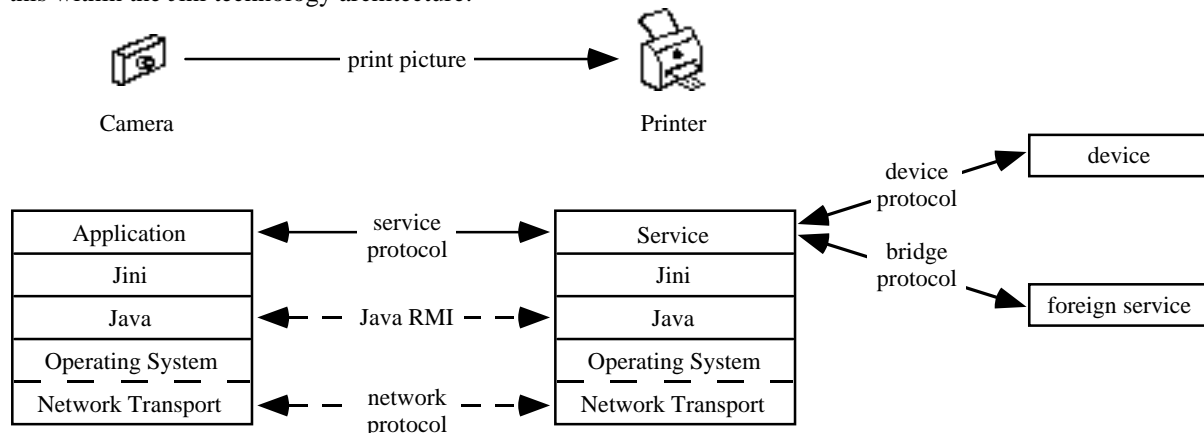


Jini™ Technology and Emerging Network Technologies

In recent years, the demand for consumer and business-related electronic devices has surged. Now we face the next challenge: bringing those individual, self-contained devices together into dynamic, transparent, and simply connected networks to offer more services and more resources to the end-user. The value of such devices to the consumer increases greatly as they can interconnect and interoperate with each other.

Several technology development efforts are underway to answer this call for more interconnectivity and an easier way to build, manage, and use the services of digital networks. One of the most exciting of those developments is Jini technology. Built on Java technology, it is designed to enable users to simply connect any number of digital devices, and to access those valuable services provided by rich, dynamic communities of systems such as personal digital assistants (PDAs), televisions, digital cameras, fax machines, cell phones, even smart card readers.

Jini technology is just one of the components of an emerging plug-and-participate world. Other complimentary network technologies, such as Bluetooth™, JetSend™, and HAVi, are also in development. To understand how Jini technology will interoperate with these other technologies, consider a simple example: a digital camera printing a picture. The figure below illustrates the various protocols used to do this within the Jini technology architecture:



On the left is a device that needs a service performed, in this case a camera that needs to print a picture. The center represents the device that offers the service, in this case printing. The service typically will be performed locally; but sometimes, as shown to the right, the service may either need to communicate with an external device, such as an older printer that does not support the Java programming language, or else bridge to a non-Jini service, such as a database of images published to the Web.

The arrows indicate the different levels of communication that are required. First, the camera locates the printer service by using Jini technology, which employs Java Remote Method Invocation (RMI™), which in turn uses whatever network protocol is supported by the operating system. Jini technology does not require any particular operating system or network transport: The camera may use infrared, radio, or be physically plugged in to the local network. Many of the emerging network technology specifications are designed for specific types of networks such as TCP/IP for ethernet, IrDA for infrared, IEEE 1394 (Firewire), or wireless. All of these support Jini technology. Likewise all of the operating systems being proposed provide the features necessary to support Java RMI and therefore communications which use Jini technology.

After the camera locates the printer service, to print the picture it downloads and runs the Java code supplied by the printing service. This code uses the underlying network transport, and perhaps RMI technology, to implement the printing service protocol needed to transmit the picture to the printer. The service protocol that an application and a service use to communicate with each other can either be an existing protocol or a new one defined by the company implementing the service. Some of the emerging network technologies are based on new service protocols that are more intelligent and flexible than current ones. These will all work very well with Jini technology.

A few of the emerging network technologies define their own protocols to locate and communicate with devices. For these, the Jini service needs to act as a bridge, translating the application's request into the protocol used by the other network and forwarding it to the other device. This requires that the service is running on a device that is also connected to the other network.

Some Examples of Complementary Emerging Technologies

Bluetooth is a technology specification for low-cost, short range radio links between PDAs, laptops, mobile phones, and other portable devices. When two Bluetooth devices come close together, they automatically detect each other and establish a network connection. This is an example of a network transport protocol that could be used to allow devices using Jini technology to communicate without being physically connected to each other.

Other technology like **Piano**, which can be built on top of Bluetooth, specifies what sort of information they exchange and how they communicate. It and other operating systems, like **EPOC32** for cell phones, provide the necessary features to support Jini technology.

JetSend technology is an example of a service protocol that allows devices like printers, digital cameras, and PCs to intelligently negotiate information exchange—without user intervention. The JetSend protocol allows the devices to identify a common data format and exchange data. Once Jini technology has been used to connect the two devices, the JetSend protocol can be used to transfer information between them.

HAVi (Home Audio-Video interoperability) is a specification for home networks of consumer electronics devices such as CD players, televisions, VCRs, digital cameras, and set top boxes. The network configuration is automatically updated as devices are plugged in or removed. Applications are expected to coordinate the control of several devices and to simplify the operation of devices by the user. IEEE 1394 is used to connect devices on the HAVi network. HAVi is an example of where a bridge protocol would be required to provide a way to share services between HAVi devices and devices using Jini technology. Applications using Jini software can gain access to HAVi devices such as VCRs. Likewise, home devices on the HAVi network, like a television, could connect to remote Jini services such as video-on-demand.

These emerging network technologies play key roles in making impromptu digital networking become a truly universal, instantly accessible, and reliable method of device interconnectivity. To ensure an open forum for development and extension of Jini technology, Jini technology is available through the Sun Community Source Licensing program. As more devices adopt and extend these and other communications protocols, the vision of simply connected, dynamic networks for home, office, and the world at large will become a reality.

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Bluetooth is being developed by IBM Corporation, Intel Corporation, Nokia Corporation, Telefon AB L.M. Ericsson and Toshiba Corporation.

HAVi is being developed by GUNDIG A.G., Hitachi, Ltd., Matsushita Electric Industrial Co., Ltd. (Panasonic), Philips Electronics N.V., Sharp Corporation, Sony Corporation, Thomson Multimedia S.A. and Toshiba Corporation.

JetSend is a product of by Hewlett-Packard.

Java and Jini are products of Sun Microsystems Inc.

Piano is being developed by Motorola Inc.

EPOC32 is a product of Symbian Ltd., a joint venture between Psion PLC, Ericsson, Nokia and Motorola Inc.

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