

Course project essay sample



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Part I

Mesh Networking

Mesh networking was developed at MIT in order to provide a method of wireless networking that is cheap, easily configurable and has a wide line-of-sight range. One of the first implementations of mesh networking was in Cambridge, MA on the MIT campus. The project was intended to explore the feasibility of non-municipal, independent wireless networks. The project, named Roofnet, was a multi-hop 802.11b mesh network, with a number of rooftop nodes acting as forwarding points; the nodes within radio range can communicate with each other directly, with communication of out-of-sight nodes taking place via multi-hop forwarding (Aguayo, 2003)

The nodes were designed with off the shelf hardware and open source software, allowing for a fast, cheap implementation of the network. A specialized routing protocol called SrcRR attempts to find high-throughput nodes with non-marginal signal in order to propagate network traffic through the most connected nodes. Roofnet was intended to grow organically, with gaps naturally being filled as service variations were found and corrected.

The success of Roofnet led to a city-wide municipal mesh network being established in Cambridge, MA, allowing users to access the Internet at other points than established wireless network points or hot spots. The service limitations were addressed by pre-seeing nodes on tall buildings and on utility poles (Savage).

Mesh networking has the capability to provide connectivity to “last mile” users in rural areas and to provide cheap, usable Internet access in poor

areas. It is the networking protocol deployed on “ children’s laptops”, or laptops designed by MIT students and staff for distribution to children in developing areas in order to provide technology and knowledge transfer.

The hardware, though initially expensive, has been reduced in price to make implementation on a small budget feasible (Merritt, 2005). Mesh networking can also provide access for other situations, such as the aforementioned public area networks. It has the capability to redefine network access from its current luxury status to a public utility, making a significant change to the IS paradigm and profit model.

Mesh networking addresses also both a structural and functional limitation of IS - namely, the requirement for infrastructure planning for formal networks. Structurally, there is no requirement for planned WAP locations, connection testing and verification or other complicated setup. Because the network grows organically rather than being planned, it will tend to develop in areas where access is required without use of resources in areas where access is not required.

Mesh networking is also less expensive than other forms of wireless access, creating a feasible way of providing a large number of connections to a shared broadband Internet access point for a small community. The cost of the hardware is low, meaning that it can be implemented cheaply in areas where hardware cost is a deciding factor, including in rural areas and developing countries.

No increase in infrastructure is required to support the network in most areas. The shallow technical learning curve, free and open source software

and inclusive nature of connections allows for fast and efficient setup even among non-technical support staff. Overall, mesh networking is an excellent technology for providing wireless access to areas where Internet connectivity is out of the reach of most residents for either financial or technical reasons.

Ultra wideband/Wireless USB

Ultra wideband/wireless USB is a wireless technology designed for personal area networks (PANs) (Kolic, 2004). Ultra wideband has high data throughput, low power consumption and a range of about 30 feet, making it ideal for data transfer between devices such as cameras and camcorders, laptops, cell phones, PDAs or Blackberries and other personal data devices. Wireless USB, intended to take the place of Bluetooth and Universal Plug-n-Play, also has the potential to take over the wired data transfer arena from protocols such as wired USB and FireWire.

Ultra wideband wireless USB would be used in the same manner that wired USB is today, with the exception of the cable used to attach devices. It will transfer data seamlessly between devices. One use noted by Kolic is purely aesthetic - communication between a flat-panel wall-mounted television monitor and the device providing video output, such as a DVD player or a cable transceiver box. UWB USB also provides a faster transfer method than existing protocols due to its high bandwidth utilization.

This technology is important for further development and integration of personal networking devices. Greater ease of use for personal networking devices will lead to greater use of them by consumers as well as technical people.

Ultra wideband/wireless USB addresses a structural limitation of IS - that is, the requirement for a physical cable or other device to transfer large amounts of data. Currently, the technology is primarily implemented in consumer electronics, such as PDAs, cell phones and laptops. However, there is no reason it could not be implemented in more complicated business or industrial settings as well.

For example, it could be implemented for direct drive-to-drive data transfer or motherboard-to-drive transfer, creating a personal computer with fewer cables inside as well as outside. While these technical implementations are on the far horizon, the promising uptake of wireless USB in consumer electronics may indicate that further development of the technology will take place.

Functionally, ultra wideband/wireless USB offers an improvement on current wireless transfer protocols such as Bluetooth. The protocol has a wider range (up to 30 feet) and much higher throughput than Bluetooth, enabling the reasonably fast transfer of much larger data sets than Bluetooth can reasonably be used for. It also has the ability to link a wider range of devices that do not currently offer Bluetooth connectivity, such as the aforementioned television and video output unit. Many devices have not been equipped with Bluetooth due to the relatively slow transfer rate impacting its usefulness for the function; ultra wideband/wireless USB will not suffer from this problem, as it is faster than most other data transfer protocols on the market.

Conceptually, ultra broadband/wireless USB continues to challenge the assumption that computers and other devices must be connected via cables for data transfer. This has continued to be a part of the image of IS even though it is no longer strictly true; laptops equipped with wireless networking cards continue to be supplied by default with modems, Bluetooth-equipped devices usually have a USB or mini-USB port located somewhere on them “just in case” and many desktop computers do not make any attempt at wireless connectivity at all. Broadband/wireless USB has the potential to change this image of computers as being connected to each other via cables rather than via networks

Part 2

Mesh Networking

Mesh networking is an excellent choice for municipal networks, “last-mile” rural solutions or wireless broadband access in developing areas where the existing infrastructure will not support traditional networking techniques. The node hardware is inexpensive and the software is free and open-source, leading to a low cost of implementation.

Additionally, the setup is not complicated and does not require a networking professional to put in place. Because the networks are designed to grow organically, gradual acquisition of the nodes and placement is a good strategy to avoid a large up-front expenditure and to optimize the network coverage. Network coverage at the edges of the network can be spotty using a mesh network, so observation of the network should be performed to maintain the required coverage.

On the other hand, mesh networking would not be a good choice for a company that offered WiFi access for sale or which relied on it for operation. Because of its organic nature, mesh networking may not be suitable for these operations for a number of reasons. First, the service is not consistent - edge coverage can be spotty, service strength may not be strong and if a node drops off the network there may be service interruptions in the connected nodes while another takes its place. These inconsistencies make mesh networking a poor fit for operationally required coverage or network access offered for sale.

There are a number of technical issues that may accompany the introduction of mesh networking. The first is the simplest - where to place the initial nodes? Nodes need to be placed within line of sight of one or more nodes in order for the network to work properly. It is assumed that as the network grows, users will detect coverage holes and leaks and request nodes to be placed in order to cover the gaps. However, initially nodes must be placed so that a significant portion of the intended coverage has line of sight access to a node.

A second technical issue is distribution of software to enable users to access the network. Mesh networking uses a specialized protocol to communicate among the nodes as well as with the outside network, and user's machines must be able to access this protocol. Third, as the network continues to grow edge signal must be managed so that there is sufficient connectivity and quality signal to nodes that lie at the edges of the network. Overall, mesh networking has few technical implementation problems, as it is designed to be implemented by non-technical volunteers.

Non-technical considerations may be more complicated with mesh networking. The protocol is designed to circumvent the for-profit Internet access companies who currently provide utility access via wireless or wired network to many residents. This is a popular concept for customers, but implementation of a municipal mesh network may engender some resistance from communications companies that currently provide these services.

For example, companies that maintain public WiFi services (“hot spots”) in local cafes may pressure business owners to oppose the changes because of the potential effect on their own businesses. However, mesh networking has been enthusiastically embraced by organizations which seek to bring Internet access to underserved areas, such as rural areas too sparsely populated for infrastructure broadband and developing countries, where the infrastructure doesn’t support broadband or it is too expensive for the majority of residents.

Ultra broadband/wireless USB

Currently, ultra broadband/wireless USB is mainly implemented in consumer technology rather than in business networking and hardware. This indicates that only an organization with a high number of employees with company-issued mobile computing devices such as laptop computers, cell phones and PDAs will find a benefit to implementing ultra broadband/wireless USB. Organizations with mostly office-bound employees or those who do not routinely use mobile computing devices will not see a benefit to implementing ultra broadband/wireless USB.

If an organization does desire to implement ultra broadband/wireless USB, a gradual acquisition strategy of replacing existing devices with wireless USB-enabled devices as the older devices depreciate and are phased out of use would be the most cost-effective strategy. Because wireless USB is a new technology, the range of devices equipped with it is limited and if an organization requires a particular device it may not yet be available on the market. The gradual acquisition strategy will also aid in this respect, because devices which are not yet available with wireless USB connectivity can be substituted with a device that implements another wireless transfer protocol such as Bluetooth.

The cost of wireless USB-equipped devices should also be taken into account. Wireless USB is still significantly more expensive than competing technologies in many applications. Although wireless USB offers significantly better throughput and wider connectivity than Bluetooth, if the organization does not use the device in question in a manner which requires a high throughput or wide connectivity, the device may be too expensive for general issue.

Technical issues with implementation of ultra broadband/wireless USB are not severe. Mainly, it should be established that devices conform to the UBW standard in order to ensure connectivity with each other, and connectivity should be tested.

Non-technical issues with ultra broadband/wireless USB may be more significant. The first issue will be user training. Many users, particularly non-technical users such as salespeople and human resources staff, may be

uncomfortable with implementing a new technology in their personal devices.

Thorough user training should be offered, covering all aspects of connectivity between devices and offering hands-on assistance to users who seem to show difficulty learning to use the devices. If possible, a user's devices should be upgraded simultaneously to ease the possibility of non-connectivity between devices and to make sure the user understands how to connect all his or her devices together. Other areas that should be addressed include user security, the file transfer rates, and other concerns expressed by the user.

Another non-technical concern when implementing wireless USB is the cost of the devices. Currently, wireless USB-enabled devices can be significantly more expensive than those equipped with wired USB, Bluetooth or other competing protocols. While this cost will fall as greater numbers of devices are manufactured, currently, the cost can be a budgetary concern. Careful examination of the provision of wireless USB and the particular devices chosen can offset the high cost of the devices by providing them only to those who truly require them to perform job functions.

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