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MultiPort Wireless Local Area Networking

Networking and electronic communication has become a vital component to efficient business operation around the globe. The Compaq Evo™ *MultiPort provides an integrated Wireless Local Area Networking solution enhancing Compaq's commitment to wireless solutions. It has many advantages over other wireless LAN solutions. The MultiPort design from Compaq has many advantages over other Wireless LAN solutions including being an innovative and revolutionary design that solves the complexities surrounding the integration of wireless solutions into the notebook. Radio Frequency (RF) signals, which are used for wireless communication, typically have reduced effectiveness when combined with other components inside a notebook computer. Antennae placement and modularity of the wireless device are key elements to an integrated solution due to the rapid evolvement and change in wireless technologies.*

COMPAQ

COMPAQ MULTIPORT

In the spring of 2001 Compaq will introduce notebooks enabled with the new and innovative MultiPort module. MultiPort is an interchangeable module located on the back of the notebook display panel. A MultiPort module can be easily slid into place and thus becomes an integral part of the display assembly. MultiPort options can be selected when the notebook is purchased and installed during the CTO (Configure-to-Order) manufacturing process. If a MultiPort module is not selected at the time of purchase, a blank cover is installed to cover the slot. A variety of both wireless and non-wireless technologies will be offered in the MultiPort form factor. A user can purchase a MultiPort module at anytime in the future to wirelessly enable their unit or upgrade to a new wireless technology. The electrical interface is based on the industry standard USB (Universal Serial Bus) technology. This USB based module concept provides a great deal of flexibility in developing numerous solutions.

MULTIPORT ADVANTAGES

MultiPort combines the antenna and radio into a single assembly, resulting in improved signal, reduced noise pick-up as well as eliminating added costs associated with internal coax cables and connectors. The combined antenna/radio module is a complete solution that can receive host-independent regulatory approvals, enabling a common, easy to manage solution across the portable product line. Its location on the display improves receive-signal-strength and reduces noise pick-up from the base of the notebook. The self-shielding effects of the display greatly reduce the possibility of RF susceptibility of the various subsystems in the base of the notebook. The optimal antenna position results in omni-directional signal reception and significantly reduces human body/hands absorption affects. The resulting maximized signal strength provides the user with greater data throughput and distance performance.

Beyond the performance and technical benefits, MultiPort leaves PC Card slots and the Mini-PCI slot available for non-wireless technologies such as classic modems and NICs as well as new technologies to be offered in the future. Customers do not need to trade-off other functionality in order to get wireless enabled notebook. The modular form-factor of the MultiPort allows the user to easily upgrade to different wireless technologies or standards.

CHALLENGES IN WIRELESS INTEGRATION

There are several challenges to overcome when integrating wireless capabilities into notebook computers. Due to the rapid adoption of wireless enabled devices

such as cellular phones, notebook vendors have experienced a variety of issues when these RF devices are placed in close proximity to notebooks. Documented cases from end-users have shown that the interaction of the RF device and the notebook has adversely affected the performance of both devices. For this reason, notebook vendors have been fighting to keep unwanted RF sources and noise from entering or exiting the notebook. Now the industry is actually attempting to integrate these RF technologies inside the notebook.

A recent study done by Compaq revealed some of the potential issues that can arise with RF interference in notebooks. For example, audible buzzing in the Audio sub-systems, cursor deflections across the LCD panel, dimming or flickering of LCD backlights, and increased modem data error rates or dropped connections. Additional failures included CDs skipping tracks or complete failure to read, shutting down DC-to-DC power supply converters and display panel invertors, and hard driver read/write failures. In some extreme cases battery packs shut down and their protective fuses were blown.

In order to minimize the effects of RF related issues in the notebook, Compaq's MultiPort solution integrates the wireless functionality into the top of the notebook behind the display. This allows wireless functionality without integrating the device inside the base unit of the notebook where RF interference can cause problems to arise.

Another challenge to overcome is with regard to antenna placement for the wireless device. Extensive research was done jointly between Compaq and some major antenna vendors and universities to determine optimal placement for an RF antenna within a notebook computer. The results of the study showed that the optimal placement for the antenna is at the top edge of the display. Antennas located anywhere in the base of the notebook were greatly affected by the conductive nature of the notebook itself.

Again the *Evo* Notebook MultiPort solution provides an optimal solution. The antenna is incorporated into the MultiPort module with the radio receiver and is at the top edge of the panel for optimal signal strength and reliability. Having both the antenna and the radio receiver built into one module has other advantages as well. In some integrated wireless solutions coaxial cable is used to connect the radio receiver to the antenna. This is more costly and results in performance loss. Signal loss of .5db can be experienced with RF coax cable connectors. Additional signal loss can be experienced in the coax cable itself. Placing the RF radio inside the base of the notebook and running coax cable up through the hinge can not only be costly but may result in a cumulative signal strength loss of 1 to 3db. (3db signal loss can result in reducing transmit/receive distance by 50%).

MULTIPORT VS. MINI-PCI SOLUTIONS

Mini-PCI is an industry standard technology for installing communication devices. Mini-PCI slots are generally located in the base of the notebook. Placing a wireless communication device in the Mini-PCI area of the notebook would cause RF interference and reliability concerns. An additional concern with Mini-PCI is the higher temperatures that reside inside the notebook. This can cause wireless devices to drift out of their intended channels or bands thus losing the connection.

The MultiPort design from Compaq avoids the issues of integrating wireless communication into the Mini-PCI slots of the notebook. With the MultiPort design the communication device is far enough from the RF sources of the notebook and the internal temperatures of the notebook thus reducing interference and signal losses. This design also offers the customer added flexibility in making technology choices. By not occupying the Mini-PCI slot, the customer is free to have a modem or modem/NIC combo in the unit for alternative connection methods.

A final concern with Mini-PCI is the ease of user installation or upgradability. The average lifetime of a notebook is 3 years, far longer than most wireless standards. If a user wishes to change to a different wireless technology or upgrade to the latest standard, they will be forced to remove screws and access doors, unplug the coax cable and pop-out the Mini-PCI device. This also assumes that the antenna that is wired into the notebook is compatible with the next generation of wireless products. The MultiPort design is such that as wireless technology advances and new standards are instituted, a new MultiPort module can be created for customers to install into their notebook. The flexibility offered by integrating the antenna and radio receiver into one MultiPort module allows the most flexibility as technology advances in the wireless area.

WHAT IS A WIRELESS LAN?

A Wireless Local Area Network is a type of LAN that uses high frequency radio waves rather that wires to communicate and transmit data among its nodes. It is a flexible data communication system implemented as an extension to, or as an alternative for, a wired LAN within a building or campus. Using a WLAN gives end users the ability to improve productivity because their campus can support untethered access without the headache of lugging around cables and searching for Ethernet access points in every office and conference room.

MODES OF OPERATION

The Compaq MultiPort WLAN module operates in either of two modes defined by the IEEE 802.11 Working Group, Infrastructure or Ad Hoc (Peer-to-Peer). Infrastructure mode provides additional features such as network access control,

reduced power operation for extended system battery life, and extended range. Ad Hoc mode provides simple peer-to-peer networking that allows for the sharing of files and printers.

The infrastructure mode is defined by the requirement to transmit all network traffic through an Access Point (AP). This allows a group of wireless clients to communicate with each other and possibly also with the campus's wired LAN. A Service Set Identifier (SSID) collectively identifies an AP and its associated clients that make up a WLAN. If all the APs on a particular campus share the same SSID, then the MultiPort WLAN module will enable roaming by searching for the best AP with which to associate whenever the Compaq Armada or *Evo*™ Notebook moves within the building or campus.

In Ad Hoc mode, the MultiPort WLAN module communicates with other computers directly without the use of an access point. Also called peer-to-peer networking, this mode of operation is the easiest to deploy and is ideal for small offices. Using this mode, end users are able to share files with other employees, print to a shared office printer, and access the Internet through a shared modem. Each wireless client in the peer-to-peer network must use the same SSID, channel and also must be in range with all of its peers.

INTEROPERABILITY WITH OTHER 802.11B PRODUCTS

The Compaq MultiPort WLAN module is compatible with products from different vendors employing the same technology (i.e., 802.11b based Direct Sequence Spread Spectrum). This specification allows end users to use client adapters from multiple vendors. The goal of industry standards, including the IEEE 802.11 specifications, is to allow compliant products to interoperate without explicit collaboration between vendors. The MultiPort WLAN module is based on the IEEE 802.11b specification, which provides the guidelines for WLAN interoperability. WECA (Wireless Ethernet Compatibility Alliance) is an industry organization that certifies WLAN products and their interoperability. WECA ensures that products interoperate in real-world applications. Wi-Fi is the trademarked name that WECA uses to signify WLAN product interoperability. The name stands for "wireless fidelity." WECA performs elaborate tests on WLAN products; those that meet the interoperability standard are awarded the Wi-Fi logo.

MULTIPORT WLAN MODULE SECURITY

The IEEE 802.11b standard provides various mechanisms to create and maintain a secure wireless network. Data security on a wireless LAN occurs via the physical and MAC (Media Access Control) layers of the 802.11b protocol standard. The mechanisms used by the IEEE 802.11b products to secure data communications are in addition to any security measures that exist at the network protocol layer (Network login, Password access, etc).

The Compaq MultiPort WLAN module implements the complete wired equivalency privacy (WEP) mechanism as defined in the IEEE 802.11b standard. WEP (Wired Equivalent Privacy) is an optional IEEE 802.11 feature used to provide data security that is equivalent to that of a wired LAN without privacy-enhancing encryption techniques. WEP will ensure the wireless LAN link is as secure as a wired link. According to the 802.11 standard WEP data encryption is used to prevent (i) access to the network by "intruders" using similar wireless LAN equipment and (ii) capture of wireless LAN traffic through eavesdropping. WEP allows the administrator to define a set of respective "Keys" for each wireless network user based on a "Key String" passed through the WEP encryption algorithm. Access is denied by anyone who does not have the required key. As specified in the standard, WEP uses the RC4 algorithm with a 40-bit or 104-bit key. When WEP is enabled, each station (clients and Access Points) has a key. The key is used to encrypt the data before it is transmitted through the airwaves. If a station receives a packet that is not encrypted with the appropriate key, the packet will be discarded and not be delivered to the host; this prevents unauthorized network access and eavesdropping.

CONCLUSION

The integration of wireless LAN technology into the *Evo* Notebook MultiPort is a great advantage for Compaq customers. The antenna and radio transceiver are combined in one assembly that is placed on the top rear of the panel assembly. This location provides the best signal strength and integrity in a wireless LAN environment. The maximized signal strength will thus result in greater data throughput and range.

The Compaq wireless LAN products are compliant to 802.11b standard and are interoperable with other 802.11b compliant products. Yet, we have implemented security features beyond the specification in attempt to decrease the likelihood that the system security is compromised under an open standard environment.