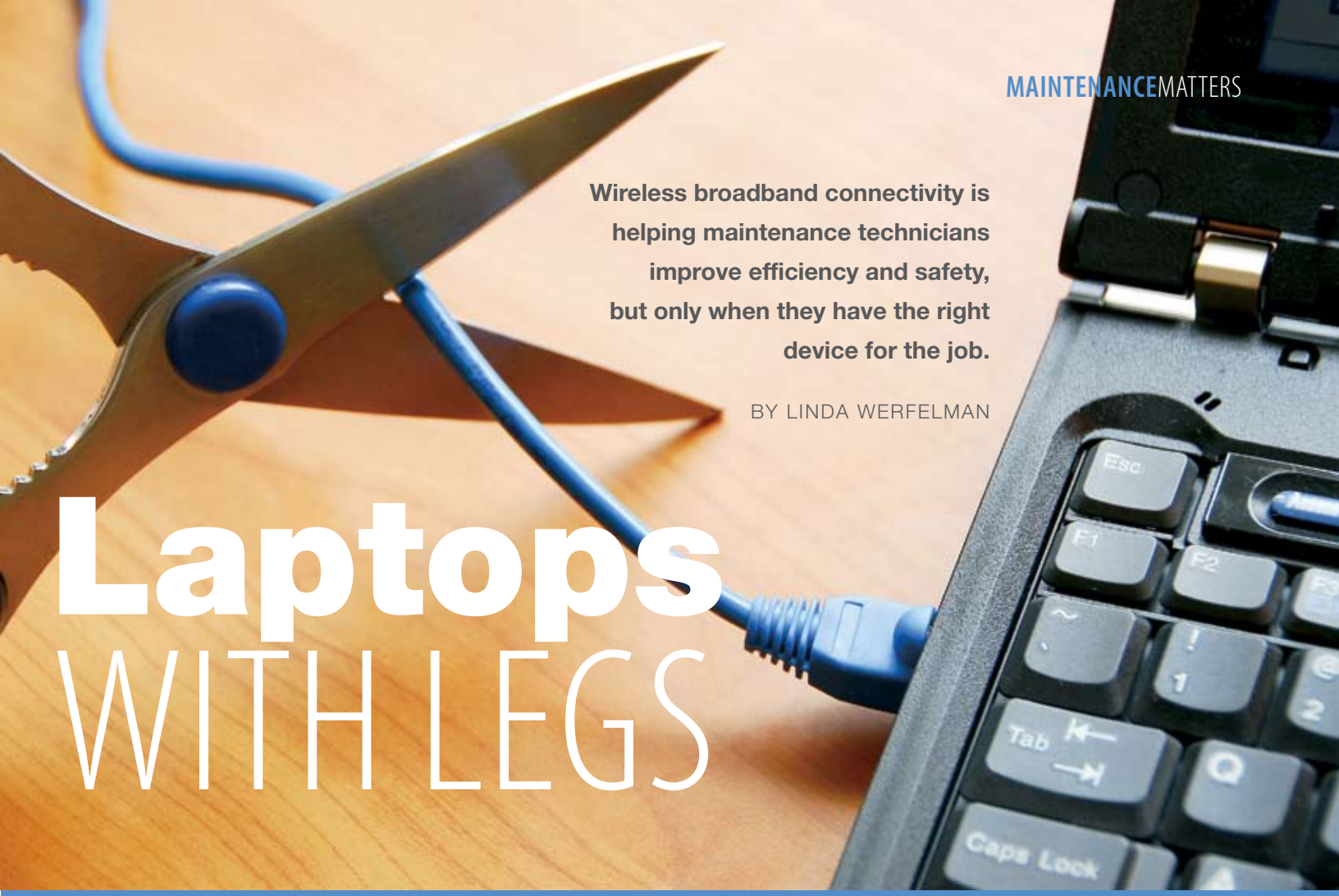

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Wireless broadband connectivity is helping maintenance technicians improve efficiency and safety, but only when they have the right device for the job.

BY LINDA WERFELMAN

Laptops WITH LEGS

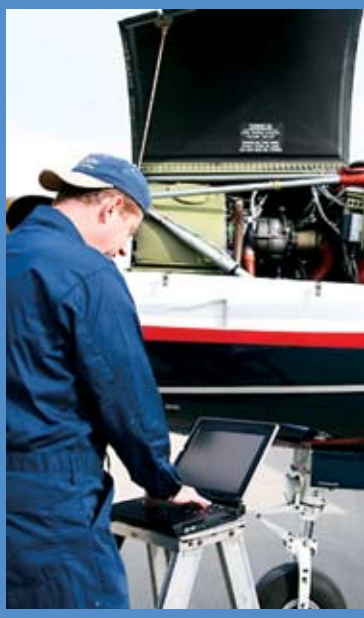
Advances in technology have given aviation maintenance personnel a choice of portable computers — including laptops and handheld and wearable devices — to take to their work. Each device is different, and each has distinct advantages and disadvantages, as well as unique human-factors guidelines for its use, but overall, this new wave of technology is bringing a more comprehensive package of information, automatically updated, directly to the worksite.

Computers have become widespread in aviation maintenance. For example, a 2003 study found that, of 18 maintenance facilities surveyed, computer technology was in use at all 18.[1] When questioned, technicians at these facilities sometimes complained that the wireless networks that supported their portable computers were slow or intermittent, that portable-computer screens were too small or did not offer high-enough resolution and that some computers were difficult to use or were not rugged enough.

One year later, another study — this one involving the maintenance facilities of two major air carriers — found that computer and broadband network technology had permeated "most every phase of the line maintenance process, with one important exception: Maintenance technicians at neither carrier used technology on the ramp when performing maintenance on aircraft." Even though one of the facilities had laptop computers, maintenance technicians were never observed using them.[2]

In the few years since those studies were undertaken, portable computers of all types — typically operated on wireless local area networks (WLAN, more commonly known as Wi-Fi) or cellular links — have become more prevalent.

"Everybody has desktops now, and most have portable computers of some sort," said



Itronix

Ed Bach, vice president of worldwide sales at Xybernaut, the first company to patent mobile computing systems. "Until two or three years ago, people just felt more comfortable with desktop computers. But portable computers have become more common in general, and wireless connections have become more reliable."

Corey Harper, national sales manager–Air Force, for Itronix, a developer of wireless, rugged computing systems for aviation maintenance personnel and other mobile workers, said that the recent increase in use of portable computers in civil aviation maintenance began after civilian operators learned about their successful use in the military.

The military's record with portable computers resulted not only in increased interest from civilian operators but also in the development of civilian versions of the computers and of a maintenance work force more comfortable with the devices, Harper said.

As technicians have left the military for jobs with civilian operators, they have taken their computer expertise with them, he said.

"The airlines aren't having to show them where the 'on' button is," he said.

Some of the complaints heard by the researchers who conducted the 2003 study probably arose because the technicians did not have rugged equipment — that is, equipment with built-in protection against vibration, moisture, harsh chemicals, extreme temperatures, and being dropped from several feet above ground — for their specific tasks; because of early flaws in the emerging technology; or because they were not yet comfortable with their portable computers, mobile-computer specialists said.

"Most laptops are not designed to work in the extreme conditions facing technicians and are at a significantly greater risk of being damaged," said Bill Presler, senior manager of market development for Panasonic Computer Solutions, which manufactures laptops and other rugged portable computers for the aviation maintenance environment. Failure rates for non-rugged laptops can be as high as 25 percent; in contrast, the failure rate for Panasonic's rugged mobile personal computers is about 4 percent, Presler said.

Itronix

Harper said that when the study was conducted, wireless computers were still relying on "leading-edge technology with accompanying problems that have since been worked out."

In addition, he said that some technicians, who did not adapt to these uses of computers, have left the field, while others have embraced the new technology.

Emphasis on Safety, Efficiency

Mobile-computer specialists said that among the primary reasons for the expanding use of computers — both desktop computers and handheld, portable and wearable computers — are safety and efficiency.

Harper said that, for example, when technical manuals are updated properly on a network server, the update is complete, current, more accurate and more uniformly available to technicians than pages in paper manuals.

Xybernaut's Bach agreed: "The fact that all that information in the computer is available immediately … that's got to increase safety."

Maintenance productivity and turn-around time are significantly improved, he said. For example, a technician trying to replace a faulty component could benefit from the immediacy of having related technical and anecdotal information, including photographs, parts diagrams, assembly instructions, schematics and technical tips, displayed on a portable computer where he or she is working, he said.

"Our goal is to make things more efficient, and overall efficiency helps you do more things, minimizes human error," Bach said.

Presler said that wireless computers could help maintenance technicians save up to four hours a day during routine maintenance and repair tasks and could "increase aircraft safety by providing technicians with the most up-to-date information everywhere they go. … Aviation personnel can use access to wireless networks or locally based information to remotely access schematics, manuals, flight information or [government regulations]. They

can perform scheduled and nonscheduled tasks more efficiently, receive flight management system updates instantly, and easily connect to on-plane computer systems to upload current information or to download and isolate faults via ARINC data loading."

The Best Match

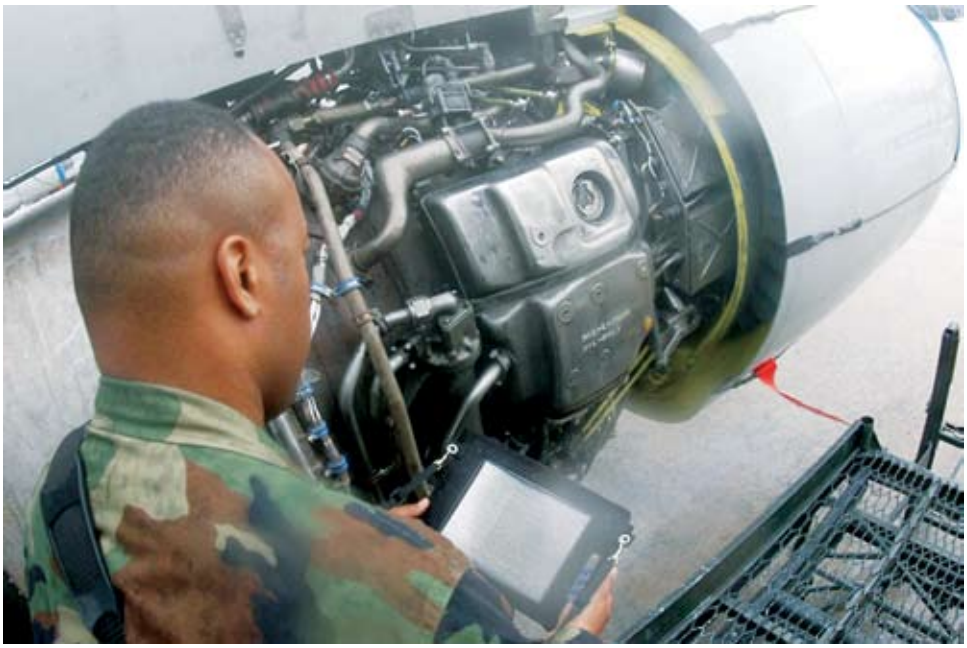
The handheld, portable and wearable computers in use today are available in several configurations and forms:[3]

- Laptop computers, also called notebooks, are smaller and lighter in weight than standard desktop computers. They typically have a built-in keyboard and a touchpad in place of a mouse, and can be used for a variety of applications, including accessing and viewing lengthy documents, detailed images and full-size Web pages;
- Personal digital assistants (PDAs), smart phones and combination PDA-smart phones such as the BlackBerry handheld are small and easily portable. Their small screens, scroll controls and proprietary keyboard interfaces make them most useful for accessing short checklists or other short items, for limited data entry and for e-mail access;
- Tablet computers, which resemble laptops in size and weight but eliminate a physical keyboard and mouse, allow users to access lengthy documents and detailed images. Typical designs are touch-activated with a stylus and/or fingertips. They can be used to run more applications than smaller portable computers. Some devices combine laptop and tablet functions; and,
- Wearable computers, typically voice-activated devices attached to belts or headgear, free technicians' hands for other tasks. They often are recommended for jobs in close quarters — jobs in which it would be difficult and time-consuming to leave the workspace and walk to a desktop/laptop computer to access information. Nevertheless, in some situations, workspaces may be too small to safely accommodate wearable computers.

Mobile-computer specialists say that, for use in aviation maintenance, portable computers of all varieties must be rugged enough to operate after being dropped, after coming in contact with harsh chemicals such as hydraulic fluid or volatile fumes and in temperatures that are very hot or very cold. In many instances, they also must be intrinsically safe for use in hazardous environments. Some specialists recommend

Some portable computers can be attached to the user's clothing.

Xybernaut



Xybernaut

The military's successful use of portable computers led to increased interest among civilian operators.

that computers meet specific standards, such as military specifications established by the U.S. Defense Department, to withstand environmental stresses, vibrations and the jolts of being dropped onto hard surfaces.

They also say that portable computers require an easy method of connecting to other systems and transferring data between those systems. If a wireless network is involved, connectivity should be highly reliable. The computers also should have sufficient battery life for task completion, and attachment to an electrical outlet should not be required.

In addition, portable computers should be small, lightweight and conveniently shaped, with covers that are hinged and permanently attached, and rounded corners and edges. The devices should not generate so much heat that the user becomes uncomfortable, and the smallest types should be equipped with a strap or clip so they can be attached to the technician's body or clothing when they are not being used. Computer displays should be legible, with good color contrast, adequate screen size and brightness that function well in operational lighting conditions.

Researchers said that human factors are not always considered when operators select portable computer equipment for maintenance personnel.

"These systems require different usage guidelines than standard desktop computing systems because of their size, portability, human-computer interface designs and intended work environment," said a 2005 report on a study conducted for the U.S. Federal Aviation Administration (FAA).[4]

"When choosing a device, the user, task and work environment must be well understood for the most appropriate selection to be made. … Choosing a device that is not well matched to the user and his needs can result in fatigue, strain, frustration and confusion, and lead to lower efficiency and increased error."

For example:

- The user's needs may be influenced by age. After 40 or 50, many people have difficulty reading smaller fonts and may require computers that display information in larger, easily readable type. Aging also can be accompanied by a decrease in fine motor control and perceptual abilities;
- Specific tasks may require specific performance from a computer, such as a large screen and a high-resolution display for tasks that involve accessing documents and manuals or viewing images; and,
- Specific conditions in the work environment also may affect either the technician's ability to use the device — for example, too much ambient light can cause difficulty viewing a computer display, and too little light can make seeing the keyboard difficult — or the functioning of the device — for example, extreme temperatures can interfere with the normal performance of some computers, liquid crystal displays (LCDs) and batteries.

Handheld, portable and wearable computers are designed to be used — intermittently — in work environments where desktops are unavailable. If they are used for tasks that typically are performed using desktop computers, such as continuous data entry, ergonomic problems are likely, the report said.

"While considerable work has been done to develop appropriate standards and guidelines for desktop workstations (e.g., seating, lighting), little has been put forward for portable devices, whose means of interaction can vary quite substantially from more traditional systems," the report said. "For example, some portable devices rely on the thumb for primary data input. This method allows the user to hold the device in one hand, freeing the other hand for other tasks, but may result in tendonitis, which doctors have attributed to overuse."

Wi-Fi vs. WiMAX

Mobile-computer specialists said that exactly how maintenance facilities' computer applications might change upon introduction of World Interoperability for Microwave Access — more commonly known as WiMAX — is uncertain, in part because there are no guidelines for how WiMAX will be used and no indication of how much it will cost. Nevertheless, the emergence of WiMAX probably will expand the options for wireless networks, said Marie Hartis, Itronix director of marketing communications.

WiMAX differs from Wi-Fi, in part, because it has greater range — about 31 mi (50 km), compared with Wi-Fi's 150 ft (46 m) — and is expected eventually to provide for wireless areas as large as airports or even entire communities.

"The more options, the better," Hartis said. "It hopefully will get us close to ubiquitous wireless."

Presler said that, as wireless technology "continues to take hold … we fully expect computer use to increase. Because of the way computers need to be used in aviation, we also expect they [maintenance facilities] will turn to rugged computing solutions because of their reliability." ●

Notes

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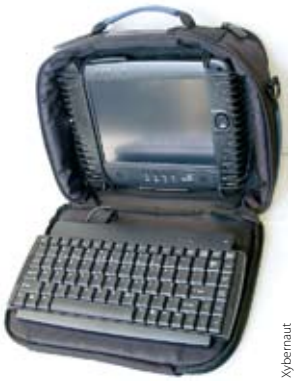
2. Casner, Stephen M.; Encinas, Charles M.; Puentes, Antonio. *Computer and Broadband Technology in Aircraft Line Maintenance: A Task Analysis and Questionnaire*. Paper presented at FAA General Aviation, Aviation Maintenance and Vertical Flight Program Review. Washington, D.C., U.S. November 2004.
3. Zingale, Carolina; Ahlstrom, Vicki; Kudrick, Bonnie. *Human Factors Guidance for the Use of Handheld, Portable and Wearable Computing Devices*. FAA. Report no. DOT/FAA/CT-05/15. November 2005.
4. Ibid.



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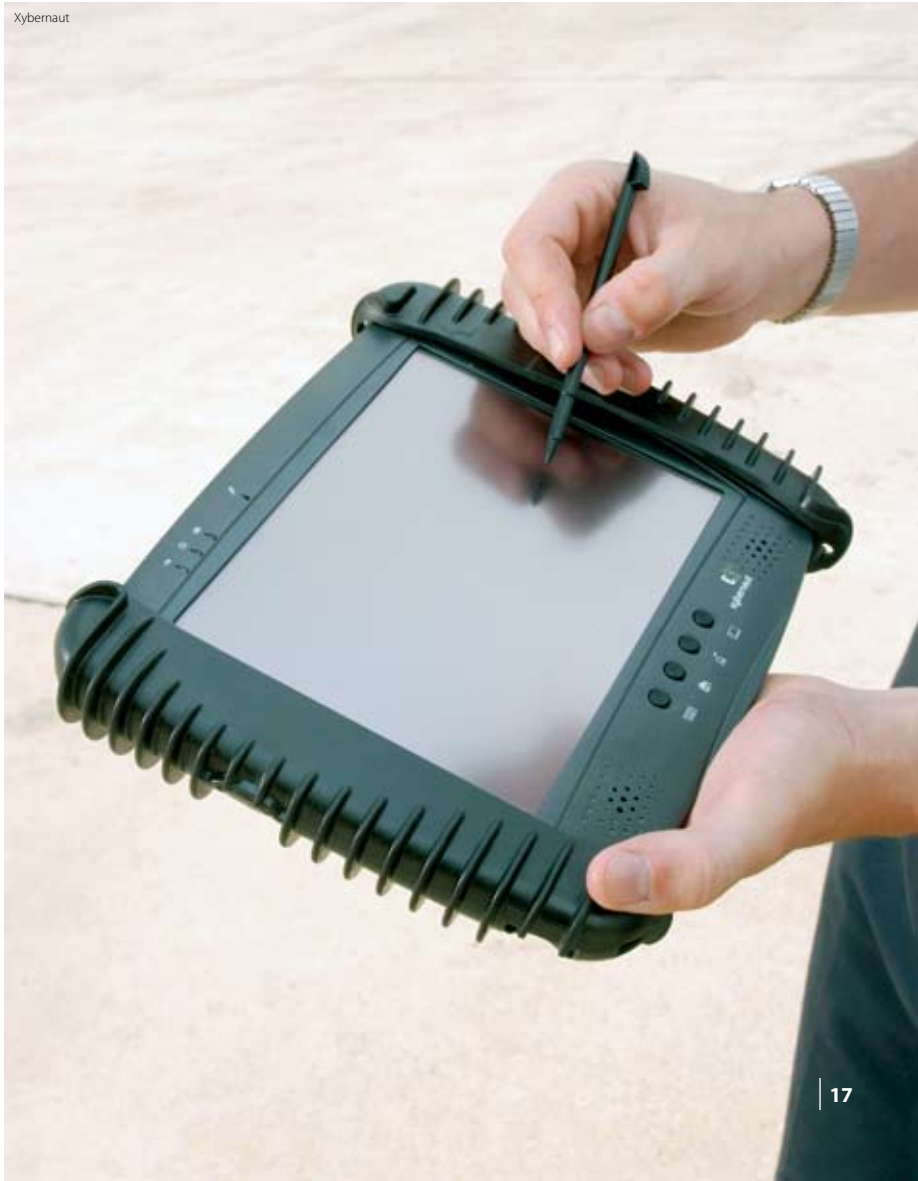
Some portable computer devices are touch-activated with a stylus or fingertips.



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