Mobile Enterprise

Act Three: The Backstage Crew

Jonathan W. Lowe

In part one of this three-part series on the mobile enterprise, we explored the software players and their attempts to support handheld devices in utilities, telecommunications, and local government. Part two revealed some of the limitations of PDAs, such as short battery life and consequent need for message queuing software. As we conclude this series, part three takes a closer look at the backstage crew of the mobile enterprise, elements that are either so obvious that they're taken for granted, or so quietly invisible that we forget they exist. Namely, we'll consider the influence of the display and wireless modem on the successful deployment of PDAs in the mobile enterprise.

As always, size matters

Most of a PDA's real estate is its display. How does a PDA's display compare with a desktop monitor? Using the Compaq (www.compaq.com) iPaq as a PDA example, the display has 240 horizontal pixels and 320 vertical pixels that fit onto a 3 × 2-inch rectangle (that's 3.75 inches on the diagonal). Subtracting the toolbars and administrative footprint leaves 235 horizontal and 215 vertical pixels on a 2 × 2-inch square area for the graphic map. Dividing the measured size by its pixel count yields a resolution of 120 pixels per inch.

Now, try recalling the dimensions of your desktop monitor's screen. Today, we're used to setting the displays of our 14 × 11.25-inch (18 inches on the diagonal) monitors to pixel dimensions like 1,024 × 768, 1,280 × 1,024, or even 1,600 × 1,200, with a resulting 73-, 91-, or 114-pixels-per-inch resolution. The point is that PDAs have excellent screen resolution compared with a typical desktop monitor. PDA-manufacturers are hoping to drive sales with entertainment programs that show family photos or play audio/video streams. Sony leads this charge with the highest resolution PDA screen — 320 × 320 pixels. Because of their screen resolution, PDAs like Sony's (www.sony.com) Clié or Compaq's iPaq render orthophotos with a sharpness similar to a desktop monitor (see Figure 1).

Read between the lines

Display resolution also impacts map annotation. For instance, on both a modern desktop monitor and a PDA screen, the smallest barely-readable size of the Arial font is 5-point. But even tiny 5-point Arial annotation begins to overlap itself at a certain zoom level. For instance, above a scale of 1:35,000 in a city like San Francisco, there's not enough space for even 5-point Arial text to fit between parallel neighboring streets (see Figures 2 and 3). Cartographers rise to this challenge by prioritizing, generalizing, and dissolving, so that, at scales above 1:35,000, maps remain readable. The information that the map conveys will be different, but not cluttered. For example, only arterial streets may get labels at a 1:100,000 scale.

The ceiling on maximum street label density at 1:35,000 scale in an urban center is approximately the same for desktop monitors and PDA screens. On a PDA's 2 × 2-inch square display, however, a 1:35,000-scale map represents an area 1-mile wide and tall. This distance could be covered in 30 minutes by the average walker, or in three minutes by car, at which point the user would have to pan the view. On a desktop, a map of the same resolution represents an area 5 miles wide and tall, a 2.5-hour walk or 15-minute drive.

This column covers the role of emerging technologies in the exchange of spatial information.

Significant? Well, imagine the effect on the user if Thomas Brothers (www.thomas.com) changed the form factor of its paper map books from 8.5 × 11- to 2 × 2-inch pages. Their map books would resemble those notepad cubes that vendors give away at conferences and would require frequent flipping from one page to the next while navigating a route by car. Flip, flip, flip . . . "Hey! Look out for that pedestrian!"

In general, PDAs are not great at conveying broad spatial context. For instance, a patrolling police officer with only a PDA as the map source might not notice patterns of restaurant robberies that span several beats, even if some occur in his own.

Also, given the fact that most PDA map viewing programs have fairly crude color, annotation, generalization, and scale dependency tools compared with their desktop parents, applications that require sophisticated cartography at scales greater than 1:35,000 or vehicle navigation above speeds of 10 miles per hour may be

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FIGURE 1 A 0.5-foot resolution orthophoto shown at 1:1,200 scale in ESRI's ArcPad on a Compaq iPAQ.

FIGURE 2 At 1:35,000 scale, the 5-point Arial street name labels still fit onto this Tele Atlas (www.teleatlas.com) basemap of San Francisco.

FIGURE 3 At 1:50,000 scale, the same 5-point Arial labels obscure each other or underlying street lines.

inappropriate for PDA deployment using today's mapping software.

Hoping to solve navigation form-factor problems, some vendors' PDA mapping programs automatically pan the map as a user's position nears the edge of the current view. Of course, this feature requires a connected GPS device to pass the user's current position to the mapping software. And maps with a life of their own that suddenly jump from scene to scene can be jarring to their readers; anti-nausea medicine may help. Maybe the message is that navigational PDAs with small screens are best suited to walkers rather than drivers.

Small screen, small edits

The more local an application's area of interest, the more likely associated data will be either an orthophoto image or CAD drawing, such as a campus or building site plan (Figure 4). Zooming to 1:1,200, 1:600, or even larger scale is not uncommon with this sort of data. These large-scale views are often where field workers graphically edit data to reflect work done while onsite. And thanks to their intuitive data input system, PDAs are good editing devices. Rivaling the maneuverability of a digitizing puck (if not quite the accuracy), and certainly easier to control than a mouse, the PDA's pen and touch-sensitive screen allow a fine degree of control. To experience the difference between desktop editing and PDA editing, try writing your name in cursive with a mouse. Does the signature look normal? Probably not. A PDA signature may not be perfect either, but will at least be similar to your real John Hancock.

Making markups. Edits with a pen are intuitive, but is there enough room to make the markup? Autodesk's (www.autodesk.com) field tests of its mobile enterprise strategy revealed that some utility workers preferred a larger form factor when editing, such as a portable touch-sensitive tablet. They considered the handheld PDAs too small and fragile for normal field use. Also, some editing tasks require multiple pans or zooms. For instance, selecting one specific object from a cluster of similar objects requires zooming. Moving that object may require zooming out to find the new location, then zooming in close again to place it correctly. In these cases, marking up paper is still more user-friendly than editing on a PDA. (We can change the zoom factor on paper by just moving our faces closer to or farther from the page!) The larger screens of portable tablets may solve some of these editing issues.

Drawing functionality. Nevertheless, the benefits of editing in the field on any form factor may be enough to support the shift away from pencil and paper. As Michael Feilmeier, Arc Seconds Inc.'s (www.arcsecond.com) PocketCAD product Manager, notes, "It is one thing to indicate that you need to move a bathroom door six inches to the left. It is another thing to know that now your door hits the sink." While this relationship between the door and sink might also be evident in a paper plan drawing, using ultra-accurate CAD tools to edit the drawing leaves no doubt about the conflict. PocketCAD, is designed specifically for PDAs and enables data creation, collection, viewing, drawing, redlining, and modification with familiar CAD drawing tools. PocketCAD is compatible with any Windows CE (version 2.11 or higher) mobile device. As the large collection of icons at the bottom of the display (Figure 5) reveals, PocketCAD's designers want to maximize drawing functionality. Some of their editing techniques even take advantage of the PDA's thumb-wheel to pan or zoom while making edits with the pen.

Silence is golden?

In most vendors' mobile enterprise systems, scribbled edits are the only information wirelessly transmitted back to the central office. The concept of an invisible connection between a mobile device and a central office is initially seductive. The possibilities for increased efficiency, such as avoidance of repeat site visits, makes sense. Why, then, isn't every enterprise already taking advantage of the technology?

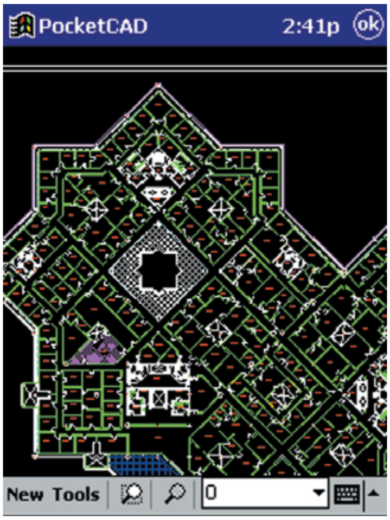

FIGURE 4 PocketCAD displays CAD architectural plan data of an office layout on a Compaq iPAQ.

Part of the answer may lie in the complexity of wireless systems. Though silent and invisible, the process has many cooperating parts that stretch far beyond the modem itself, and vendors are gradually developing the necessary partnerships to enable a smooth flow of data from start to finish. When packaged, these long-awaited unified solutions lead to fast growth of the companies offering them. For example, Discrete Wireless (www.discretewireless.com) was able to sign 125 service and distribution businesses as customers within the first 180 days of launching its vehicle tracking product called MARCUS.

MARCUS, for example. Vehicles carrying MARCUS devices appear as points tracked on an Internet map, but only after the data passes through a complex chain of linked technologies. Every 10 seconds, MARCUS uses a Trimble (www.trimble.com) GPS receiver to capture a latitude/longitude position from the satellite constellation in orbit around Earth. Then, every 5 minutes, MARCUS transmits the accumulated collection of position information (as well as vehicle engine state or other conditions) as individual 512-byte packets, sent in the order they were collected. (Recalling part two of this series, for speedy delivery the packet transfer protocol is a version of UDP called X25.)

FIGURE 5 PocketCAD's editing tools cater to those who rely on a variety of drawing options.

Each data packet travels over Cingular Wireless' (www.cingular.com) Mobitex network, described by the Mobitex Operators Association (www.mobitex.org) as "a dedicated, packet-switched, data-only network that is extremely reliable, always available, and optimized for the transmission of the short but frequent data exchanges occurring in a real-time traffic information system."

MARCUS' packets then arrive at a data center managed by Inflow (www.inflow.com), a company that promises "uptime all the time" for all computer equipment housed at its facilities with uninterruptible power supplies, backup generators, fire detection, raised floors, HVAC, separate cooling zones, humidity and temperature control, and physical security. Inflow's goal is to guarantee high reliability for all participants at reasonable prices achieved by economies of scale.

In the data center, Discrete Wireless' computers use a Delorme (www.delorme.com) mapping engine to create graphic maps that include the vehicle's location. Customers view the maps via a password-protected, Internet-hosted application that offers additional services including reverse geocoding of the vehicle position to a text address, alerts for speed violations, and automated alarms if a vehicle crosses a forbidden boundary.

Discrete Wireless' founder and vice-president, Jeff Thacher, reports that despite the complexities of this system, failures are rare. The GPS signal capture is one weak point. "Occasionally, strange things can happen at high speeds," says Thacher, citing proximity to a bridge as a source of GPS signal corruption. As for the network transmission, Cingular's service has been 99 percent reliable for Discrete Wireless' customers.

Modeling for success

Discrete Wireless' systems are relatively inexpensive. In April 2002, a single unit (the box, the GPS, and the radio frequency antenna) cost $799 plus a $75 installation fee. Monthly service fees for accessing the secure Internet map application were $34.95, which included the alerts and alarms.

Given Discrete Wireless' success in this market, one might expect the GIS vendors' strategies for wireless spatial data transfer to follow a similar path. Maybe because they are not selling turnkey solutions, though, GIS vendors seem reluctant to recommend any particular wireless infrastructure. Intergraph IntelliWhere (www.intelliwhere.com), for instance, uses a 10:1 compression technique to reduce the data size as much as possible in case the wireless connection is slow.

One small step . . .

Whether the mobile spatial enterprise has yet hit its stride remains arguable. If you're a utility, telecommunications firm, or local government with a pioneering spirit, though, it may be an excellent time to forge a relationship with any of the vendors eagerly seeking success stories, give them a long leash, and let them build a dream system in your backyard. The initial investment in hardware is low, so even if your field testers reject the system, the learning experience may be worth the entrance fee. If they embrace the technology, the payoff is in time saved due to the increased efficiency of instant spatial data access even when the office is far away. ⊕