Prototype for Next Generation Mobile Access to Satellite Data

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Introduction

Our Earth is a dynamic and interesting object of study. NASA's Earth Sciences Division at GSFC, located in Buildings 32 and 33, studies climatic change, atmospheric and ocean patterns, and forest ecosystems. The many earth-observing satellites operated by NASA return huge amounts of data for scientific analysis. For example, the MODIS instrument aboard the Terra satellite acquires 70 GB of data daily, from which 880 GB of science products are produced.

This large volume of data is often not easily accessible to scientists when it is most needed. Currently, a person wanting access to this data must be situated at a personal computer connected to the internet. We describe here the development of a more versatile and convenient system of data access through a wireless network for the handheld computing environment.

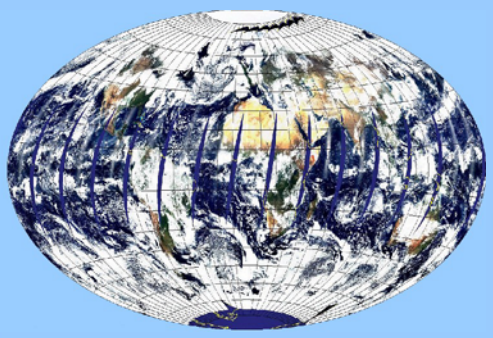

Figure 1: A typical finished data product – MODIS land surface reflectance

Typical Data Flow

Data are first transmitted from the satellite to the ground station, after which four levels of processing occur. The data are calibrated, time-ordered, and geo-located. Data products are then shipped to a DAAC (Distributed Active Archive Center), where they are archived and distributed to end-users in the scientific community.

The wireless network will provide convenient remote access to DAAC data to handheld computing devices. This will open the door to a new market for NASA s earth science data, with unprecedented data mobility and integration.

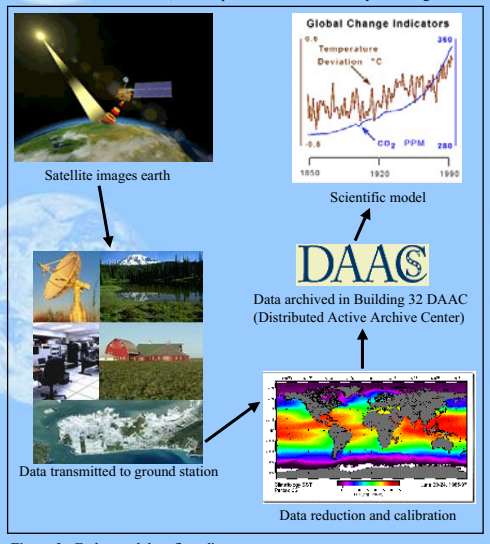

Figure 2: End-to-end data-flow diagram

The Hardware

Two of the major companies producing handheld computing devices running the PalmOS® operating system are Palm, Inc. (www.palm.com) and Handspring (www.handspring.com). Each produces several different models, ranging in price from $100 to $500. The Handspring models have an expansion port, called the Springboard™, which allow the Handsprings to be extended in a number of different ways. Magellan (www.magellangps.com) produces Springboard™-compatible GPS units, and Xircom (www.xircom.com) sells wireless Ethernet expansion cards. Our concept for a prototype integrates these three components in a wireless setting.

Figure 3:
Xircom Wireless Springboard Unit

Figure 4: Handspring Visor Palm

The Development Environment

Metrowerks (www.metrowerks.com) produces a suite of programs (called an Integrated Development Environment [IDE]) to simplify the process of creating software for the PalmOS®. The product is called Codewarrior®, and programming can be done in either C++ or plain C. Palm, Inc. also develops a desktop emulator of the PalmOS®. This allows the developer to write, debug, and prototype right on the desktop computer, without downloading to the handheld. This creates a more stable development environment, and the development cycle is greatly reduced.

Figure 5: Screenshot of desktop development environment

The Software

The client on the handheld communicates with the remote data server using TCP/IP (Transmission Control Protocol / Internet Protocol). The PalmOS® is a convenient operating system for development because of its simplicity and extensive library support. PalmOS® is equipped with a low-level network sockets library called NetLib, which simplifies the process of TCP/IP communication. A convention of messaging between the client and server helps to establish an abstraction barrier that simplifies system development. A local file cache allows the application to quickly access recently visited images and maps without relying on the network. The coordinates of the unit are obtained and cached by the Magellan GPS unit. The display shows the map, and allows for panning, zoom, and feature selection. A popup menu bar allows for fast navigation and access to connection options

Programming for the handheld presents its own set of obstacles. The display on most handhelds, already limited to 160 by 160 pixels, is usually 4-bit grayscale. The Visor Prism is the only exception, with 16-bit color. These limitations on display size and resolution present interesting challenges for displaying image data. An important question for investigation is: How to compress the images and yet render them efficiently on the handheld display?

Current Progress

We have developed the components for a first-configuration end-to-end prototype. Please feel free to play with the demo.

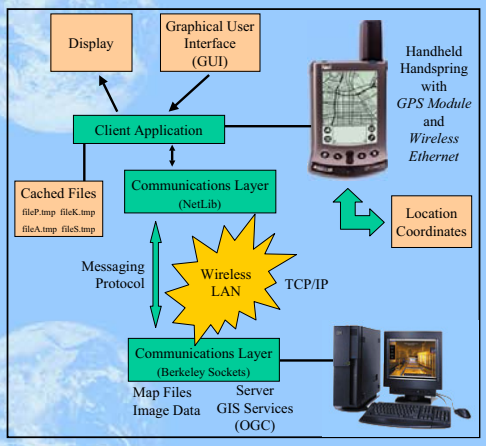

Figure 6: Application data-flow diagram (see description under 'The Software')

Future Applications

The flexibility, size, and power of handheld devices make them extremely versatile general-purpose machines with many possible applications. The application that we are developing is capable of general-purpose data transfer over a wireless Ethernet network. This project is funded in part by GSFC s Director s Discretionary Fund. Funding is also being sought under a collaborative venture with the U.S. Forestry Service. The men and women fighting a forest fire may in the future carry a GPS-equipped handheld device, which will allow them to see in real-time the spread of the fire, the available escape routes, and the locations of their fellow firefighters.

Another potential application is in the medical field. Physicians in a hospital setting are constantly working with large amounts of information, to which they need immediate access. Once an entire hospital is equipped with wireless network access, physicians can be automatically paged to their handhelds, and new patient information, emergency conditions, or data from lab measurements and instruments can be available immediately. The result is a more efficient, responsive, and friendly health care system. The market for such a system is very large, and already estimates show that up to 20% of physicians are currently using handheld devices in some matter in their practices.

Another possible market is field scientists and explorers, who are traveling to remote places where they need access to the network, but traditional computing is too large or inconvenient to carry. In the not-too-distant-future, we may even be able to launch and control a satellite right from the palm of our hand!

Acknowledgements

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