supported by NT. In other words, a network of DigiCORA III-based stations can form a scalable and automatic data and meteorological message relaying infrastructure for local, national and international needs.

Sounding software

The sounding software utilizes the advanced multi-tasking properties of Windows NT. This allows the software to run multiple sounding sessions concurrently, each of which can access a common data source. The soundings can be either live or sounding simulations using previously saved sounding data. At present only one of these can be a live sounding, but the architecture allows for operating multiple simultaneous live soundings from a single workstation, once the hardware capability becomes available.

DigiCORA III provides the user with a very rich collection of data from each sounding, as all received data can be saved and stored for later analysis. The database for storing soundings uses the Microsoft access format. Customers can therefore query the database with standard Microsoft Office 97 tools, like Excel 97. Separate API data access will be available in the future, allowing customers to make and use custom data processing and analysis tools to suit their specific requirements.

Meteorological messages

Several meteorological messages are available: the WMO standard messages, as well as BUFR and CREX. The NATO STANAG module extends the use of DigiCORA III to customers with tactical weather observation needs.

The available messages, parameters and message formats are specified in the DigiCORA III database. The user can predefine which messages should be generated at what time during or after the sounding. The user is also able to configure where the messages should be sent and whether a header or footer section should be appended. Real-time message generation is invoked utilizing the triggering server.

Orders for Upper Air Systems from North America

During September and October 2000, Vaisala received several substantial new orders from North America for its upper air observation system products. Deliveries will take place over the next three to five years.

“The orders include new upper air observation solutions for our customers, as well as additional orders for existing solutions. These new observation solutions have recently been introduced in North America, and the new orders confirm the market acceptance of the solutions. The North American market represents about one third of Vaisala’s annual sales and is an area of considerable potential for Vaisala in the future,” says Pekka Ketonen, President and CEO of Vaisala Group.

The US Department of Defense has placed an order for new upper air observation systems through Vaisala’s cooperation partner in the United States. These new Vaisala systems will measure upper air meteorological data. The order incorporates an initial engineering and manufacturing development phase for four systems. Production options are estimated to cover 82 additional systems. Furthermore, the Department of Defense has placed orders both for their annual radiosondes for the next five years and for 17 observation systems.

The US National Weather Service placed an order for radiosondes to be delivered in 2001 and 2002. According to the agreement Vaisala will deliver some 50,000 radiosondes annually, which represents about two thirds of the US national requirements for upper air weather observations.

Additionally, the Mexican Meteorological Office ordered radiosondes for use at all 14 of the national synoptic upper air stations in Mexico.

Aurora’s payload system was developed for high altitude dropsonde missions, for use on low speed platforms such as Pathfinder, Altus and Perseus B. Due to funding cuts, the dropsonde payload was not permitted to be deployed and operated from Pathfinder. Nevertheless, Aurora tested and qualified the payload for flight, using its high altitude test chambers. Vaisala’s drop sondes were an integral part of this scientific experiment. Researchers are using drop sondes to get a more accurate picture of hurricanes.
Aurora’s Research Project on the UAV Dropsonde Payload

Carrying Dropsondes into the Atmosphere

High altitude (over 55,000 feet) dropsonde missions can be flown from a very limited number of aircraft. These include NASA’s ER-2, AeroVironment’s Pathfinder UAV, General Atomic’s Altus, and Aurora’s Perseus B UAV,” says Glenn Jackson from Aurora.

High altitude research missions

Aurora’s payload system was developed for use on low speed platforms such as Perseus B. On these vehicles the payload dispenser is mounted on the wing and dispenses dropsondes via the ORBCOMM over-the-horizon communications system. Information on the payload position and status is sent back to the atmospheric researcher via the same over-the-horizon system. Radiosonde telemetry is received line-of-sight and ported onto the Internet via ORBCOMM. Researchers can monitor and control experiments remotely, thus reducing the cost and inconvenience of in-field deployments. Figure 1 is a high level schematic representation of the data flow during operations. This graph depicts the message pathways and the major components of the UAV dropsonde system.

On April 1, 1998, the high-altitude UAV dropsonde project was kicked-off with NASA ERAST funding. Mark Callender was the avionics and dropsonde engineer, and Will Marchant was the long-range communications and software engineer. Dr. John Langford, company president, provided technical advice and manage-
Figure 1. Operating concept of UAV dropsonde system.
ment direction. David Tsou, a student at Virginia Tech, joined the project as an engineering assistant. All of the design, fabrication, coding, testing, and assembly was carried out by this team. The Aurora manufacturing and quality group provided critical support, advice and assistance through design reviews and inspections. The NASA point-of-contact (POC) was John Del Frate from Dryden Flight Research Center and AeroVironment’s POC was Kirk Flint. To keep people focused on the task and to simplify communications for the customer, the project manager was the single point of contact for Aurora management, NASA and AeroVironment.

Thorough tests at high altitude chambers

The project relied heavily on off-the-shelf technology. “Testing was conducted in parallel with the engineering effort to prove designs and validate ideas. These tests included an engineering mock-up of the dropsonde dispenser, transceiver testing, payload computer breadboard testing, and dropsonde altitude testing,” says Dr. John Longford, President of Aurora. Additionally, Mark Callender traveled to Helsinki, Finland, and received training and technical support from Vaisala with regard to their hardware and software. Similarly, throughout the program, Vaisala engineers from the United States and Finland provided technical support by telephone and via the Internet.

“Due to funding cuts, the dropsonde payload was not permitted to be deployed or to operate from Pathfinder. Nevertheless, Aurora tested and qualified the payload for flight, using its high altitude test chambers. These tests demonstrated sonde drop and telemetry from as high as 70,000 feet and at temperatures as low as -50° C,” concludes Dr. Longford.

Requirements, design and testing

The system requirements were derived from Pathfinder interface guidelines, government range requirements, and NASA’s requirement to drop radiosondes above 55,000 feet. In this particular project, specifications were created to minimize the impact to the operations and performance of the Pathfinder UAV, while allowing for a meaningful demonstration of the system in operation.

According to Project Manager Glenn Jackson, two sets of integrated altitude chamber tests were conducted. Each test was completed with the hardware required for a Pathfinder deployment in Hawaii. The overall test duration was representative of the Pathfinder mission. Payload operations during the test were representative of operations on the Pathfinder and included complete power cycling and cold soaking of the payload. In total, 18 hours were spent operating the integrated payload.

“The payload consisted of a lightweight composite shell structure with provisions to be suspended under the wing via a strut. A microcontroller interfaces with the satellite transceiver and controls sonde release. The dispenser contains four Vaisala dropsondes, “says Glenn Jackson. (See Figure 2).

Dropsonde payload integrated in the altitude chamber

Before each test, Mark Cal- lender, Will Marchant, David Tsou and Glenn Jackson assembled and integrated the dropsonde payload in one of Aurora’s three altitude chambers. For testing purposes, an extruded aluminum strut was used to attach the payload to the altitude chamber support structure (See Figure 3).

<table>
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Table 1. Payload system specifications.

“GPS signals were fed into the chamber using an amplified GPS antenna. Thermocouples provided skin temperature measurements on the payload structure, dropsondes and avionics. Thermocouple data was recorded by hand and through a computerized data acquisition system. Electric power (12 VDC) was fed into the chamber and powered the ORBCOMM transceiver and the payload control system, as if the payload was integrated on Pathfinder,” explains Mark Callender. “Payload current draw was monitored with a current probe and the benchtop power supply’s current meter. A 400 MHz monopole was strung inside the chamber to pipe-out the telemetry signal from the dropsondes. This monopole was directly connected to the Vaisala telemetry transceiver. Data was ported to a laptop PC and processed in real time using Vaisala’s Dropview software. The altitude chamber door contained a window and the payload was positioned in such a way that on-board diagnostic LEDs were visible outside the chamber.”

70,000 feet altitude and -50°C ambient temperature reached

The testing took place on August 5, 1998. The sondes were repacked appropriately and loaded in the dispenser. The maximum altitude achieved was approximately 70,000 feet and the minimum ambient temperature reached was -50°C.