

IAC-03-P.5/T.5.04

**Learning Without Boundaries: A NASA – National Guard Bureau
Distance Learning Partnership**

**Christopher J. Chilelli, NASA/Johnson Space Center
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With a variety of high-quality live interactive educational programs originating at the Johnson Space Center in Houston, Texas and other space and research centers, the US space agency NASA (National Aeronautics and Space Administration) has a proud track record of connecting with students throughout the world and stimulating their creativity and collaborative skills by teaching them underlying scientific and technological underpinnings of space exploration. However, NASA desires to expand its outreach capability for this type of interactive instruction. In early 2002, NASA and the National Guard Bureau --- using the Guard's nationwide system of state-of-the-art classrooms and high bandwidth network --- began a collaboration to extend the reach of NASA content and educational programs to more of America's young people. Already, hundreds of elementary, middle, and high school students have visited Guard e-Learning facilities and participated in interactive NASA learning events. Topics have included experimental flight, satellite imagery-interpretation, and Mars exploration. Through this partnership, NASA and the National Guard are enabling local school systems throughout the United States (and, increasingly, the world) to use the excitement of space flight to encourage their students to become passionate about the possibility of one day serving as scientists, mathematicians, technologists, and engineers.

At the 54th International Astronautical Conference MAJ Stephan Picard, the guiding visionary behind the Guard's partnership with NASA, and Chris Chilelli, an educator and senior instructional designer at NASA, will share with attendees background on NASA's educational products and the National Guard's distributed learning network; will discuss the unique opportunity this partnership already has provided students and teachers throughout the United States; will offer insights into the formation by government entities of e-Learning partnerships with one another; and will suggest a possible future for the NASA – National Guard Bureau partnership, one potentially to include live multi-party interaction of hundreds of students in several countries with astronauts, scientists, engineers and designers. To inspire the next generation of explorers as only NASA can!

As a guide for us in writing our paper. What we said we did and what we said we would share. Last is what is the future of the collaboration

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1. NASA is providing a variety of high-quality live interactive educational programs.
2. NASA has a track record of connecting with students throughout the world and stimulating their creativity and collaborative skills by teaching them underlying scientific and technological underpinnings of space exploration.
3. NASA desires to expand its outreach capability for this type of interactive instruction.
4. In early 2002, NASA and the National Guard Bureau --- using the Guard's nationwide system of state-of-the-art classrooms and high bandwidth network --- began a collaboration to extend the reach of NASA content and educational programs to more of America's young people.
5. As a result hundreds more elementary, middle, and high school students have visited Guard e-Learning facilities and participated in interactive NASA learning events such as experimental flight, satellite imagery-interpretation, and Mars exploration.
6. Through this partnership, NASA and the National Guard are enabling local school systems, otherwise lacking this technology, a greater access to the excitement of space flight as together NASA and NGB help to encourage students to be passionate about the possibility of seeking careers as scientists, mathematicians, technologists, and engineers.

During the presentation NASA and NGB will share with attendees:

1. Background on NASA's educational products
2. The National Guard's distributed learning network
3. Unique opportunity this partnership already has provided students and teachers throughout the United States
4. Offer insights into the formation by government entities of e-Learning partnerships with one another
5. Suggest a possible future for the NASA – National Guard Bureau partnership, one potentially to include live multi-party interaction of hundreds of students in several countries with astronauts, scientists, engineers and designers. To inspire the next generation of explorers as only NASA can!

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Abstract

The National Aeronautics and Space Administration (NASA) has a long history of connecting students throughout the world with live, interactive, educational programs that provide the scientific and technological foundations of space exploration. As a result of NASA's goal to expand its outreach capability, early in 2002, NASA and the National Guard Bureau --- using the Guard's nationwide system of state-of-the-art classrooms and high bandwidth network --- began a collaboration to extend the reach of NASA content and educational programs to more of America's young people. Through this partnership, NASA and the National Guard are enabling local school systems throughout the United States (and, increasingly, the world) to use the excitement of space flight to encourage their students to become passionate about the possibility of one day serving as scientists, mathematicians, technologists, and engineers.

This paper introduces the dynamic partnership between NASA and the National Guard Bureau. This partnership leverages best practices in education, communications, and information technologies together with a discussion of the unique opportunity this partnership has already provided students and teachers throughout the United States; insight into the formation by government entities of e-Learning

partnerships with one another; and suggests the next step in the future for the NASA-National Guard Bureau partnership.

NGB/NASA Partnership

Through the direction of the United States Congress, the National Guard was tasked to create a cutting-edge e-Learning infrastructure of classrooms and connecting networks for the educational needs of its members, as well as students and adults throughout the local community.

This mission was given to the National Guard because of its unique status of being a centralized federal command with 50 state and 4 territories that report to individual state/territorial governors -- until mobilized to support national defense, security and/or combat operations as directed by the federal government.

Within a few months of the beginning of the NASA - National Guard partnership, hundreds of elementary, middle, and high school students visited Guard facilities participating in interactive NASA events. Through this partnership, both agencies began leveraging the excitement of space flight to encourage students across the United States and the world to become scientists, mathematicians, technologists, and engineers. This began the experience of learning without boundaries.

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NASA's Mission and Its Vision

Integral to this partnership is NASA'S vision for the future of our planet and the future of space exploration. This vision is:

- To improve life here
- To extend life to there
- To find life beyond

In order to meet this vision, part of the answer lies in executing NASA's mission:

- To understand and protect the earth
- To explore the Universe and search for life
- To inspire the next generation of explorers

The benefit we enjoy worldwide through American investment in NASA is exhibited daily in technology that improves everyday life. From medical devices to better tires, many of the products we use and experience have their origins in NASA technology.

NASA's continuing missions are expected to reveal complex interactions among the Earth's major systems, vastly improving weather, climate, earthquake, and volcanic eruption forecasting—and the impact that the sun has on our world. Evidence continues to mount for other possible origins of life on planets within our own solar system, as revealed by advanced generations of robotic explorers.

NASA's technologies have resulted in dramatic improvements in air transportation via higher-speed international travel and innovative measures to reduce aircraft accidents and delays.

But NASA's mission of understanding and protecting our planet and of exploring the universe cannot be accomplished if we do not have the people to do it. Employment opportunities in science and engineering are expected to increase at a rate almost four times greater than for all other occupations through this decade, while enrollment in science and engineering college courses has been in decline. America's best and brightest are being drawn into other professions.

NASA's vision of the future is to elevate education to a core mission. Its renewed focus to education means not only inspiring America's youth but also providing educators with the tools they need to teach and improve the country's literacy in science and math. NASA has those tools available today.

In short, NASA wants to make science, exploration and research exciting for students everywhere. By motivating our youngest generation now – from kindergarten through college - there is a greater prospect that this generation will choose to pursue scientific disciplines later.

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The Guard and Distance Learning

The National Guard Bureau's Distributive Training Technology Project (DTTP) is focused on providing access to the highest quality education, training and knowledge assets, tailored to individual needs and delivered cost-effectively, anywhere anytime. DTTP's high-speed network of approximately 320 classrooms enable support to Guard members and shared use partners at their kitchen tables, duty stations, mission staging areas, armories and in locations where access to advanced distributed learning and knowledge assets is needed.

By leveraging the appropriate DTTP assets, individuals, teams and communities can participate in learning activities across a continuum spanning: individual self-paced learning; individual/cohort-based blended learning; collective training and mission rehearsal; and organization-wide distributed simulations and war-gaming.

DTTP's broad range of resources and capabilities enable the National Guard and its partners to identify, create, and distribute course and content objects, expertise, job aids, and collaborative workspaces. These assets and activities sharpen the Guard and America's competitive edge in the military battle space and in the global economic marketplace.

National Guard Bureau Mission and Distance Learning

The National Guard Bureau, Army National Guard and Air National Guard carry out training to support their roles as an integral element in the Nation's ability to conduct mission operations in the event of a national or international crisis. In addition to the federal mission of supporting the Army and Air Force, the National Guard operates as a community-based operation. The National Guard operates over 3,300 armories and supports over 15,000 training, aviation and logistic facilities nationwide. Because there are Guard units in cities and towns all over America, state governors rely on the Guard's ability to rapidly respond and mobilize to handle emergencies, civil disturbances and natural disasters. Even though the Guard has more than 362,000 members, most are part-time with civilian careers and jobs. This poses a unique organization challenge for education and training.

To meet these challenges the Guard strives to leverage and integrate the best instructional methodologies, information systems, and communications technologies to deliver education, training, and performance-enhancing tools. To better train and prepare its members, the Chief, NGB has been designated by Congress as the Executive Agent to conduct the National Guard distance learning project, also known as the Distributive Training Technology Project

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(DTTP). This responsibility includes the overall design and implementation of the network backbone, delivery system, software, equipment installation, integration, and facilitating courseware availability. The DTTP currently consists of approximately 320 multimedia classrooms and has a leased, national Asynchronous Transfer Mode (ATM) communications network in place to support Distance Learning in all 50 states, three territories (Puerto Rico, U.S. Virgin Islands, and Guam), and the District of Columbia.

A Congressional Mandate for Shared Use

In addition to creating the first federal "enterprise-wide" distributed learning effort designed to impact over 500,000 personnel in over 3200 communities spanning 15 time zones, Congress gave the Guard the mission to pioneer the establishment and promotion of "shared usage" of the Guard's DTTP sites on a space available, reimbursable basis. The issues confronting today's National Guard are shared by all organizations in the public and private sectors and highlight shifting roles and responsibilities. The need to attract and retain high-quality personnel; the need to transfer knowledge in the face of attrition and increased operational requirements; the demand for enhanced communications; and budget constraints are relevant to every industry. The NGB's shared use partnerships leverage the DTTP's resources to effectively

address these universal problems. The partnerships encourage collaboration among these disparate entities, which promotes sharing of information, ideas, and technologies.

Moreover, the associated costs, including continual improvements and technical upgrades, make it virtually impossible for most agencies and organizations to establish a nationwide network to serve individual training and communications needs. However, the availability of the National Guard's resources on a reimbursable basis enables these organizations to use emerging technologies while minimizing related investment and infrastructure costs.

To the best of our knowledge, the NGB's partnership with other military entities, federal and state government agencies, businesses, industry, academia, and local communities through its shared use efforts is unique in the areas of federal government and of Distance Learning. Through Congressional mandate, the Guard's shared use activities involve the sharing of DTTP classrooms and resources on a space-available cost-reimbursable basis. Through this innovative federal business model, revenue generated through the shared use of equipment and services may be used to provide a continuous stream of funding for the system, while the collaborative nature of the partnerships enables other government agencies and local

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communities to satisfy their growing need for telecommunications, and provide remote access to learning resources, bridging the “digital divide”. In addition, DTTP partnerships help avoid duplicate Distance Learning efforts being conducted by these public and private organizations, while encouraging the sharing of information and lessons learned.

NASA’s Digital Learning Network

As NASA continues its education mission to inspire the next generation of explorers, instructional technology will play a crucial role in providing teachers and students meaningful encounters with NASA educators, engineers, researchers, and scientists. By consolidating the various processes that make up effective content delivery and using technologies such as videoconferencing, NASA seeks to reach greater numbers of educators and students with digital learning opportunities that engage and inspire the explorers of tomorrow.

Within the past five years NASA has begun to exploit the benefits of interactive video technologies in order to reach its diverse customers. NASA’s new Digital Learning Network (DLN) will seek to consolidate existing distance learning activities and resources within the agency and set new directions for collaborations between all ten NASA Research Centers and external educational organizations.

Three Centers in particular are using videoconferencing as part of their educational outreach efforts and have developed their own facilities apart from NASA’s main videoconferencing infrastructure. They are NASA Johnson Space Center (JSC) in Houston Texas; NASA Glenn Research Center (GRC) in Cleveland, Ohio; and NASA Langley Research Center (LaRC) in Hampton, Virginia. They have developed these digital learning initiatives independently and have recently been directed by NASA Headquarters to begin planning for a more collaborative approach.

To achieve this mission the Distance Learning Network will connect existing digital learning resources in the agency under a centralized management structure that will consolidate scheduling, training, technical expertise, and content design and development. Participating education offices will retain the unique characteristics that reflect the mission and research objectives of their field centers while collaborating with other centers’ digital learning activities.

NGB-NASA Partnership Activities

As part of the United States Congressional mandate to make the DTTP system available to its’ nation’s citizens, the National Guard Bureau began conducting joint NASA-National Guard classroom demonstrations in different locations nationwide. To date, the following highlighted activities demonstrate the variety and quality of

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this partnership, and more are being planned to engage students in different parts of the country:

- Through the DTTP classroom at the Regional Training Institute in Austin, Texas, junior high school students explored “Space Farming” with educators from NASA’s Johnson Space Center in Houston, Texas. Technicians established a third videoconference link to the DTTP classroom with the Advanced Distributed Learning (ADL) Co-Laboratory in Alexandria, Virginia, for Guard staff members to observe and evaluate the event.
- Middle-School students from Virginia, Maryland, and Texas with Johnson Space Center educators to study “Imagery from Space.” The hour-long videoconference linked DTTP classrooms at National Guard Bureau Headquarters in Arlington, Virginia, the ADL Co-Lab in Alexandria, Virginia and the Regional Training Institute in Austin, Texas with the NASA facility.
- Fourth-grade students from Woodbridge, Virginia connected with Johnson Space Center educators 1200 miles away to explore “The Effects of Space on the Human Body.” Students proposed counter-measures to reduce the effects of space with astronauts in microgravity.
- More than 200 children attending a National Guard summer camp, over several days at Camp Ripley, Minnesota, connected to NASA’s Langley Research Center in Hampton, Virginia allowing them to participate in several educational programs: “Understanding Our Weather”, “Planetary Exploration: Mars or Bust” and an overview of NASA’s robotic-exploration program for the next 10 years.
- Middle-school students from Anchorage, Alaska used DTTP network resources to study the principles of aerodynamics and powered flight with scientists at the NASA Glenn Research Center in Cleveland, Ohio. The National Guard Bureau’s DTTP and NASA conducted two sessions that provided more than three hours of connectivity. In addition, NASA’s Glenn Research Center coordinated a live webcast of the event that resulted in the participation of computer users in 26 U.S. states and 19 countries.
- STARBASE Academy instructors in Martinsburg and Charleston, West Virginia along with engineers at NASA’s Langley Research Center in Hampton, Virginia, led students through an aircraft flight simulation demonstrating “Principles of Flight”. Students learned about the fundamentals of powered

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- flight and the delicate balance of forces that enable aircraft to fly. Passive participants included: NASA Johnson Space Center, NASA Glenn Research Center, Ohio National Guard, National Guard Bureau in Arlington, Virginia and the Challenger Learning Center in Wheeling, West Virginia.
- The National Guard Bureau conducted a videoconference designed to advance a joint-classroom demonstration between NASA, the United States, and the United Kingdom, establishing an international reach for DTTP as a delivery mechanism. The subject matter, history of the Industrial Revolution (began in Telford, United Kingdom), was co-developed and team-taught between Montevideo High School in Minnesota and Telford in the United Kingdom.
 - Middle-school students from Columbus, Ohio's City Schools' Young Astronauts Program participated in "Comets in the Classroom" conducted by NASA Langley Research Center in Hampton, Virginia. Additional participants included three Columbus, Ohio schools and the NASA's Glenn Research Center.
 - Students from Franklin and Milford, Massachusetts participated in "Exploration of the Solar System" in reference to the launch of Mars Rover Spacecrafts. The programs led by NASA's Glenn Research Center in Cleveland, Ohio covered the history of space exploration from Sputnik to the mammoth rockets that reached the Moon and beyond.
 - The Massachusetts Army National Guard conducted two vide-conferences with the NASA Extreme Environment Mission Operations at NASA's Johnson Space Center. Students from the National Guard Blackstone Valley Young Marines in Milford, Massachusetts, in Bartlett and Austin, Texas participated in this Distance Learning Outpost Underwater Laboratory Event with the Aquarius Underwater Crew, highlighting communication skills that duplicated construction tasks in space, underwater, and in the classroom via video-conference.
 - The most ambitious NASA connection took place during a two week Minnesota Youth Camp at Camp Ripley in Brainerd, Minnesota. National Guard family school children participated in a 7-session educational event conducted by NASA's Langley Research Center on the "Centennial of Flight: The Wright Math" while continuous classroom connectivity was maintained between students and teachers.

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Students concluded their experience by testing the aerodynamics of their experimental kites.

- The National Guard Bureau supported the launch of a major new education initiative from NASA, the NASA Explorer Schools Program, where teams of teachers from competitively selected middle schools across the US will participate with, and be supported by, NASA during a three-year partnership. These Explorer Schools will work with NASA scientists and educators to spark creativity and develop innovative ways to teach science, mathematics, technology and engineering. The highlight of the ceremony included the announcement of the signed Memorandum Of Understanding (MOU) between the National Guard Bureau and NASA. This MOU completes the first step in the Shared Use Partnership for expanding the use of the NGB's DTTP Classrooms with NASA's educational content.

NASA's Distance Learning Outpost

An exemplary model for this wide ranging and in-depth educational mission is the collaborative partnership between NASA's Distance Learning Outpost (DLO), providing extensive space related educational content, and

the NGB's DTTP, providing an extensive national and global videoconferencing network.

NASA's Distance Learning Outpost (DLO) provides students and teachers an opportunity to participate in live, interactive videoconferences featuring "virtual" field trips where students interact with NASA experts, tour unique world-class facilities, and observe cutting-edge technologies. These interactive learning events are offered to K-12 and college students in classrooms throughout the United States and around the world.

DLO began in the mid 1990's with a team at JSC using videoconference equipment to connect classrooms across the country for 30-minute 'virtual' tours of the space flight training facilities at JSC. Today, the DLO hosts an expanding menu of educational topics through 25 connections each week, averaging 1,200 live events annually to an audience of K-12 and college students and their teachers in 50 states and 10 countries.

DLO Capabilities

Within NASA's new Vision and Mission the capability of NASA's DLO educational effort will potentially double. The concept of classrooms without walls or learning without boundaries, through distance learning technology will soon encompass three NASA hub sites (Johnson Space Center, Langley

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Research Center, and Glenn Research Center) with the ability to connect all ten NASA centers to classrooms across the country and the world.

The Distance Learning Outpost's education programs are aimed at inspiring students to achieve success in science, technology, engineering, and mathematics (STEM), as well as, creating learning opportunities. All are consistent with NASA's Educational Mission:

- To motivate students to pursue careers in science, technology, engineering, and math.
- To provide educators with unique teaching tools and experiences.
- To improve America's scientific literacy.
- To engage the public in shaping the experience of exploration and discovery.

DLO Educational Principles

DLO's Guiding Educational Principles are to:

- Encourage students to consider careers in science, mathematics, technology, and engineering.
- Partner within NASA and with other external organizations to increase accessibility.
- Continue the educational experience with students and teachers after each event through repeated experiences and relevant follow-up activities.

- Provide high quality, standards based, interactive educational programs.
- Utilize technology to reach a greater number of students and teachers.

These principals are met through two primary educational formats, Expeditions and Challenges, available for student and teacher participation.

Expedition Format

Each NASA-DLO Expedition features an integrated educational package of grade-appropriate, standards-based instructions and activities centered on a live interactive videoteleconference with a NASA-DLO education specialist or subject matter expert. Relevant on-line activities are listed under each DLO topic for classroom teacher selection to prepare students for each event. These activities are referred to during the event, allowing students to demonstrate and present their understanding and insights as it relates to the event topic. An increasing number of selected pre-event activities will focus on problem-based experiences. Each Expedition lasts 50 minutes with several prompted Q & A opportunities between NASA's DLO host and students. Topics to date include: Astronomy, Robotics, Geography, Microgravity, Aeronautics, History, Astroculture, and Careers, with others currently in development.

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Challenge Format

Each NASA-DLO Challenge provides an in-depth, multi-event, inquiry- based opportunity for students to explore, solve, interact with and formally present solutions to NASA's DLO education specialists or subject matter experts. Students participate in one of three Challenge areas: an engineering design problem, a research activity, or a mission operations problem.

Challenges usually involve two or three DLO connections. The first event connection is designed to introduce the Challenge and provide background-expectations for the students and their presentations at the conclusion of the Challenge. An optional second connection can be used to review, update, and suggest additional resource locations for students. The final connection allows for in-depth student presentations of their solutions to the NASA-DLO educational staff. Time is built in to allow for follow-up questions by the DLO host for the student teams to verify understanding and knowledge. Each event connection lasts 50 minutes. Topics to date include: Rocket Probability and Reliability, Aeronautic Shoebox Design, The Next Generation of Space Station, and others. These DLO event connections are made possible through ISDN (Integrated Services Digital Network) - H.320, IP (Internet Protocol) - H.323, and/or Internet connectivity web casting.

NASA plans for the Distance Learning Outpost to become the portal for students and teachers internationally seeking to experience the exploration of space. Through partnerships, collaboration, and a shared passion for learning, together, we will keep this spirit of discovery alive and ensure that there will be a next generation of explorers.

Future Plans

The first phase of the NASA/National Guard partnership relied heavily upon centralized control by the National Guard Bureau to ensure quality control, permit early mistakes to be of limited consequence, attain the political buy-in of NASA and Bureau leaders, and derive lessons learned to be applied prior to the initiative's attaining national scale.

By early 2003 successful partnership events were becoming routine. Intensive national oversight by the Bureau, once the norm, was no longer required. Moreover, a new political strategy was emerging within the Bureau, one in which the NASA partnership's potential benefits to states (e.g., favorable DTTP program publicity, increased use of classrooms, improved community relations) would be emphasized at the expense of continued nationally centralized control. Through implementation of this strategy at a time when the Congress was looking more closely at the level of use of DTTP by the various states, the Bureau hoped to

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demonstrate the increased relevance of the overall DTTP program to its intended beneficiaries --- in part through their increased participation in the NASA/NGB partnership.

Thus, earlier this year the National Guard Bureau actively began to promote the partnership to Distance Learning managers, and other Guard personnel, in each of the fifty states, the territories, and the District of Columbia. A sort of competition was created, in which each Distance Learning manager --- trying to offer at least the same level of service to their customers as those offered by other managers --- was made to feel that their service offerings would be incomplete if involvement with the NASA partnership was not part of the mix. As a result, states such as Minnesota, Massachusetts, Texas, Maryland, Virginia, Alaska, Ohio, and West Virginia have opened up their DTTP classrooms to children and teachers; involvement by additional states is imminently expected. Indeed, Minnesota has become such an enthusiastic participant in this endeavor that it has, over two consecutive years, involved youth summer campers, permitting several hundred young people to learn from and communicate with NASA instructors directly from its classrooms. The state's senior Guard leadership continues to seek out new ways, (including further partnership with United Kingdom distance learning personnel, who already had been working with NASA on international

distance learning initiatives), to provide innovative learning to the children in Minnesota.

In summary, this collaboration has generated widespread and continuing community use of DTTP classrooms. It has increased students' interest and participation nationwide in the study of mathematics, science and technology. Our goal now is to increase the reach of NASA's educational content through the comprehensive DTTP network of the National Guard and NASA's Distance Learning Outpost and NASA's Explorer School Program. As partners, we are committed to this goal.

(For more information about the National Guard Distributive Training Technology Program, log onto: <http://www.dttp.ngb.army.mil>.)

(For more information about the Distance Learning Outpost, log onto: <http://learningoutpost.jsc.nasa.gov>.)

(For more information about the wide range of NASA distance learning opportunities, log onto: <http://education.nasa.gov/fieldtrip.html>.)