

NYSERNet, Inc.
2011 Annual Report

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Dear Colleagues,

I am pleased to present the 2011 NYSERNet annual report. In the two years since these reports began to help articulate for a broader audience the work of the NYSERNet Board, staff, and community, and the possibilities enabled by advanced networks and network applications, the scope of the conversation has continued to broaden.

Some of this report is devoted to core competencies like advanced networks, optical infrastructure in New York City and statewide, the global peering and colocation facility in Manhattan, and our rapidly expanding education and training program. Our consortium started twenty-seven years ago to create what became the first statewide implementation of the Internet protocol, and with our members' guidance we have continued to enhance and evolve that core technology as it has assumed an ever more critical role in the research and education enterprise.

But our community, and the collaborations that it supports, is the cherished treasure that has enabled everything. In this report we discuss other collaborations such as our work with New York's K-12 schools, and the Regional Information Centers and BOCES that support them, and how they are driving a rapidly growing number of international collaborations. We talk about how our extraordinary strategic telecommunications partners Lightower, ION, and the Development Authority of the North Country, are working with us to expand the network's reach to new geographic areas and communities. The NYSERNet community is also part of the High Performance Computing Consortium, an effort by academic institutions, industry, and New York State to make advanced computing resources more widely available. We talked about this work in last year's report, but both the challenges we are undertaking and the number of HPC2 participants have grown extraordinarily since.

We all work to make our individual and collective efforts viable, but bigger challenges, like energy, climate, healthcare, and global financial stability, also drive us. Each of these is too hard for any of us alone to contemplate. As Ben Franklin aptly stated upon signing a document launching our great experiment in government, "We must all hang together, or assuredly we shall all hang separately."

Regards,

Timothy L Lance, President and Chair, NYSERNet, Inc.

HPC2 – Collaborating to Tackle Global Problems

How can we tackle problems bigger than any discipline, institution, or sector? How can we sustain the broad collaborations needed to address climate change, advancing healthcare, financial modeling? “With our partners in industry and government we began wrestling with these seminal questions some five years ago,” notes Rensselaer VP and CIO John Kolb, principal investigator on a NYSTAR grant supporting such collaborations in high performance computing (<http://hpc2.org/>), “and focused first on connecting problem solvers in industry and the academy with critical computational tools to solve the complex challenges that we face today.”

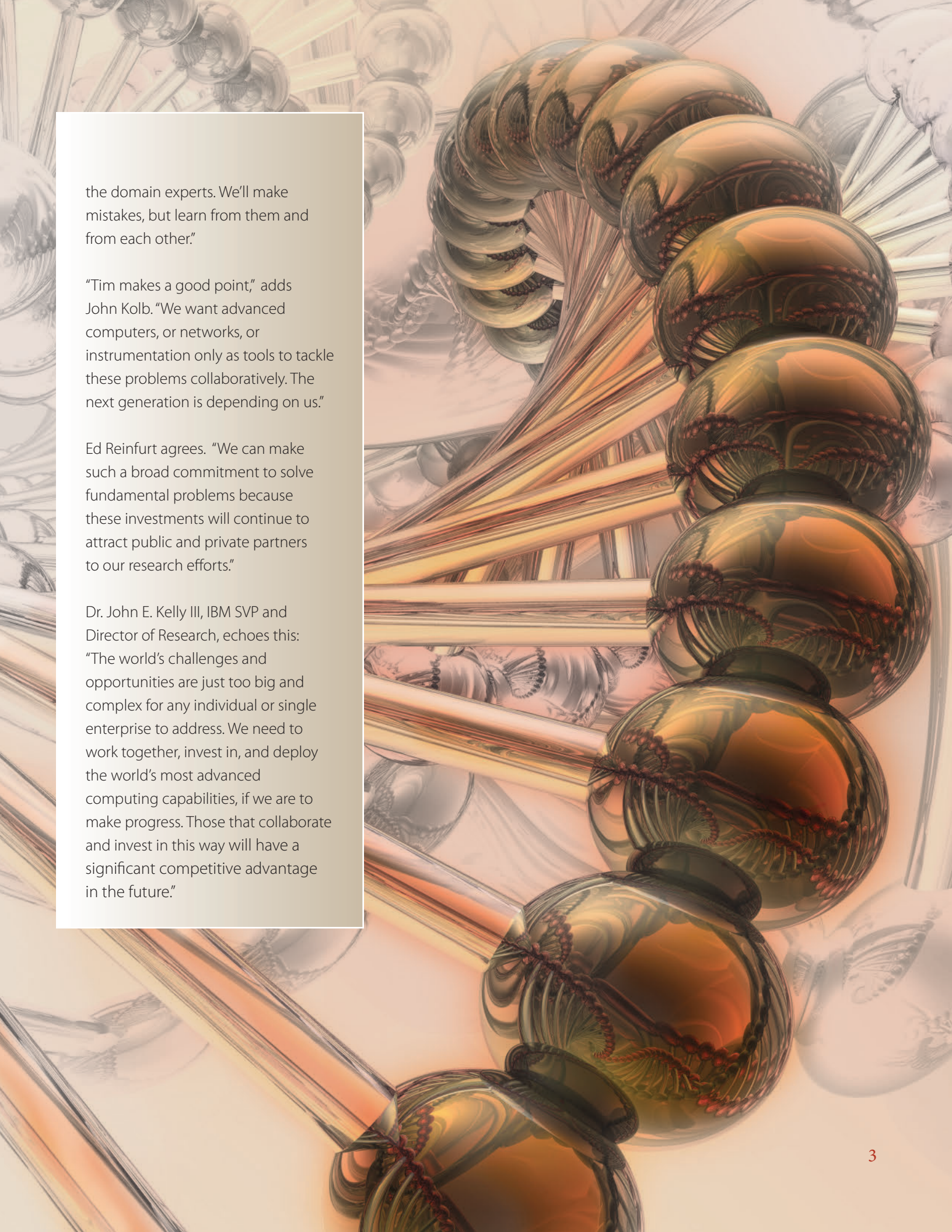
The High Performance Computing Consortium (HPC2) effort has advanced on several fronts: the power of the machines, the researchers and research areas using them, and the business community. “An effort like this could not go forward without balancing State support for basic research with the business needs and economic health of New York,” notes Edward Reinfurt, Director, Division of Science, Technology, and Innovation, Empire State Development, “I am delighted how the HPC2 consortium has balanced these dual needs and reached out to a broad community.”

“But is it really balancing?” asks Dr. Tom Furlani, Chief Information Officer of the University at Buffalo and Director of the Center for Computational Research. “With each use of advanced computing by researchers or industry we all learn—solving problems in either area provides insights in the other—it’s a symbiotic relationship to be sure, so perhaps ‘reinforcing’ or ‘amplifying’ might be a better way to describe our experience with HPC2. And there is magic in all of this, not only in basic research and application to manufacturing but it turns out that Harry Potter’s invisibility cloak needed high end computing.”

As data intensive problems proliferate, this effort helps determine which of a growing number of commercial cloud computing services or the dedicated massive machines in New York with tightly coupled code are best. “We will always be wrestling with this question as the computing landscape continues to change,” says Mr. Kolb. “This ongoing dialectic, focused not on a particular architecture but on how best to serve a diverse community, would be impossible without the trust that has long existed within NYSERNet.”

Researchers in biology and medicine have long used advanced computing for problems like protein folding and gene research, but excitement is building this year: a Blue Gene Q computer is coming to the University of Rochester, with a concurrent National Institute of Health grant awarded to Rochester lung researcher Dr. David Topham, partly based on this new computing capability. “We see convergence of informatics and high performance computing in biomedical research,” says Dr. Topham. “Low cost sequencing and sophisticated imaging and diagnostic technologies generate large, complex data sets that require powerful computational tools to analyze. The ultimate objectives are to predict severe disease before it happens, removing the pathogen’s invisibility cloak, if you will, and tailor medical treatments to the individual’s needs.”

“The problems we are tackling continue to expand in range, difficulty and urgency,” comments NYSERNet CEO Dr. Timothy Lance. “The HPC2 program is an effort by the entire community—academe, government, and industry—to make the computing resources essential for handling them available to



the domain experts. We'll make mistakes, but learn from them and from each other."

"Tim makes a good point," adds John Kolb. "We want advanced computers, or networks, or instrumentation only as tools to tackle these problems collaboratively. The next generation is depending on us."

Ed Reinfurt agrees. "We can make such a broad commitment to solve fundamental problems because these investments will continue to attract public and private partners to our research efforts."

Dr. John E. Kelly III, IBM SVP and Director of Research, echoes this: "The world's challenges and opportunities are just too big and complex for any individual or single enterprise to address. We need to work together, invest in, and deploy the world's most advanced computing capabilities, if we are to make progress. Those that collaborate and invest in this way will have a significant competitive advantage in the future."


Member Education

NYSERNet is committed to offering its members educational opportunities that promote collaboration and support the successful adoption and implementation of new technologies. In keeping with this commitment, NYSERNet increased the number of hands-on technical workshops offered members from eight in 2010 to nineteen in 2011. Topics covered in this year's sessions included: IPv6, BGP and Routing, MPLS and VRF in a Campus Environment, DNS & BIND, DNSSEC, and Fiber Optics Maintenance and Testing. Two hundred and fifty-five individuals representing thirty-six member institutions took part in these events. With the exception of the MPLS and DNS offerings, which were developed collaboratively with Internet2 and Internet Systems Consortium (ISC), all of this year's session content was developed and presented by NYSERNet staff. Participant evaluations of session instructors and content were uniformly outstanding.

NYSERNet expanded our educational collaborations with our peer Advanced Research Networks (ARNs) in 2011, piloting an on-line, hands-on BGP/Routing workshop with Merit Network and delivering two IPv6 Migration workshops at NJEDge's annual member conference in November. The BGP/Routing workshop will be available to Merit's and NYSERNet's members starting Q1 2012, with other ARNs also likely to participate. We are also developing an advanced network troubleshooting and performance testing workshop for delivery late 2012. The workshop will feature exercises based on real-world troubleshooting scenarios gleaned from the experiences of our members' top network engineers.

IPv6 drove another education related initiative in 2011. In July, we met with networking staff from Cornell University to discuss the implications for campus back office systems of implementation of IPv6. Meeting participants concluded that NYSERNet members would benefit from a broad discussion exploring these impacts, and Cornell and NYSERNet agreed to co-sponsor. The forum, which took place in Syracuse and online on November 15th, was attended by seventy-five network, information security, and systems engineers representing twenty-three institutions. Speakers from Cornell and NYSERNet presented on seven areas of chief concern: address management, network monitoring, security, support and performance, applications, wireless, and ISP-related issues. Working groups formed subsequent to the forum met virtually to consider each of the areas.

NYSERNet hosted its first annual Network Security and Engineering Technical Summit (*Tech Summit*) on May 18th in Syracuse. *Tech Summit* focused on security related topics, including incident response, PCI compliance, DNSSEC justification, and tools for intrusion detection. Institutions contributing presenters to *Tech Summit* included Cornell University, Columbia University, New York University, REN-ISAC, and Internet Systems Consortium. In all, sixty-five participants from thirty-five institutions met to discuss recent developments in the field. Our 2012 *Tech Summit* takes place May 23 at the American Museum of Natural History. The summit will feature sessions on PalRS/BayesianIDS, automated DMCA processing, and diagnosing and fixing network performance problems. There will also be a panel discussion relating solutions generated by the IPv6 working groups and a presentation on the Museum's new *AMNH Explorer* app for the iPhone.



The 2011 New York State Conference of Higher Education CIOs (NYSCIO): *Leadership and Developing the Next Generation of CIOs* drew seventy-two senior IT leaders from forty-nine academic institutions, both new attendance records for this conference. The event, which took place at Marist College, July 13-15, commenced with a presentation by Linda Sanford, Senior Vice President for IBM, who shared lessons she learned leading change at IBM. Charles Payne, Fox News contributor and founder of Wall Street Strategies, discussed how his formative experiences influenced his leadership style. Timothy Lance, President of NYSERNet, Rob Shanahan, President of Lightower Fiber Networks, and Mark Luker, Telecommunication Specialist with NTIA, spoke on the role of corporate/government/non-profit partnerships in developing advanced research networks. Jeanne Casares, CIO of RIT, presented on the leadership development framework that RIT ITS is employing to develop leaders in the organization. The meeting concluded with a presentation by Rob Dyson, CEO of Dyson-Kissner-Moran, speaking on the various types of leadership, and the defining characteristics and challenges associated with each. NYSCIO 2012, *Disruptive Technologies: Innovation and the New Reality*, takes place July 18-20 at the Rochester Institute of Technology.



Pioneering teachers throughout the world are using Research & Education networks to build partnerships, enhance the learning environment, bring cultural diversity into the classroom, and let students from around the world work together to study and try to understand challenges that are inherently global, like energy and climate change. Distance learning makes the teaching and learning experience interactive and collaborative, helping students develop critical thinking and problem solving skills by working with a broader community.

Is the research network necessary? Absolutely! The technology tools used in these distributed learning environments are very sensitive to network performance. R&E networks like NYSERNet's provide the performance essential for the proper execution of those tools and ultimate success of the distance learning experience. NYSERNet also helps teachers identify and promote new and exciting distance learning opportunities, overcoming another obstacle to classroom adoption: lack of time. Finally, NYSERNet acts as match-maker, bringing together teachers and classrooms from around the world to create learning opportunities like these that are dynamic, immersing and uniquely engaging:

- Exploring some of the astronomical data from telescopes in Hawaii and Chile, and using it to study astrological phenomena
- Participating in virtual concerts with professional musicians from around the world and taking master classes offered by some of the world's finest musicians
- Interacting with CERN physicists looking for clues to the birth of the universe
- Engaging NASA simulators to experience a spacewalk or land the shuttle
- Exploring the human body through NIH's Visible Human Project

In 2010, NYSERNet and JANET—the United Kingdom's R&E Network—created Teaching & Learning across the Pond (T&LAtP), the first virtual student exchange program exclusively available over R&E networks. Teaching & Learning across the Pond partners K-12 classrooms throughout New York State with their counterparts in the United Kingdom. Students in participating classrooms collaborate with their peers on STEM and Humanities projects, adding a unique cross-cultural dimension to the projects. Originally conceived to connect six to ten classrooms, the program has exceeded expectations. Twenty-four paired classrooms now participate, with ten more joining in early 2012. As word of T&LAtP has spread, teachers in other countries are asking how their schools can become involved, too. DANTE, which operates GÉANT, the pan-European R&E network, is working with eleven of the thirty-eight GÉANT connected countries to bring additional classrooms into the project. DANTE is also using T&LAtP as the foundation for a case study that will be used to promote distance learning integration in classrooms across Europe.


With the success of T&LAtP, NYSERNet and JANET are expanding the program to include special events. In April students from Scotia-Glenville High School participated in the first annual Cross Atlantic Alternative Energy Debate with students from Oaks Park High School in Essex, England. Over the course of ninety minutes, students debated the relative risks and merits of nuclear energy, bio-fuel, solar, wind, tidal and other alternatives as potential sources of energy. And Monroe #1 BOCES in Rochester, New York, is working with several of its schools to create a monthly student-created, student-produced newscast of international events specifically for 10-13 year olds worldwide. Monroe plans to distribute the program live using multicast, commencing in 2012.

Distance Learning over the NYSErNet R&E Network

“For the first time, I can point to a project that all of my students: average, over-achievers and under-achievers, participated in equally. The Cross Atlantic Energy Debate that NYSErNet facilitated fully engaged them, starting with the research and preparation stage, through rehearsals, the actual debate, and the post-presentation discussion. Even students that normally do not speak up in class were engaged and participatory.”

—James “Rick” Warren, English teacher,
Scotia-Glenville High School, Scotia, NY






NYC Metropolitan Fiber Network and Peering Hub

NYSERNet's Metropolitan Dark Fiber Network, now approaching its tenth anniversary, continues to demonstrate through growth in participation the principle argument supporting its construction: owning dark fiber enables the development and operation of networks that are cost-effective, robust, flexible, and effectively future-proof.

In 2011, we welcomed a new partner to our dark fiber program, the most significant of many developments for the network and the peering hub this year. With its purchase of Lexent Metro Connect, Lighttower Fiber Networks assumed operational responsibility for the entire 1500-mile network, adding to its already substantial New England and New York footprint. The resulting transition in operational responsibility went exceptionally smoothly thanks to the diligence and hard work of both Lexent and Lighttower. We and our members look forward to exploring the opportunities for network expansion the acquisition promises.

In 2011, The New School became the latest participant in the program with the completion in Q1 of its new fiber ring. Participation by institutions already connected increased as well, with the City University of New York, Mount Sinai School of Medicine, and



New York University adding sites to existing fiber loops. Other participants invested in equipment upgrades designed to add capacity and new functionality to their existing networks, for them the second generation of equipment used to light their fiber rings. Several other fiber expansion projects underway at the end of 2011 will complete in 2012, adding yet more sites and fiber miles to this vital networking resource.

Despite the improving economy, IT budgets remained under pressure in 2011. To help reduce the stress, NYSERNet accelerated a plan to renew member dark fiber leases through 2017. By offering participants the opportunity to renew these leases in 2011 instead of 2014, NYSERNet was able to extend them immediate savings, while providing them a firm base for long-term budget projections. By the end of 2011, all of the institutions eligible to renew their fiber leases had either done so or were in the process of so doing.

Central to NYSERNet's Metropolitan Fiber Network is our Global Peering Hub. Home to the NYC network nodes of Internet2, National LambdaRail, ESnet, and USLHCNet, as well as international networks like CANARIE and NORDUnet, the hub is the most important exchange point for international research and education traffic on the east coast. To ensure the hub continues to meet participating institutions' ever-increasing demands for reliable power, NYSERNet upgraded the facilities' DC power plant in 2011. Planning for a refresh of the hub's backup battery plant commenced soon after. The battery plant project is scheduled for completion in Q1 2012.



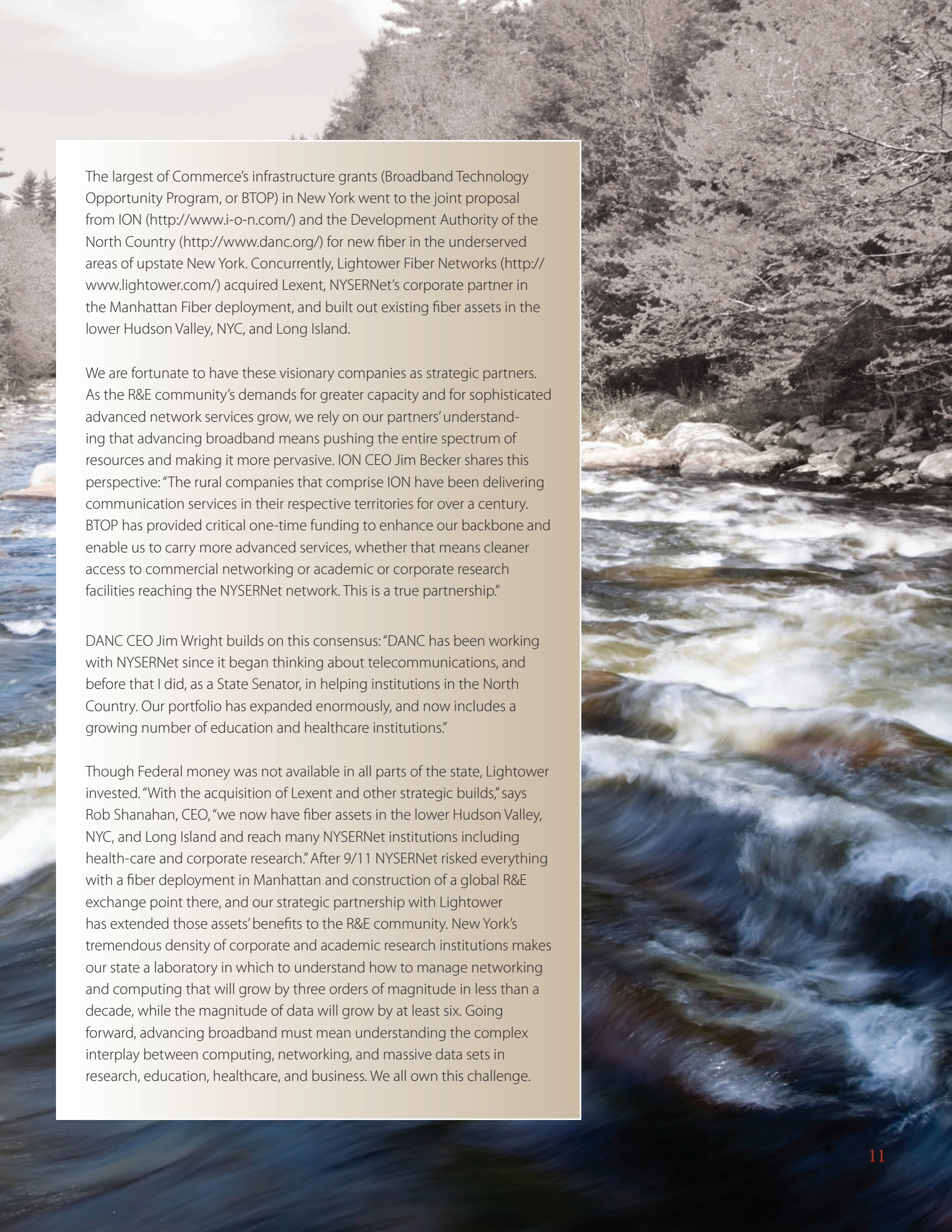
Raising All Boats

Sustaining the Ever-Evolving Network

Though “broadband” is particularly popular in public and political discourse, no consensus regarding that term’s definition has emerged, nor is its rapid evolution often discussed. In 1987, when NYSERNet’s initial backbone became the first to employ the Internet protocol outside of the United States Government, “broadband,” not yet in the vernacular, would have meant 56 kilobits per second, and that backbone, and those of NSFNET and other regional networks soon to follow, then comprised the Internet’s totality.

Within two years those inaugural backbones had been upgraded to 1.54 megabits per second, NYSERNet had spun off PSInet, the first commercial Internet service provider, which was speedily joined by other regional networks’ commercial ISP spin offs, and major carriers had begun to offer Internet services. But 56 kbps circuits were still in use, bandwidth had become an accelerating spectrum of possibilities, and the web’s emergence, a host of Internet applications, and commercial providers had begun transforming the Internet from exciting experiment to core infrastructure.

Given network capacity and capability’s continuing explosion, how can we best increase and extend the benefits of broadband? In March 2010 the FCC released its national broadband plan, and in late 2009 and summer 2010 the Departments of Commerce and Agriculture awarded several billion dollars for grants and loans, primarily for middle mile infrastructure in rural areas.



The largest of Commerce's infrastructure grants (Broadband Technology Opportunity Program, or BTOP) in New York went to the joint proposal from ION (<http://www.i-o-n.com/>) and the Development Authority of the North Country (<http://www.danc.org/>) for new fiber in the underserved areas of upstate New York. Concurrently, Lighttower Fiber Networks (<http://www.lighttower.com/>) acquired Lexent, NYSERNet's corporate partner in the Manhattan Fiber deployment, and built out existing fiber assets in the lower Hudson Valley, NYC, and Long Island.

We are fortunate to have these visionary companies as strategic partners. As the R&E community's demands for greater capacity and for sophisticated advanced network services grow, we rely on our partners' understanding that advancing broadband means pushing the entire spectrum of resources and making it more pervasive. ION CEO Jim Becker shares this perspective: "The rural companies that comprise ION have been delivering communication services in their respective territories for over a century. BTOP has provided critical one-time funding to enhance our backbone and enable us to carry more advanced services, whether that means cleaner access to commercial networking or academic or corporate research facilities reaching the NYSERNet network. This is a true partnership."

DANC CEO Jim Wright builds on this consensus: "DANC has been working with NYSERNet since it began thinking about telecommunications, and before that I did, as a State Senator, in helping institutions in the North Country. Our portfolio has expanded enormously, and now includes a growing number of education and healthcare institutions."

Though Federal money was not available in all parts of the state, Lighttower invested. "With the acquisition of Lexent and other strategic builds," says Rob Shanahan, CEO, "we now have fiber assets in the lower Hudson Valley, NYC, and Long Island and reach many NYSERNet institutions including health-care and corporate research." After 9/11 NYSERNet risked everything with a fiber deployment in Manhattan and construction of a global R&E exchange point there, and our strategic partnership with Lighttower has extended those assets' benefits to the R&E community. New York's tremendous density of corporate and academic research institutions makes our state a laboratory in which to understand how to manage networking and computing that will grow by three orders of magnitude in less than a decade, while the magnitude of data will grow by at least six. Going forward, advancing broadband must mean understanding the complex interplay between computing, networking, and massive data sets in research, education, healthcare, and business. We all own this challenge.




Research & Education Network

In 2011, the NYSERNet statewide optical network marked its sixth birthday; that's young for a child, middle-aged for a dog, and for many networks it would mean retirement is near. Ours, though, was created just as two new technologies were becoming available: reconfigurable optical networks and direct connections between the optical and routing layers. Together they gave the network a powerful combination of flexibility and pent-up capacity.

On the day it first carried traffic, the busiest part of the fiber optic backbone had six separate gigabit Ethernet circuits - fast for that time, quite pedestrian in today's world. But from that very first day, capacity was already built in for 320 gigabits per second, and if we reach that limit there are ways to add even more. The R&E routers have gone from 1 to 10 gigabit Ethernet, with plenty of growth still in them and upgrades on the calendar for 2012. Back in 2005 our members, not knowing what their future needs would be, installed their own fiber optic paths to reach the network, more than enough for their initial needs and now serving as multi-gigabit paths for R&E, commercial and private connections.

This kind of future-proofing isn't always possible, and it is especially difficult in an environment where new technologies, research projects and experimental environments arrive all the time. The NYSERNet network is well-equipped for that challenge by providing a platform to implement multiple services, ranging from production networking to highly experimental projects that need extensive resources but can't be allowed to interfere with other network users.


In late 2010 the NYSERNet Board approved a new membership tier that includes a full gigabit connection to the network. Eleven member institutions moved



into that tier during the past year. With such large connections into the high-performance network we are commonly seeing individual researchers able to use most of the campus bandwidth with a single data transfer. Rates of 1 gigabit per second may seem incredibly fast, but when your dataset is several terabytes, anything slower simply won't work. In response to this growing demand the network is now able to provide connections at up to 10 gigabits per second; backbone upgrades beginning in early 2012 will spread that capacity across the state.

Our involvement in experimental and research networking continues with member-driven engagement in circuit-based, dynamic networking and the still experimental but rapidly progressing world of Software Defined Networks. The network will provide members with access to national-scale testbeds like GENI, enabling network researchers while keeping the network stable and available for all research and education users. In 2012 we will begin to experiment with OpenFlow, the cutting-edge technology that will allow software control of network devices.

As we look forward to the next year, the NYSERNet backbone continues to serve in its original role as a high-performance gateway to the world of research networking, connects our members to each other and to other NYSERNet services, and provides a platform for our future development. We look forward to 2012 knowing that our community can continue to build on its solid foundation.




VMware ELA

On the 30th of June, 2011, NYSERNet executed an Enterprise License Agreement (ELA) with VMware. Under its terms, NYSERNet members are eligible to purchase VMware and Zimbra software licenses from NYSERNet—with VMware's 24x7 Production Support included – for significantly less than VMware's standard academic price. As a bonus, NYSERNet members were offered the opportunity in June and September to renew existing software support contracts and upgrade them to VMware's Production Support (SnS) level.

The decision to enter into the ELA grew out of a working group of representatives from member institutions formed in 2010 to help identify opportunities for new NYSERNet services. Group members reviewed NYSERNet's then current offerings, considered findings from a survey NYSERNet conducted of our peer regional networks' service offerings, and heard presentations from a variety of technology vendors. The group ultimately identified several ideas meriting additional exploration, chief among these the potential for savings from the aggregation of demand for software licenses.

The decision to work with VMware to develop the new service was easy. VMware's software is widely used by NYSERNet's members, and they understand its value. Several of our peer regional networks – Merit Network, NJEDge.Net and OARnet – had already negotiated successful ELAs with VMware and generously offered to share their knowledge and experience with us. Central to our decision, however, was the commitment of our members to make their VMware purchases through NYSERNet.

The background of the page is a photograph of a server room. On the right side, there are several rows of server racks. The racks are dark-colored with perforated doors. In the foreground, a rack door is slightly open, revealing a silver handle. The lighting is dramatic, with bright yellow and orange light trails or beams of light crisscrossing the scene, creating a sense of motion and energy. The overall color palette is dominated by these warm tones and the dark greys of the server hardware.

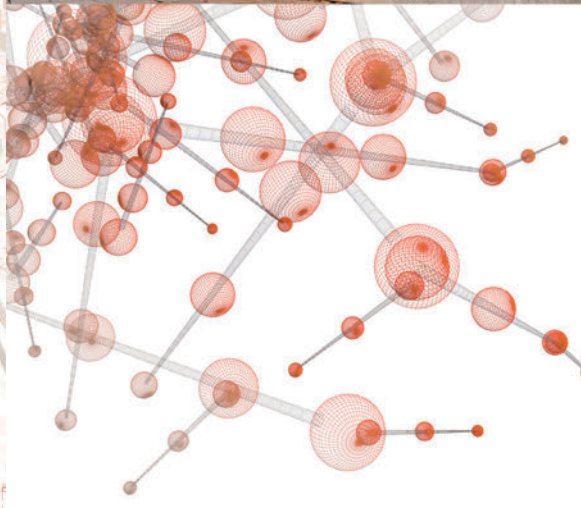
Subsequent to signing the ELA, NYSERNet and VMware collaborated on a series of webinars to raise awareness about the new program and encourage participation. More than one hundred individuals representing fifty institutions participated in these events, drawn by the promise of savings in the midst of a challenging budgetary climate. Many represented institutions that had never before participated in NYSERNet. Their response to the program was overwhelmingly positive. By the end of 2011, we had nearly fulfilled our commitment to VMware, while participating institutions had saved in excess of \$350K on new licenses and SnS renewals.

We anticipate our relationship with VMware will only grow in the benefits accruing to members. In 2012, our goal is to expand participation in the ELA beyond the early adopters, as we promote the program's benefits and savings to New York's broader K12 and higher education communities. In parallel, NYSERNet and VMware are exploring building a community cloud service based in NYSERNet's Syracuse data center that will provide members access to virtual machines and disaster recovery resources. Training, too, will be part of the program. NYSERNet is working with VMware's Education Services group to provide our members with convenient, affordable access to VMware's many training offerings.

Based upon the success of this program, NYSERNet is gauging the potential of expanding it to include other software vendors. As with the VMware ELA, the amount of the potential savings combined with the level of member interest will ultimately determine whether or not we expand NYSERNet's ELA portfolio.

Member Institutions & Project Participants

Alfred University	Hofstra University	St. John's University
The American Museum of Natural History	IBM Watson Research Center	SINET
ARTstor	Information Technology Exchange Center	Skidmore College
Binghamton University	Internet2	Stony Brook University
Buffalo State College	Le Moyne College	SUNY College of Environmental Science and Forestry
CANARIE	Madison-Oneida BOCES	State University of New York at Geneseo
Canisius College	MAGPI	State University of New York at Potsdam
Capital Region BOCES/NERIC	Marist College	Syracuse University
City University of New York	Massachusetts Institute of Technology	Teachers College, Columbia University
Clarkson University	Monroe #1 BOCES/Monroe #1 RIC	TWAREN
Colgate University	Mount Sinai School of Medicine	University at Albany
Columbia University	National LambdaRail	University at Buffalo
Cornell University	The New School	University of Rochester
Corning Community College	New York Presbyterian Hospital	Upstate Medical University
Daemen College	New York University	USLHCNet/CERN
DANTE	NORDUnet	Weill Medical College of Cornell University
Eastern Suffolk BOCES/ESRIC	Onondaga-Cortland-Madison BOCES/CNYRIC	Weill Medical College of Cornell University in Qatar
Erie #1 BOCES/WNYRIC	Rensselaer Polytechnic Institute	Yeshiva University
Erie Community College	Rochester Institute of Technology	
Fordham University	The Rockefeller University	



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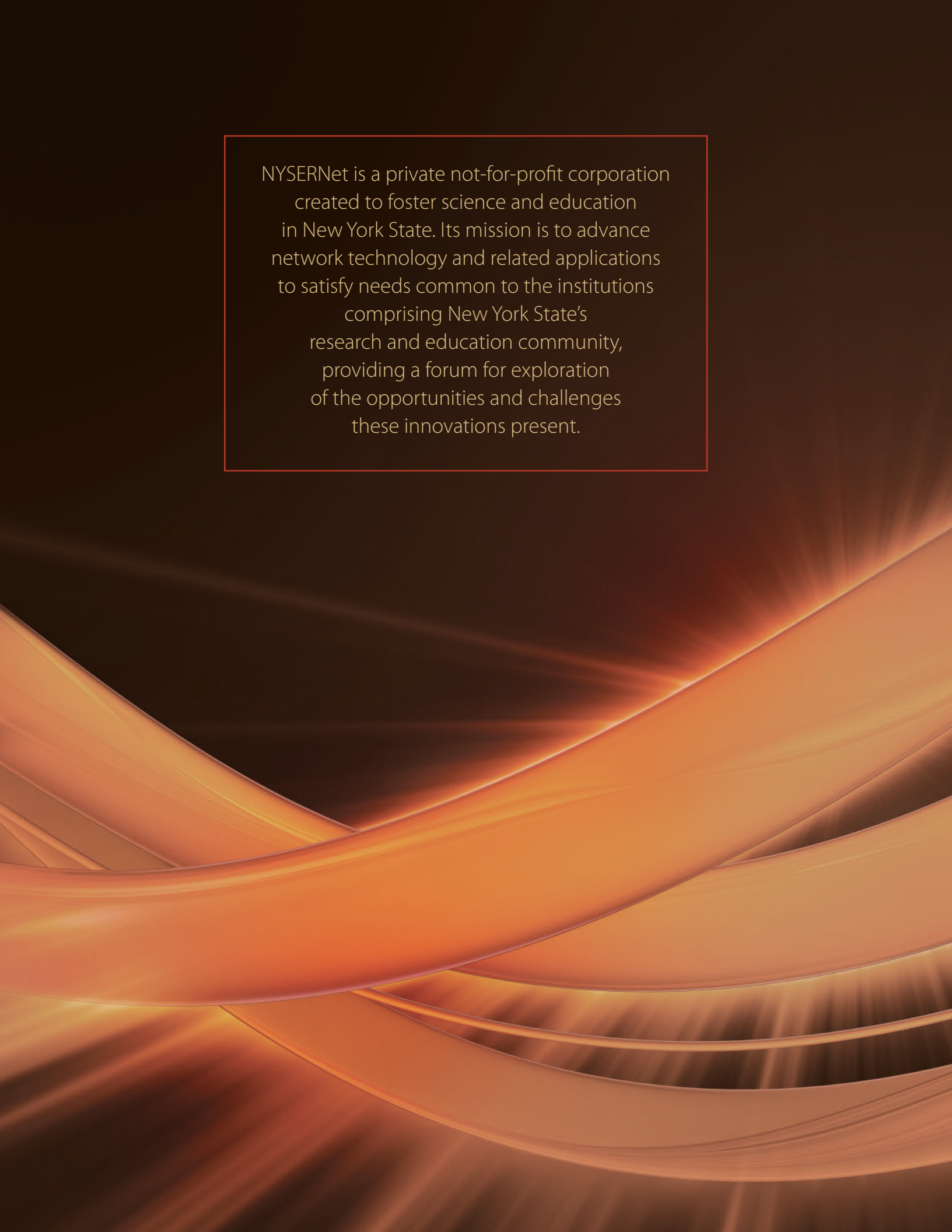
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NYSERNet is a private not-for-profit corporation created to foster science and education in New York State. Its mission is to advance network technology and related applications to satisfy needs common to the institutions comprising New York State's research and education community, providing a forum for exploration of the opportunities and challenges these innovations present.