

2009

Cyberinfrastructure (CI) in Kentucky

A Framework for Strategic Planning

At the request of the National Science Foundation, the Kentucky Experimental Program to Stimulate Competitive Research has conducted a strategic planning exercise to support the development of Cyberinfrastructure in Kentucky. This report is the result of input by a multi-institutional steering committee and a workshop in which several different sectors of Kentucky society participated. This report covers the current state of cyberinfrastructure in the Commonwealth, and makes recommendations for augmenting it in the future. These recommendations are to be aligned with the future needs of Kentucky, such as energy production and consumption, increasing the effectiveness and efficiency of health services, improving resources to carry out research and providing better education, and promoting economic development.

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VISION

A public and private sector collaboration improving the quality of life in Kentucky through the judicious use and leveraging of technology

As we emerge from the second largest economic crisis in 100 years, we may be at a unique point in time where our states are rethinking economies; and business approaches and investments have at their doorstep a maturing set of information technologies that permeate all facets of our lives. These technologies, however, are not yet fully integrated in either a business or technical sense. And while opportunities abound, much work lies ahead in building new and strengthening existing partnerships, breaking down technology silos and reaching out to our citizens who may still live on the other side of the digital divide.

This report suggests a framework for action.

BACKGROUND AND PROCESS

Note: Appendix D provides a set of definitions for the acronyms and technical references in this document.

Recognizing the criticality of a vibrant cyberinfrastructure to research, education, healthcare and economic development for the state, the Kentucky Statewide Experimental Program to Stimulate Competitive Research (EPSCoR) program launched an effort to build a cyberinfrastructure (CI) roadmap as part of its overall strategic plan for research.

A diverse steering committee of distinguished individuals from the public and private sector was formed in May 2009 (See Appendix C) and met on May 29, 2009 to plan a workshop, which was held on July 23-24, 2009. The steering committee met again at the workshop endorsed the importance of CI to future education, health care and research progress as well as economic development within the state and converged on a vision for a statewide plan for cyberinfrastructure in Kentucky.

Members of the CI Steering Committee identified lead planning efforts in each of four strategic focus areas. Planning efforts will include shaping a prioritized agenda for each of the strategic areas with subsequent mapping of a cyberinfrastructure plan to achieve the defined objectives.

This document outlines a framework for action. The four themes or directions (**4 E's**) identified were: **energy efficiency, eHealth services, education and outreach** and **economic development**. An initial set of goals, actions and metrics for each of these areas is outlined. Lead partners in each collaboration should be identified to coordinate that effort. Strategic partners from the private sector are necessary for the full deployment and integration of a next generation cyberinfrastructure for the state. This may sometimes be difficult given the inherent competitive nature of the private sector. A part of CI includes a shared common infrastructure that could form a *competitive platform* for all citizens including public and private entities from which to compete. Innovative arrangements such as “pre-competitive” and “pre-commercial” collaborations should be explored to insure that critical, common pieces of the infrastructure are developed and deployed.

Bringing new technologies and approaches and a comprehensive focus on these strategic areas will enhance research, education, and economic development for the state and also allow the new technologies and new economies to not only reach out to citizens in all parts of the state, but also empower those citizens to effectively use and engage the resources.

Presently, the skills, intellectual capabilities and insights of many researchers working in Kentucky are among the best in the nation. Yet our researchers are unable to compete for grant monies in many federal agencies because the state lacks what is considered basic cyberinfrastructure necessary to apply for the funding.

Although this document has its roots in the National Science Foundation (NSF) whose mission is to advance science in the United States, we should be reminded that it was out of some of the early NSF programs in cyberinfrastructure that Mosaic was born, leading to an opening of the World Wide Web to the general public and the foundations of e-commerce as we know it today.

Cyberinfrastructure supporting science can and will impact our economy.

CYBERINFRASTRUCTURE DEFINED

The lead article in the July 2008 edition of *EDUCAUSE Review* notes that the idea of cyberinfrastructure and the word itself moved more widely into use after the 2003 publication of the report by the National Science Foundation Blue-Ribbon Advisory Panel on Cyberinfrastructure. The report, *Revolutionizing Science and Engineering through Cyberinfrastructure*, stated:

“The term *infrastructure* has been used since the 1920s to refer collectively to the roads, power grids, telephone systems, bridges, rail lines, and similar public works that are required for an industrial economy to function. Although good infrastructure is often taken for granted and noticed only when it stops functioning, it is among the most complex and expensive thing[s] that society creates. The newer term *cyberinfrastructure* refers to infrastructure based upon distributed computer, information and communication technology. If *infrastructure* is required for an *industrial* economy, then we could say that *cyberinfrastructure* is required for a *knowledge* economy.”¹

More than the Internet

Cyberinfrastructure differs from traditional web and broadband access in its focus and magnitude. Consumer broadband allows us to watch movies online, quickly download music files, or use visually engaging and media-rich online learning resources. In contrast, the high-performance computing and networking resources of cyberinfrastructure enable researchers, for example, to create fully interactive, three-dimensional models of severe weather systems and to make those models available to other researchers across the country—instantly, at any time. CI resources give scientists and educators opportunities to create and collaborate in entirely new contexts—to *experience* processes and results even if the technologies and data sets are thousands of miles away.

Cyberinfrastructure will play an increasingly important role in the management of human health. New diagnostic modalities, as well as electronic medical record keeping and transmission, will increase the quality and outcomes of medical care while reducing costs. Likewise, cyberinfrastructure will be an enabler for ‘smart’ electrical grids that offer new levels of energy generation and usage efficiencies thereby increasing our energy security. CI’s role in a knowledge-based economy is invaluable.

¹ <http://www.nsf.gov/cise/sci/reports/atkins.pdf>

STRATEGIC FOCUS AREAS – THE 4 Es

Workshop attendees including the steering committee converged strongly on the four “E” themes. A set of goals and strategic actions for each area follows:

1 **EDUCATION, RESEARCH and OUTREACH**

Goal: *Develop a robust cyberinfrastructure backbone connecting Kentucky educational centers.*

Strategic Actions:

1. Extend the Kentucky Regional Optical Network (KyRON) backbone level connectivity to Kentucky’s comprehensive universities and the Kentucky Independent Colleges and Universities.
2. Subsequently, establish KyRON backbone connections with the 67 campuses of the Kentucky Community and Technical College System (KCTCS).
3. Expand KyRON through KCTCS links to K-12 institutions and public libraries which are the primary connection points between rural communities and the internet.

Goal: *Provide for the implementation of cyber-tools, software and relevant education and training that enable integration into and utilization of statewide cyber resources*

Strategic Actions:

1. ***Review existing capabilities and programs within the state.***
2. ***Review available funding opportunities to build foundational programs that supplement existing programs***
3. ***Assess the appropriate advocacy position for the coalition and/or coordinating role***

Goal: Encourage and support private sector connections with the KyRON tree of networks for the accomplishment of research and education related activities. This goal should not provide competition with private sector Internet Service Providers (ISPs).

Strategic Actions:

1. Work with private sector to provide KyRON level access to the private sector.
2. Encourage local communities to connect hospitals, clinics and doctor offices.

Goal: Develop the human resources needed to expand and support Kentucky's entire cyberinfrastructure including other strategic focus areas.

Strategic Actions:

1. Conduct assessment of anticipated human resource needs and current capacity of academic curriculums to meet those needs.
2. Work with the Council on Postsecondary Education (CPE) to ensure that Kentucky's academic community has the budgetary resources needed to meet human resource needs.

2 e-HEALTH

Goal: Develop a secure, interoperable electronic health network and technical support resources to enable the rapid adoption of e-health technologies to improve the quality and cost-effectiveness of health care and to provide access to useful, timely and accurate health information.

Strategic Actions:

1. Establish partnerships with the following organizations to insure a balanced cyberinfrastructure approach: Governor's Office of eHealth; eHealth Board and eHealth Authority
2. Identify existing and create new data centers to provide administrative and disaster recovery/business continuity support for rural/remote physician systems.

3. Develop broadband capability for transmission of high information content data between medical centers, data centers, rural health clinics and consumers/homes.
4. Establish CI standards and operational protocols in accordance with those supported by the Kentucky eHealth Network Board and required by the Office of the National Coordinator for Health Information Technology (ONC)

KY eHealth Network Board: <http://ehealth.ky.gov/board/Pages/default.aspx>

ONC: <http://healthit.hhs.gov/portal/server.pt?open=512&mode=2&cached=true&objID=1200>

5. Align and integrate federally funded Kentucky academic research activities when feasible to support e-health enablement.

3 ENERGY

Goal: *Develop a CI enabled “smart grid” network to achieve electrical generation and distribution system efficiencies and real-time feedback in consumer homes.*

Strategic Actions:

1. Develop the necessary broadband capability to enable the connection of smart appliances with utility load demand.
2. Coordinate smart grid cyberinfrastructure needs with the needs of other focus areas.
3. Develop the necessary middleware and software applications to manage and analyze the vast volume of data that will be generated by collecting real-time usage information from each utility customer or electrical device.
4. Communicate with the electricity providers within the state to ensure that they are aware of the CI resources within the state, especially within the university system.
5. Align and integrate federally funded Kentucky academic research activities when feasible to support smart grid enablement.
6. Engage the Kentucky Public Service Commission in the smart grid initiative including an assessment of current capabilities state wide.

4 **ECONOMIC DEVELOPMENT**

Goal: *Ensure that Kentucky's cyberinfrastructure will be globally competitive so that the Commonwealth has an advantage in retaining, attracting and developing knowledge-based industry which is dependent on CI.*

Strategic Actions:

1. Encourage the state to have CI included in Kentucky's Strategic Economic Development Plan.
2. Identify barriers to technology adoption by Kentucky's business community and develop strategies to increase technology and CI awareness and usage.
3. Identify existing resources to assist CI development for industry, and develop strategies to remove service gaps.
4. Develop last mile strategies to ensure high-speed Internet connectivity for all Kentuckians to facilitate the increase of technology enabled businesses and opportunities.

Goal: *Facilitate human resource development to provide a cyberinfrastructure skilled workforce.*

Strategic Actions:

1. Establish grassroots programs to provide training; and drive adoption of CI at the county level inclusive of major industry sectors.
2. Develop strategies to ensure technical installation, repair and support structures exist for CI technology throughout Kentucky

Information Security

With the expansion of the cyber infrastructure in Kentucky, and the expected order of magnitude increase in throughput and storage of data, the threat to government and commercial networks from foreign and domestic sources to unlawfully gain access will increase. As Kentucky expands and enhances its cyber infrastructure in areas such as research and development, e-health, energy, and overall economic development projects, the quantity and sensitivity of the data flowing across the networks will increase exponentially. Therefore, any implementation of the proposed cyber infrastructure plan must include the best technical and procedural security practices.

The coalition should assess the appropriate security model(s) for the strategic focus areas. One option is to use the model adopted by the Department of Defense which offers Kentucky an approach that will enhance the security of Kentucky's networks, as their capability is increased.

The federal model has at its core, the use of Computer Network Defense Service providers (CNDSP). These certified trusted agents install sensors on selected networks and provide monitoring and analysis of a twenty-four hour basis. These sensors and the analytical support combined with sound security procedures such as 'strong' passwords and periodic security training can provide Kentucky with the best environment in which to expand its cyber infrastructure.

As a minimum, the implementation plans for each area, e-health, energy, research and development, etc, should include a security section detailing the actions to be taken to create the proper security environment. Topics for consideration include:

- A risk analysis on design, device management, intrusion detection, monitoring procedures, and access
- Disaster recovery and business continuity
- Policies, including firewalls, access controls, remote access

- Identity Management, Authentication and Authorization
- Mitigation procedures
- Health Insurance Portability and Accountability Act (HIPAA): layers, perimeter security, segmentation, access controls, etc.
- Data encryption

Recommendation

Establish a public-private collaborative body

Cyberinfrastructure is inherently cross cutting and enabling. Multiple institutions, both public and private, have a vested interest in developing Kentucky's cyberinfrastructure to both leverage existing infrastructure and partner on the deployment of new CI for the common good. A need for collaboration exists so that these institutions and Kentucky's citizens can reap maximum benefits for the CI investments made.

Accordingly, the creation of a Kentucky Cyberinfrastructure Coalition is proposed to effect collaboration and ensure that federal funds received through academic channels are most effectively spent to ensure long-term economic impact. Providing a robust, easily accessible cyberinfrastructure will also enhance the state's attractiveness to new businesses and organizations seeking relocation or a friendly place to get started.

Appendix A

Kentucky's Cyberinfrastructure: 2009

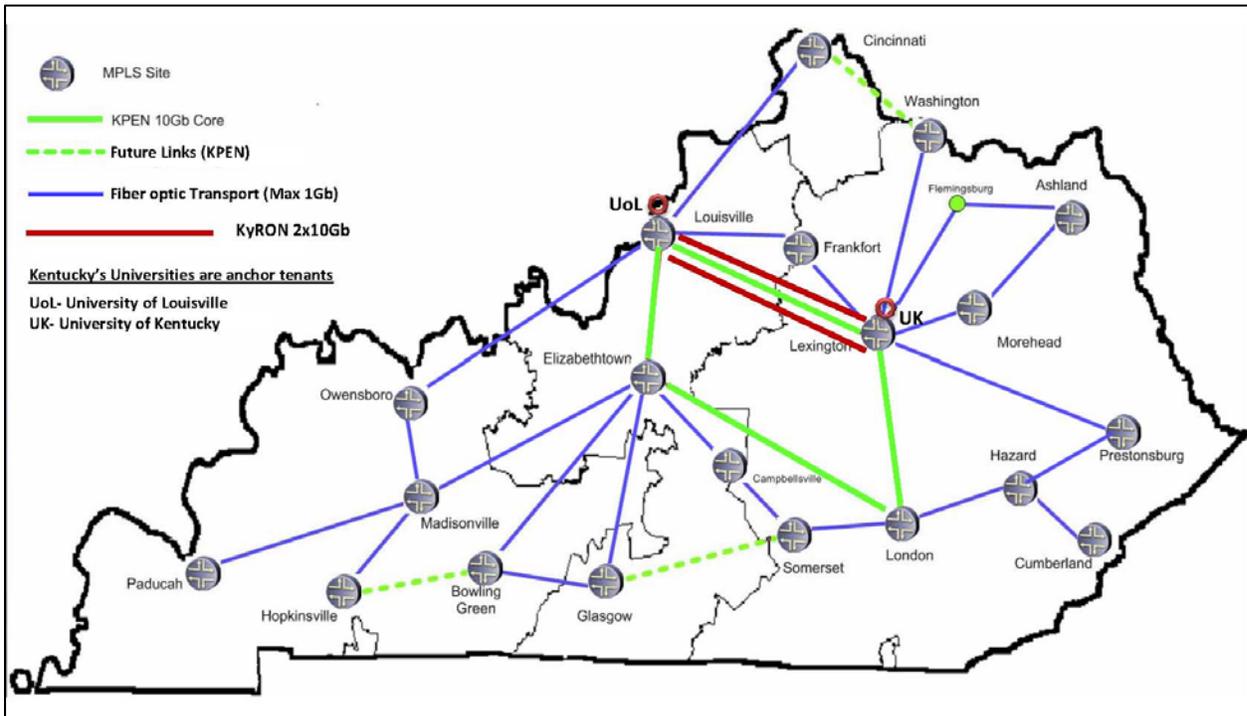
Kentucky's network infrastructure includes a rich mix of infrastructure and "help" resources representing a public-private "network of networks" providing access, content and training to the citizens of the state. These include:

1. **Consumer Networks** – Connect Kentucky - has completed or is in the process of achieving an ambitious set of goals for its constituents including:
 - a. full broadband coverage for all Kentucky households;
 - b. dramatically improved use of computers and the Internet by all Kentuckians;
 - c. a meaningful online presence for all Kentucky communities; and
 - d. re-establish eCommunity Leadership Teams in every county that bring local leaders together to plan and implement technology growth strategies for every sector of the community.

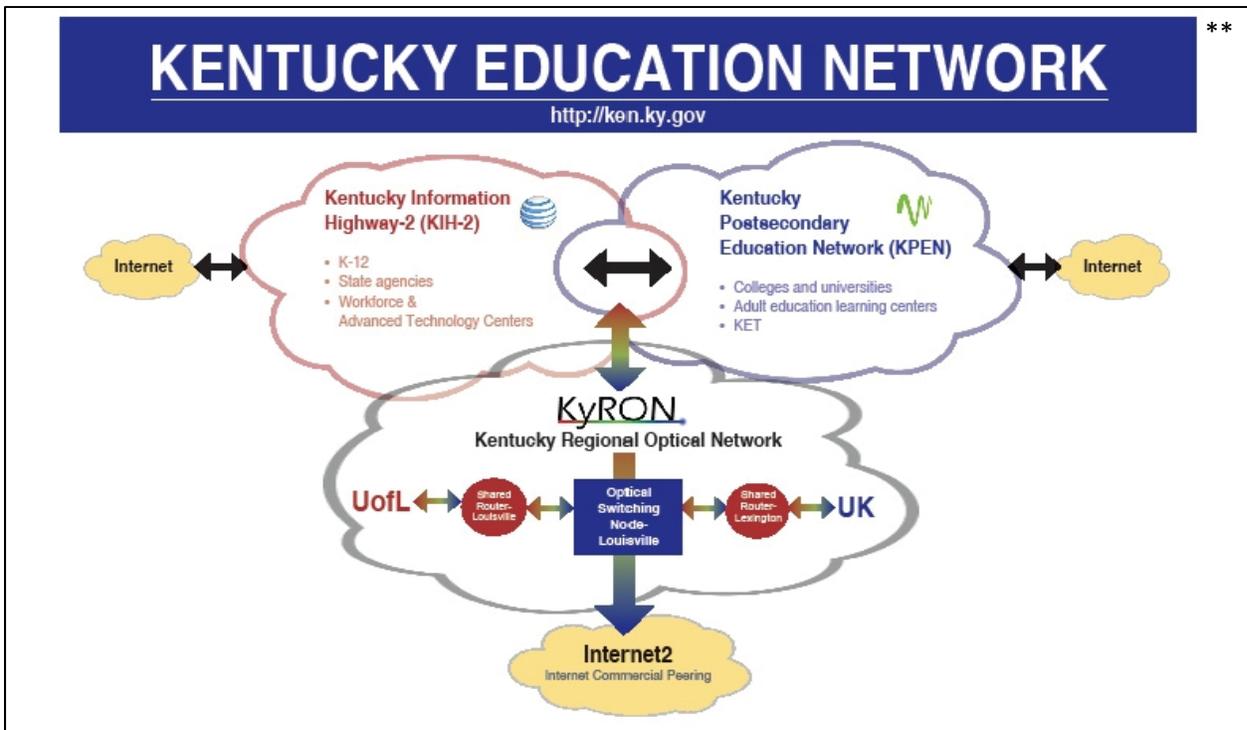
2. **Education Networks** – KEN (KY Education Network) – is working within the state to achieve the following vision.
 - a. To develop a seamless education-centric network that will grow and scale to meet new, increasing, and unforeseen needs to support equitable lifelong learning for all Kentuckians.
 - b. To break down the physical and political barriers between secondary and postsecondary education.
 - c. To share learning content and resources throughout P-21 both virtual and physical.
 - d. Research Networks - KyRON (Kentucky Research Optical Network) connects the Kentucky education community to the national and international communities through Internet2. The 10 gigabit connection between UK and U of L enables the universities to qualify for federal research grants.
 - e. Implement advanced distance learning programs using Kentucky's education networks and remove barriers to adoption.

3. **Supercomputer Capacity** - Two multi Teraflop machines are located at UK and U of L. These are invaluable for research and development carried out by faculty and students across the Commonwealth. The applications include physics, chemistry, engineering and biomedical activities such as computer aided drug design and proteomics.
4. **Technical support** - for computer applications are provided by the UK Center for Computational Sciences and the Kentucky NSF EPSCoR office. The current generations of high performance computers are sufficiently complicated that the interface between them and science must be ameliorated by a technical interface consisting of middle software and technical experts. New areas which are aided by this interface are advanced materials design, bio informatics and nanotechnology, all of which are potentially important for economic development.

Appendix B Map of Kentucky Networks *



* Map of networks reproduced using information provided by Windstream Communications



**Source: <http://kyron.ky.gov/> and <http://ken.ky.gov>

Appendix C

Cyberinfrastructure Steering Committee

David Atkinson, President **KY State Chamber of Commerce** / Private Sector
Jim Barnhardt, Deputy Commissioner, **Commonwealth Office of Technology**
Richard Clover, Dean Public Health & Information Services, **University of Louisville**
Gary Cox, President, **Association of Independent KY Colleges & Universities**
Doyle Friskney, Associate Vice President & CTO, **University of Kentucky**
Robert Esterhay, Chair Dept. of Health Management, **University of Louisville**
Bob Gray, Policy Consultant, **KY State Chamber of Commerce** / Private Sector
Priscilla Hancock, Chief Information Officer, **University of Louisville**
Chris Jaynes, Chief Technology Officer, **Mersive Technology** / Private Sector
Al Lind, Chief Information Officer, **Council on Postsecondary Education**
Vince Kellen, Chief Information Officer, **University of Kentucky**
Manuel Martinez-Maldonado, Executive VP for Research, **University of Louisville**
Len Peters, Cabinet Secretary, **Kentucky Energy & Environment Cabinet**
Craig Stewart, Associate Dean, Research Technologies, **Indiana University**
Carol Steltenkamp, Associate Professor of Pediatrics, **University of Kentucky**
Edwin Tivol, Vice President, **Electronic Warfare Associates, Government Systems Inc., Intelligence Operations and Homeland Security**
Rene True, Executive Director, **Connected Nation**

Ex-Officio John Connolly, Director **KY NSF EPSCoR, University of Kentucky**
Ex-Officio Rick Kurzynske, Director **Kentucky Statewide EPSCoR Program**

Consultant Jim Bottum, Vice Provost & Chief Information Officer, Computing and Information Technology, **Clemson University**

Appendix D Definitions

CI – Cyberinfrastructure - Infrastructure based upon distributed computer, information and communication technology.

(www.nsf.gov/cise/sci/reports/atkins.pdf)

CPE – Council on Postsecondary Education (<http://cpe.ky.gov>)

EPSCoR – Experimental Program to Stimulate Competitive Research – A group of federal programs to strengthen research and education in science and engineering throughout the United States and to avoid undue concentration of such research and education. (NSF EPSCoR: www.nsf.gov/od/oia/programs/epscor/about.jsp)

Internet2 – A U.S. advanced networking consortium led by the research and education community since 1996, that promotes the missions of its members by providing both leading-edge network capabilities and unique partnership opportunities that together facilitate the development, deployment and use of revolutionary Internet technologies. (www.internet2.edu)

KCTCS - Kentucky Community and Technical College System (www.kctcs.edu)

KEN – Kentucky Education Network (www.ken.ky.gov)

KPEN - Kentucky Postsecondary Education Network - a collaboration of all state-supported institutions in a high-speed network specifically designed for postsecondary education applications. (<http://cpe.ky.gov/nr/rdonlyres/e33cc609-0980-4007-92af-cddcec5f8676/0/kpen.pdf>)

KyRON – Kentucky Regional Optical Network – The next generation network for Kentucky’s postsecondary education community (<http://kyron.ky.gov>)

Smart Grid - delivers electricity from suppliers to consumers using digital technology to control appliances at consumer's homes to save energy, reduce cost and increase reliability and transparency. (http://en.wikipedia.org/wiki/Smart_grid)

Teraflop – A measure of a computer’s speed which can be expressed as a trillion floating point operations per second. (http://searchcio-midmarket.techtarget.com/sDefinition/0..sid183_gci213119.00.html)