

American Higher Education Is Going Global:
Implications for CIOs, National Networks, and Federal Policymakers

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Good afternoon.

It is a pleasure to have the opportunity to speak with you this afternoon. My topic concerns the shift in higher education towards ever-tighter global integration, and its implications for information technology.

I should say at the outset that I wear several different professional hats. Two of them are relevant to what I will be talking about this afternoon.

The first hat is that of Board Chair at Internet2. This is a hat I have worn for the past 15 months, and it has given me a wonderful opportunity to participate in America's advanced research and educational networking community.

The second hat is one I have been wearing for only about 9 months, and that is of Chancellor and Founding Dean at the Peking University School of Transnational Law. Last summer, Peking University, with the endorsement of the Chinese government, decided to launch China's first American-style law school, with courses all in English and leading to a J.D. degree. I have been leading this effort, and we are set to begin teaching our first class of students this coming fall.

In combination, these two roles have given me a special window onto two vitally important questions: what does information technology have to say about the way in which higher education globalizes, and what does the ongoing globalization of higher education say about information technology policy?

But before I explore those questions, I need to make clear that in speaking to you today I am not wearing either of my official hats. What I am about to say reflects my own personal interpretation of the world and does not represent the official policy of Internet2, Peking University, Cornell University, or anybody but me.

In approaching these two questions, let me begin with some background observations that I expect you will not find controversial.

To begin at the beginning, let us all agree that globalization in American higher education is real. Think of globalization as the diminution in significance of national borders and geographic distance. Over the past two decades we've gone from about 380,000 international students at American universities to about 580,000. During the same timeframe we've gone from fewer than 50,000 American students overseas to almost 225,000. See www.openddoors.iienetwork.org.

And if I had statistics on the rate at which faculty cross borders, the trends would all point in the same direction, perhaps even more dramatically.

But when we speak of globalization, we are usually thinking about more than just

the movement of people. We're thinking also about the movement of goods and services and financial capital and information and threats and cultures. And what I want to suggest this afternoon that when we think about the globalization of American higher education, it is helpful to focus on the movement of information across international borders and geographic distance.

Note that if we think of globalization in the higher education context as being about the movement of information, we can think of the movement of people as being partly a special case of the larger phenomenon.

We move people as a way to move information. Bring students here. Send students there. Bring faculty here. Send faculty there. Have them learn things. And then have them bring what they have learned home.

And I want to note that when we move people in this way we move a huge amount of information. The experience of being in a particular location, in the physical presence of other people, is so data-rich, so transformative, that it is often qualitatively different from the electronic alternatives. To take just one trivial example, two undergraduates kissing on a Second Life island is qualitatively different from the real thing.

But we should also recognize that sometimes we aren't so interested in the full immersive experience of physical presence. Sometimes we are only interested in moving a restricted set of information. Sometimes moving people is a kind of data overkill, kind of like reserving a digital circuit in order to send an email message.

This is important because, while the world may be flatter than it used to be, it isn't completely flat. It is not costless to move people around. It may be a lot cheaper to fly around the planet than it used to be, but it sure isn't free. And that is especially so if one considers not only the dollar cost, but also the cost in time and the cost in carbon.

And that is the second half of what we think about when we think about globalization. The first half is the magnitude of the flows – flows of goods, services, people, information, etcetera. The second half is the extent to which the cost of those flows goes up with the distance traveled, and goes up when it crosses a national border.

To say that American universities are globalizing is to say that the flow of information between them and points overseas is increasing and the cost of having information flow across borders and over distance is decreasing. And when we define it in that way, there is no doubt that American universities are continuing to globalize rapidly.

Let me just make an aside that one of the most visible, flashiest signs of this phenomenon of globalization concerns the establishment of branch campuses abroad. Many universities, including Cornell, have taken this step. And I learned over lunch that Georgia Tech is in the process of opening its sixth overseas campus. Opening an overseas campus is a major commitment for a university. It extends the university's reputation to a new location in a highly visible and vulnerable way. It can involve massive investments in buildings and other elements of infrastructure. And it inevitably commits a significant number of faculty members to what I have been calling information exchange with one, concentrated location.

But when we focus solely on the information transmission aspect, we can see that these campuses are only one, highly concentrated end, of a spectrum that moves through a variety of activities that send students and faculty across borders across to a variety of activities that send information across borders.

But that background provides a context for my first few points this afternoon. They are these:

First, in our lifetimes it will not become costless to move people around. It is going to remain the super-high-bandwidth, super-high-cost way to move information.

Second, we should be aware of what can come from the deployment of advanced, high-bandwidth, highly secure networks with sophisticated software applications. We will not, in our lifetimes, be able to provide an equivalent to being there. I do not foresee a day in our lifetimes when we will be able to say we don't need to have conferences like this one because people will be able to do all the networking and information exchange they need to do via webinar. But in the years ahead we will do better and better. More and more frequently we will be able to say that our interest in moving information does not require a perfect equivalent to being there, and more and more frequently we will be able to turn to a much cheaper, much more efficient alternative.

Third, it should be a policy priority – at the level of governments and at the level of universities – to make nuanced, thoughtful tradeoffs when it comes to moving information. Our commitments to environmental responsibility and sustainability imply that we should be asking whether there are lower-cost alternatives to physical presence that would be just as good. As I said earlier, especially when it comes to teaching and learning, the answer today is often no.

And fourth, we're not so far away, technologically, from a point where the answer can often be yes. And so it should be a crucial policy priority – at the level of governments and at the level of universities – to develop our network infrastructure, with the attendant applications, so that we can be in a position to make nuanced, thoughtful tradeoffs, precisely calibrating our decisions about what we want to accomplish and how we can most effectively do so.

So what kind of progress have we made?

During my adult life, we have obviously made tremendous progress. When I started out, data moved in the form of human travel, telephone conversations, the shipment of paper documents, and occasionally the shipment of data on magnetic tape.

In my adult life we have seen Moore's law apply to the development of storage media, including storage media that can be shipped, and the development of networking technology with the attendant capacities for email, file transfer, and videoconferencing.

So let me give an example of how these advances have concrete implications for the work I am doing in China. Our new "School of Transnational Law" is located on Peking University's branch campus, on the northern edge of the city of Shenzhen. We will have 60 students this coming fall, and their studies will be primarily of subjects in American law, but also of other subjects of well. In planning the school, we would like our students to have the opportunity to hear lectures from prominent members of the global legal community.

We will be bringing many such people to Shenzhen to teach, and to give lectures. If they happen to be in Hong Kong, it's not a problem, because Hong Kong is only about 50 miles away from our campus. But if they happen to be in Washington, D.C., it's expensive.

One obvious answer is to have a guest lecture by videoconference. I have been using videoconference guest lectures in my classes in US law schools for more than a decade. And that has been to avoid the need to bring someone from DC to Ann Arbor or Ithaca. The cost savings would obviously be orders of magnitude better if we could do it from Shenzhen.

Moreover, in terms of the quality of the experience – how good a substitute the videoconference is for actually being there – we have seen great advances over the past decade. The current version of DVTS allows surprisingly high quality videoconferencing while requiring surprisingly little bandwidth – about 30 Megabits per second.

But how can I set up a DVTS videoconference between Shenzhen and, say, Ann Arbor, Michigan?

Obviously, for me, I take off my China hat and put on my Internet2 hat and ask Heather Boyles of the Internet2 staff for help.

But that's not what I was asking. What I was asking was, what is the organizational and network infrastructure that is required to operate such a videoconference? It is a complex, multiparty activity that illustrates where some of the key policy challenges lie.

Suppose Professor Howard Bromberg at the University of Michigan is going to give a lecture to our students in Shenzhen. He is sitting at his desk with a computer that has an external DV videocamera attached to a firewire port on his computer. His computer is connected by Ethernet cable to the wall, where it interconnects with what is sometimes described as the first tier of our multi-tiered networking structure – the campus network of the University of Michigan.

Michigan's campus network carries his signal to a point in downtown Ann Arbor where the campus network interconnects with the second tier, the regional network operated by Merit.

Merit carries Howard's signal to Chicago, where it interconnects with the third tier, the national network operated by Internet2.

Internet2 carries the signal to Los Angeles, where it interconnects with Transpac2, an NSF-funded link from Los Angeles to Tokyo.

In Tokyo, the signal hops across the APAN Tokyo point of presence and gets to carried to Hong Kong across a kind of ad hoc link jointly funded by Japan and China, where it then moves to CERNET, the Chinese national university network, which carries the signal to to Shenzhen, where it interconnects with the Peking University campus network, and that then goes to the classroom.

I walk you through all this because, as a policy matter, there is enormous significance to each of these tiers. They solve collective action problems by allowing the end users to aggregate demand and reap economies of scale.

It would be prohibitively expensive to run cable from Howard's desk to the classroom in Shenzhen. Or from the University of Michigan to the Peking University campus in Shenzhen. Or even from Merit to CERNET. But by aggregating upwards, we can make investments worthwhile.

This has implications, by the way, for how campuses should act. In the U.S., we encourage them to aggregate demand through regional intermediaries. Overseas, we encourage branch campuses of U.S. institutions to aggregate demand through the national research and education networks of the host countries. This contributes to the process of pooling demand and aggregation that legitimates investment in the build-out of the global network infrastructure.

There are 88 national research and education networks around the world today. And more are being created all the time.

During my time as chair of Internet2, we have been focusing a great deal on the challenges of governance within a multi-tiered organization. And one of the core lessons we have learned is that at each level of aggregation it is important to provide meaningful voice to individuals whose experience is focused at each subsidiary tier.

So at the campus governance structures should give voice to faculty.

At the regional level governance structures should give voice to faculty, and also to representatives of universities.

And at the national level governance structures should give voice to faculty, to representatives of universities, and to representatives of regional networks.

Moreover, it is important to understand that in a healthy system no tier should be seen as merely a "pass-through" of ideas and agendas from above or below. Universities are more than just conduits between individual faculty and regional networks. Regional networks are more than just conduits between campuses and the national backbone. And the national network is more than just a conduit between regional networks and the outside world. Each tier has its own distinct mission and agenda to fulfill. Each has to operate in a way that is sustainable and accountable to its stakeholders. Each has to operate on the basis of a financial model that allocates costs fairly, and at the same time establishes financial incentives for behavior that promotes the common good.

What is the common good? In this context, it certainly includes the ongoing build-out of an advanced network infrastructure that transforms each wave of technological innovation into ever-broadening access to ever-higher-performance applications. And it also means keeping the network's performance frontier far enough ahead of current demand that there is room to develop more powerful and bandwidth-hungry applications than are today's state of the art.

All of which is background to my central point this afternoon. And that is, we need to work on the fourth tier. We need to work on the fourth tier.

When we at Internet2 develop a collaboration with an NREN in Qatar or in China, we are like two individuals in a Hobbesian state of nature, trying to accomplish something together, without the background institutions of a modern nation-state. Or, to take a more modern analogy, we are like two faculty members running Ethernet cable

between their offices because there is no campus network. It's okay. But it's not great. We aren't paying a lot of attention to the impact our cable might have on other faculty members walking down the hall. And we aren't getting the benefits of any scale economies.

I would submit that the time has come for us to outgrow the model of stringing cable down the hall. The flow of data associated with the research and education community in one country and points overseas is accelerating geometrically or faster. We are all waiting with baited breath for the large hadron collider to come online, and we are all bracing ourselves for the impact.

It bears mention that transnational structures are in place in some parts of the world. There is an international network in Europe that has existed for a decade. Newer multi-NREN networks exist in South America and Southeast Asia. But in some ways it is hard to know whether to think of these as fourth-tier structures, or merely the third tier for continents that are divided into lots of countries that are much smaller than the U.S.

More to the point would be collaborative efforts that cross continental borders and give serious thought to the development of institutional structures of governance.

One example of such an effort would be the so-called DICE collaboration. From North America, that collaboration involves Internet2, Canada's CANARIE network, and the Department of Energy's ESNET project. From Europe, it involves the continental GEANT2 network.

The DICE collaboration has been working to develop some sustainable organizational and operational models to ensure that the infrastructure and services that link the participating networks actually work for the end-users. For example, DICE members (along with RNP in Brazil) have engaged in joint development of the perfSONAR monitoring and measurement system. The goal is to do more than exchange measurement statistics and fault notices at arm's-length. Rather it is to develop a common system that can be deployed across all the participating networks.

In order for us to realize the dream of high performance, highly reliable, end-to-end dedicated services for users scattered around the planet, I have no doubt that a true fourth tier organization must be developed.

But here's the bad news. In order to do that, we will need to develop an effective and appropriate governance structure.

And let me put in my two cents about what that governance structure might require. Frightening though it might seem, I believe that structure must find a way to give voice to every subsidiary layer, all the way down. National networks, regional networks, campuses, and yes, even individual researchers. This is a very different model from the suggestions that have been made that governance of the fourth tier be simply consigned to the International Telecommunication Union.

Even more significantly, I believe that an effective fourth tier governance structure must draw in an entirely new set of actors. I am speaking here of national policy makers.

In some parts of the world, this is not a shocking notion. The EC has played a

huge role in the development of GEANT. It has recognized the network as a European strategic asset. Whereas the NSF does not invest in our national R&E network the EC has invested heavily in GEANT as a continental network. It has invested more than ten times as much as the NSF has invested in helping to link its network to other parts of the world. And it has participated in governance.

Interestingly, in the early days of advanced network development, the same was true in the United States. NSFNET was, after all, a creature of NSF. But for the past decade our network infrastructure has slipped from the top of the national agenda. It's not gone entirely – remember Transpac2 that I mentioned a minute ago. But it is nothing like what it once was.

And I do not believe that we can properly develop the fourth tier without bringing our national policy leadership back into the process. The fourth tier is a global strategic asset. We are, as a nation, coming to terms with some of the costs of globalization. If we are to reap the benefits of globalization, if we are to ultimately shape a world where any American sell his or her talents to anyone else on the planet without getting on an airplane, then we need to support the thoughtful and orderly build-out of the fourth tier. Critically, that will require a cost allocation mechanism that both is fair and also establishes financial incentives for behavior that promotes the common good. That will ultimately require some coordinated system of government-level financial support, where different countries contribute in a way that reflects both ability to pay and consumption from the common pool.

This is more than just a subject of concern for the National Science Foundation and the Department of Energy. It should also be of interest to the Department of State. It should also be of interest to the Agency for International Development.

As a nation we are soon approaching a window of opportunity when it might be possible to re-engage our national government. Next January a new administration will take the reins here in Washington. It will have an opportunity to consider afresh the role our nation should play in the build-out of the global networking infrastructure. It will have an opportunity to think once again about its partnership with the research and education community in advancing the frontier while at the same time expanding access to what is already well understood, reliable, and robust.

But I would submit that it is unlikely that the new administration will seize this opportunity on its own. The higher education community, led by organizations like EDUCAUSE and Internet2, must make the case for why this is important. It will have to show its ability to be a responsible, reliable strategic partner to the government in promoting the common good.

How realistic is that? Is our community really capable of working together on such a difficult and challenging problem? Can we find a way to engage the new administration with all our collective intellectual might? Can we effectively demonstrate the national interest in having America work as a true partner with other nations on a project such as this? Can we then work in close collaboration with our global peers to craft the kind of fair and effective structures of governance and participation that are needed to make the fourth tier work well?

Skeptics might think the answer to such questions is “No.” But I feel differently. To me this feels very similar to the situation our community faced two years ago, when Internet2 was challenged to undertake a transformative renewal of its own governance structure. Many thought it was impossible, but in the end our community proved the skeptics wrong.

I feel the same way about this question. Can we find it within ourselves to build the fourth tier, and thereby forge an institution that will allow human society to reap the full benefits of next-generation networking? Yes, we can.