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Assessing China's Efforts to Become an "Innovation Society": A Progress Report

Mr. Chairman, members of the Committee, thank you for the opportunity to contribute to today's hearing. China is investing in Cloud Computing on an industrial scale. Its Government, State Sponsored Industry and Academic Institutions are operating in a coordinated fashion to construct a national asset platform for accelerating the pace of technical innovation. The initial infrastructure roll out approved by the Ministry of Commerce in 2011, as part of the 12<sup>th</sup> Five-Year Plan will direct over \$300B of domestic information technology investments with Cloud Computing receiving a beneficial share of funding. Cloud Computing represents to China a vehicle to showcase their vast resources and ambitions. China is a late entrant to the field of Cloud Computing but any detrimental position caused by their delay in execution is quickly being offset by their current pacing and sheer volume of investment. China who desires to become a net-exporter of Cloud services, will leverage its resources to create jobs in directly related categories and in the extended supply chain. In some key areas that we will review, China is outspending the United States Federal Government by nontrivial orders of magnitude. This misaligned spending will add to the advanced persistent threats against our critical infrastructure, has the potential to further challenge our cyber warfare posture and seeks to attract the same foreign direct capital pool for innovation that could be deployed here in the United States.

During the last 15 years I have been on the cutting edge of technology creation, investment and management for the Enterprise and Government markets. I have helped guide four start-up organizations from incubation to over \$2B in aggregate revenue, managed technical and commercial relationships in more than 35 different countries and have spent a significant amount of time in China. In 2007 my team developed one of the first commercially viable Cloud Computing platforms designed to protect information assets. During the most recent five years, the technology we created has become the foundation for some of the largest Cloud systems in the world. I have been recognized as an industry leader on the topic by the Department of Defense, contributed to the House Oversight and Government Reform Hearings on Cloud Computing and I write the popular educational blog @GovCloudTalk. My remarks, written testimony and any related discussions for the US-China Economic and Security Review Committee may coincide with the views of my employer but do not necessarily represent them. The views expressed herein are entirely my own.

Cloud Computing is both a collection of discreet technologies and deployment business models. The National Institute of Standards started its valuable work to craft a formal definition in 2009 and published its final definition in October of last year. According to the official NIST definition, cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources that can be rapidly provisioned and released with minimal

management effort or service provider interaction. The NIST definition lists five essential characteristics of cloud computing: on-demand self service, broad network access, resource pooling, rapid elasticity or expansion and measured service. It also further lists three service models (software, platform, and infrastructure) and four deployment models (private, community, public and hybrid) that together identify the delivery of computing services. For our purposes here I might suggest to the committee to think about Cloud Computing as an aggregation of technical resources, across extended geography, that offers an easy way for operators to manage a very vast pool of computing power. An important point not captured in the formal NIST definition of Cloud Computing but one that is widely accepted in the commercial community is in building this new type of computing resource pool using commodity off the shelf components. COTS equipment is cheaper to build, cheaper to own and cheaper to operate than equipment built to unique or exacting specifications. Most large purveyors and institutional consumers of Cloud Computing readily deploy commodity components for the costing benefits and availability of market supply. The unique attributes set forth in the NIST definition are achieved principally through software. This nuance is important to understand as it speaks to where current innovation is actually occurring and where next generation breakthroughs are apt to originate. That is: In Cloud Computing Software. Not the hardware assets that power them.

To date, China's indigenous technical innovation attributed to Cloud Computing software, has been surprisingly limited. The first formal Chinese body organized for the pursuit of Cloud Computing was assembled in January of 2010 under the direction of the Ministry of Industry and Information Technology. In a model and format well known to other industries, the new formal body, China Cloud Computing and Industry Alliance (CCCTIA), has been seeking to establish a roster of experts from around the globe to educate their elite and extensive scientific community on the new methods of Cloud Computing. Now in its second year of operation, the CCCTIA has benefited from the contributions of individuals, small but innovative firms and major technology suppliers alike. Commercial suppliers are readily participating in the exchanges for the benefit of establishing thought leadership in the domestic China information technology market and for the opportunity to compete for integration and supply contracts. Practically speaking, participants are aware that their ideas, methods and unique intellectual property may be co-opted but do not wish to be excluded from commercial opportunities for lack of engagement. The size and breadth of the effort can be difficult to quantify for the Committee, but as a baseline, the Chinese Institute of Electronics, an appendage body to the Ministry of Industry and Information Technology that represents over 100,000 members of China's engineering community in 30 different provinces is actively participating through direct member involvement and in the solicitation of industry expert panels. China is currently lagging behind in its domestic production of Cloud Computing software but this is not hindering its capabilities as best in breed software titles are readily available for purchase through global supply channels. In many instances, open source derivatives of commercially supplied Cloud Computing software packages can be downloaded from the internet and are accessible to anyone with an introductory proficiency to the technologies.

Where China is lagging in its domestic production of cloud computing software it is excelling in its commitment for sourcing commodity infrastructure components and property and plant build out to house its acquired Cloud Computing assets. While multi-billion dollar Cloud Computing efforts are underway in Beijing, Shanghai, Shenzhen, Hangzhou and Wuxi with the benefits of direct technical contribution from the University Systems in each of these cities, the largest effort underway by a wide margin is in the municipality of Chongqing. In Chongqing, a city sized Cloud Computing complex is being constructed. The Liangjiang International Cloud Computing Center broke ground in January of 2011, in terms of scale, a single data center in the complex is planned to be physically larger than the Pentagon. At a point in time where our own nation is closing more than 1000 data centers through the Federal Data Center Consolidation effort, China is building millions of square feet of new data center space to house its Cloud Computing platforms. Chongqing is an interesting site selection for such a large Cloud Computing infrastructure in the country of China. A direct controlled municipality with approximately 30 million residents Chongqing, now under the leadership of Chinese Vice Premier Zhang Dejiang, serves as an outpost for many global technology suppliers. Specifically technology suppliers that excel in manufacturing commodity line computing resources that are to be the foundation of Cloud Computing environments. In Chongqing, China has an integrated supply base that can readily produce the hundreds of thousands of units that will be needed to fully populate the new Cloud Computing environments. But the location is not without its challenges. Chongqing is plagued with excruciatingly high temperatures, high humidity and an electricity system that, by western standards, experiences significant levels of downtime. I highlight for you these three characteristics, which under normal circumstances, would be completely avoided when attempting to site a new data center for facilities that house Cloud Computing infrastructures as they are dependent upon a stable power grid and carefully orchestrated cooling processes to maintain the computing equipment in a beneficial operating condition. China is innovating in the areas of cooling and power distribution but there must be another strategic imperative for selecting Chongqing to house such a massive new environment. With Chongqing's close proximity to the Chengdu Military Region and other assets which contribute to the Peoples Liberation Army Information Operations it takes only a marginal inference to suggest the these new environments can contribute to both civilian and military pursuits. Recall that one of the benefits of Cloud Computing, embedded in its official definition, is the ability scale and dynamically retask an environment in rapid fashion. Dual use capabilities are inherently constructed in the cloud computing software stack today which permit an operator of an otherwise benign appearing system to deploy it for civilian pursuits in the arts, finance, education or healthcare one moment and use the very same system for national strategic pursuits the next. The software technology exists today and is being deployed in China at a rate without precedent. The aggregation of the resource pools being constructed in Chongqing alone for national strategic purposes could easily double the scale of the advanced persistent threat facing the United States' critical infrastructure.

Construction of these major centers is being directed and financed through a combination of national level policy and executed at a provincial level. While Cloud Computing in China offers the promise of reducing technology costs for domestic firms of all sizes it offers for the innovation community a combination of unique opportunity and unique threat profile. Cloud Computing offers an individual technology consumer the ability to harness a vast resource pool with very limited expense. This model is

especially interesting for small firms that do not yet have access to expansion stage capital or cannot afford to procure their own systems. Cloud Computing lowers the economic threshold for good ideas to reach the global market. This, however, leaves the innovative consumer in China with the tradeoffs of risk and control. Risk in that the computing assets being leveraged are effectively state controlled and can be shut off at any time, control in that these centralized points of management at the provincial level offer an easier footprint to censor.

Chinas near and mid-term prospects are favorable at a sovereign national level, at a domestic consumption level and as a consumer for technology providers. The 12<sup>th</sup> five-year plan directs spending for informational technology assets that will benefit global technology providers while China continues to assemble its domestic industrial base for supplying Cloud Computing Software. From the perspective of domestic consumption it offers to organizations a unique opportunity to reduce operating costs and balance sheet expenses for warehousing computing infrastructure. At a sovereign national level, China is constructing a massive Cloud Computing infrastructure that can be used for civilian benefit or other strategic pursuits.

China is a late entrant to the field of Cloud Computing but any detrimental position caused by their delay in execution is quickly being offset by their current pacing and sheer volume of investment. China is innovating in the Cloud Computing supply chain, by necessity in power and environmental cooling systems and building its initial capabilities on a combination of globally source software and open source derivatives. China who desires to become a net-exporter of Cloud services is building a computing infrastructure that can be leveraged for both commercial purposes and national strategic pursuits. China is outspending the United States Federal Government by nontrivial orders of magnitude. This misaligned spending will add to the advanced persistent threats against our critical infrastructure, has the potential to further challenge our cyber warfare posture and seeks to attract the same foreign direct capital pool for innovation that could be deployed here in the United States.