

NC Education Cloud Feasibility Report

1. Problem Definition and rationale

North Carolina districts are generally ill-equipped to manage production server infrastructure. Server infrastructure is most often housed in facilities that lack sufficient space, power, and cooling. Further, as district servers are typically located in school buildings that are frequented by thousands of people on a daily basis, security exposure is high. Backup systems for power, cooling, storage, and the like are essentially non-existent. Finally, districts have little luck recruiting or retaining qualified information technology professionals trained in server administration.

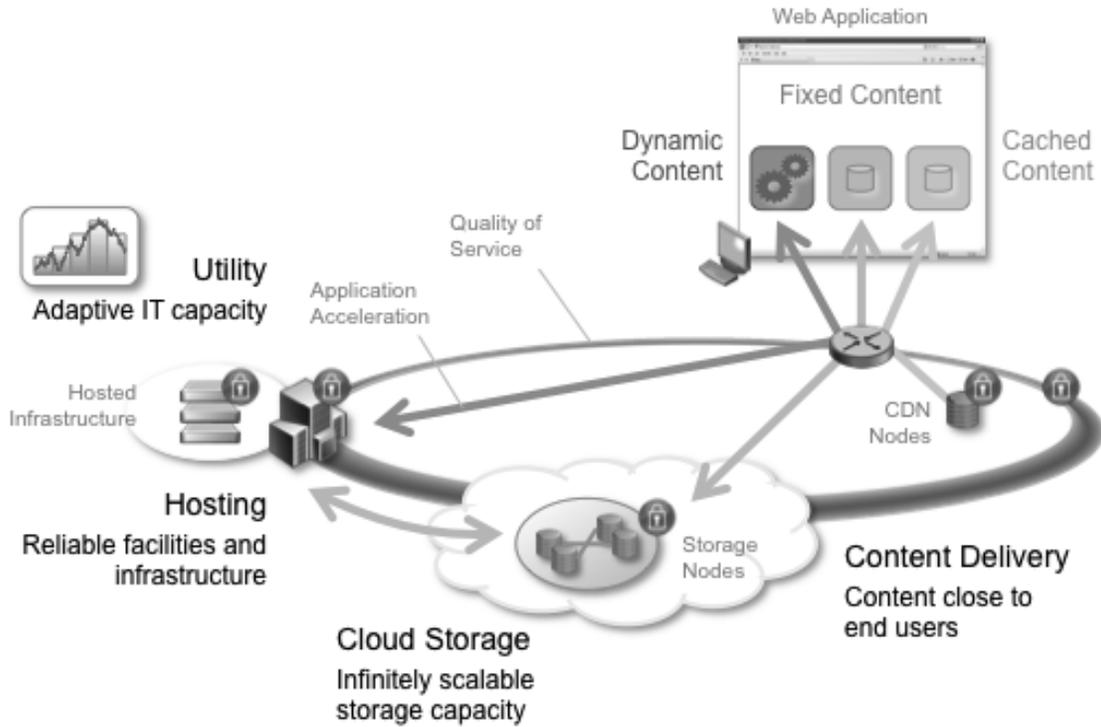
Recent advances in virtualization and cloud computing have led to competitive service provider offerings of infrastructure as a service (IaaS). Amazon, AT&T, IBM, Microsoft and a number of others have public cloud solutions that provide for both persistent (24x7x365) and on-demand hosted infrastructure services. A comprehensive statewide migration to IaaS would provide equity of access to highly available services. By aggregating demand from across the K-12 enterprise and taking advantage of usage-based cloud offerings the state can realize dramatic cost savings in infrastructure support.

While this set of circumstances is not unique to North Carolina, as a state we are in a unique position to deploy a statewide education cloud solution. In order to successfully deploy infrastructure as a service, each school must enjoy reliable, high-bandwidth, low-latency network connectivity. Fortunately, the \$22M annual recurring investment by the state of NC in the School Connectivity Initiative provides exactly that.

2. Introduction and Objective

We propose the creation of the NC Education Cloud (NCEdCloud) to provide a highly reliable, highly available, server infrastructure supporting the K-12 education enterprise statewide. Specifically, we recommend a migration from LEA-hosted server infrastructure to cloud-hosted infrastructure as a service. The primary objective of the NCEdCloud is to provide a world-class IT infrastructure as a foundational component of the NC education enterprise. Moreover, the NCEdCloud will provide for:

- Equity of access to compute and storage resources;
- Efficient scaling according to aggregate NC K-12 usage requirements;
- Consistently high availability, reliability and performance;
- A common infrastructure platform to support emerging data systems;
- Sustainable and predictable operational cost.



It is difficult to reconcile a sustainable RttT proposal that does not invest in a contemporary IT infrastructure. Robust technology infrastructure will be required to support data-driven decision-making, for the development of and access to online instructional resources, and to transition the focus of district technical resources from infrastructure to users and instruction. Furthermore, prudent one-time investments in technology infrastructure service platforms buy down long-term IT costs, providing sustainable funding for new instructional and leadership programs that speak directly to RttT guidelines.

3. Goals and Target Outcomes

In creating the NCEdCloud we aim to improve service reliability, increase efficiency, and decrease long-term IT costs, while re-aligning local technical resources away from supporting and managing infrastructure. As this recommendation is related to the deployment and support of technology infrastructure, we make no claims related to educational outcomes. We do however enumerate project outcomes here.

Goal	Details	Targets
Increase IT reliability	All servers hosted in data centers with reliable and resilient power, cooling, and network. Data backed up and distributed across at least 2 data centers	99.9% server uptime All Critical data recoverable according to backup/recovery SLA.

	All server infrastructure secured physically and logically	Monthly security audits of all compute and storage resources.
Increase IT efficiency	Leverage server virtualization to deploy logical servers Provide single server instances to support common services across LEAs Automatically scale server and storage resources to meet demand.	<u>80%</u> utilization of infrastructure resources
Decrease cost	Purchase infrastructure as a service Pay based on usage for all non-persistent services Shift power, cooling, backup and the like to the cloud	Cut aggregate server infrastructure costs in <u>half</u>
Increase number of LEA technical staff supporting instruction	Transition server hosting and management to cloud providers Transition infrastructure planning and provider management to MCNC	Free up on average <u>one</u> technical FTE per LEA

The target completion for the measurable goals outlined here is 36 months from the initiation of the project. More granular interim milestones will be defined during the project planning process.

4. Key Elements, Roles and Partners

The NCEdCloud initiative is at its core an outsourcing program. The NCEdCloud program transitions LEA server and storage infrastructure to commercial cloud providers and establishes an NCEdCloud administrator to oversee the commercial providers and to manage the process of moving services into and out of the cloud. The key elements of the program are:

- Planning
- Cloud Deployment
- Pilot Migrations
- Statewide Migration
- Measurement and Monitoring
- Cloud Administration

The NC School Connectivity Initiative built the foundation for the NCEdCloud program both in terms of providing network infrastructure to all LEAs and in terms of establishing a rigorous project planning and deployment methodology. In the paragraphs that follow we summarize each of the program elements.

Planning

As with all IT initiatives the deployment of the NCEdCloud will require careful planning. The planning team will comprise a group of infrastructure experts led by the Manager of Connectivity Services at the NC Department of Public Instruction and supported by the MCNC Client Network Engineering Group. The planning team will be tasked with developing an implementation and operating plan for the NCEdCloud. The planning process will include an onsite assessment of infrastructure and infrastructure support resources at each of the 115 NC LEAs.¹ Project planning will begin immediately upon funding of the proposal and will require 6-9 months to complete. The estimated cost of the planning is \$1.65M.

Cloud Deployment

Upon completion of the planning process, the planning team will present the community-vetted implementation and operating plan to the NC State Board of Education for review and approval. Upon approval of the plan DPI will establish deployment support contracts with MCNC and other state partners as specified in the plan. MCNC is the logical NCEdCloud administrator given that the not-for-profit has served as the de facto education service provider in NC for over two decades. MCNC operates the NC Research and Education Network (NCREN) that connects all NC LEAs in a high-speed statewide education backbone that includes universities and tier one network service providers. The initial execution elements will be related to building a relationship with one or more commercial cloud providers. The cloud deployment phase will likely require a competitive procurement process and as such the development of a request for proposal. The data collected during the LEA infrastructure assessment will serve as the basis for the scope of the cloud RFP in terms of types and numbers of server instances. MCNC will work with the selected cloud provider(s) to roll out combination of reserved (persistent) and on-demand server instances and storage resources to meet the aggregate needs of the NC K-12 education enterprise. As part of the rollout process MCNC will manage the development of any middleware required to integrate the cloud with LEA directory, authorization, and authentication systems². We estimate that the cloud deployment phase will require 6 months and on the order of \$7.5M. Costs include deployment administration by MCNC, middleware development, and one-time costs for initial server instantiation.

Pilot Migrations

In parallel with cloud deployment and based on the implementation plan DPI will orchestrate a group of carefully selected pilot migrations of LEA and DPI infrastructure to the NCEdCloud.

¹ How do we address the 100 Charter Schools?

² MCNC has done some initial work on federated identity management that will prove useful here.

The pilots will include representative hardware platform types, persistent and on-demand resource allocations, and services that extend across LEA boundaries. The primary goal of the pilots is to validate planning assumptions and to fine-tune migration and steady-state support processes. We estimate that pilot migrations will require 3 months and \$1M. Costs include DPI pilot administration, MCNC cloud administration, and one-time cloud provider migration fees.

Statewide Migration

With lessons learned from the pilot migrations, DPI will manage a 30-36 month statewide migration of LEA server and storage infrastructure to the NCEdCloud. MCNC, as the NCEdCloud administrator, will facilitate directory integration and network provisioning to support the unique requirements of each infrastructure and service migration. In some cases shared applications will be migrated to the cloud and users will be transitioned to the cloud service together. In other cases individual resources will be turned up, tested, and transitioned on an LEA-by-LEA basis. During the migration project it is also likely that new data systems supporting innovation in instruction and leadership will be designed from the beginning as cloud services. Existing LEA infrastructure arrangements, licensing agreements, and federal e-rate guidelines, may impact the migration timeline and schedule. We estimate that the 30-36 month statewide migration will cost \$6M. Direct costs include DPI project management, MCNC cloud administration, and cloud provider one-time migration fees.

Measurement and Monitoring

A significant benefit of procuring infrastructure-as-a-service is that the provider will be held to account through a service level agreement (SLA) that specifies commitments related to service availability, performance, and support responsiveness. The NC Education Cloud will be instrumented for measurement and monitoring in order to manage to the SLA. Data collected through this instrumentation will also be used to scale resource allocations for both new and existing services. Finally, the NCEdCloud will also collect data related to user access. User access data can inform assessment systems developed in support of core RttT proposals. MCNC will coordinate instrumentation of the NCEdCloud with the cloud service provider during cloud deployment and service migration, as appropriate. Instrumentation costs are included in deployment and migration project budgets.

Cloud Administration

DPI will manage a contract with MCNC as the cloud administrator. DPI and MCNC will review the details of the NCEdCloud service with the NC K-12 community at least annually to optimize offerings, support opportunities for federal e-Rate support, and to add or remove cloud providers. In order to provide for sustainability of the NCEdCloud moving forward DPI will expand the existing Client Network Engineering support contract with MCNC by \$500,000 per year to cover LEA engineering support and will expand the existing NC Research and Education Network contract with MCNC by \$1.5M annually to cover cloud operations. MCNC may expand the NCEdCloud offering to the broader K-20 public education community in NC. While it is beyond the scope of this proposal it is worth noting that such expansion would benefit the K-12 community and MCNC is well positioned to facilitate such an expansion given their role as a network services provider to K-20.

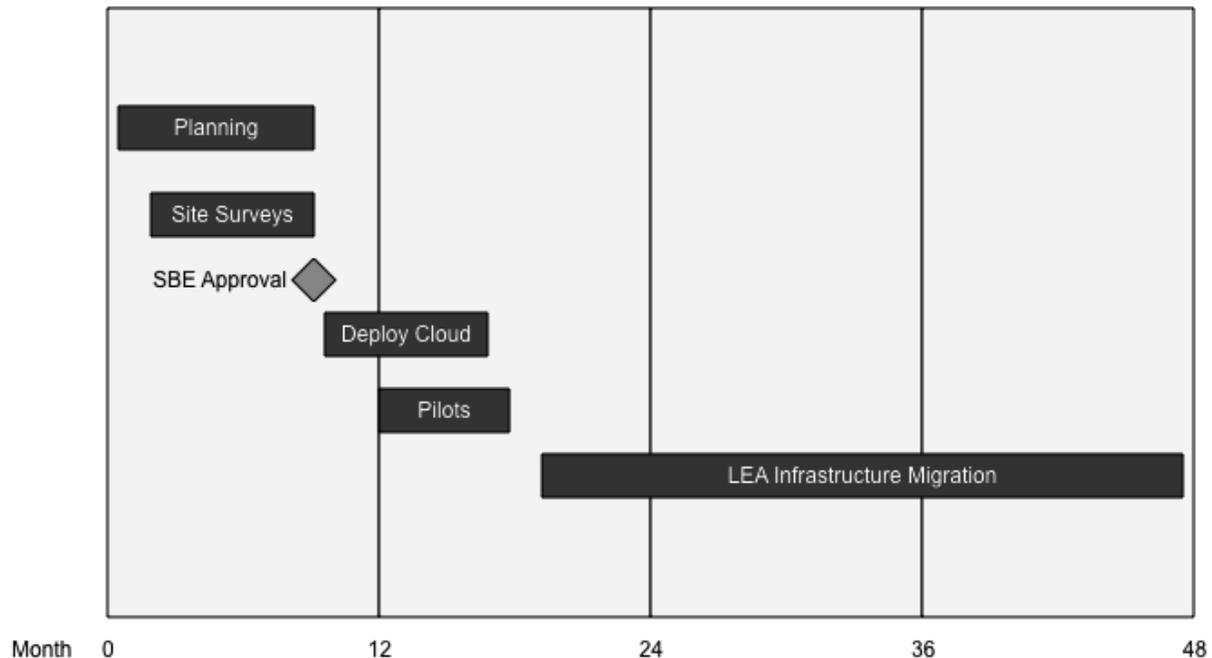
5. Implementation Setting

We offer the NCEdCloud as a statewide implementation deployed as a partnership between the Department of Public Instruction, MCNC, and the Local Education Agencies. By its very nature the benefits of a cloud grow with the size of the cloud and as such we will seek opportunities to expand the scope of the NCEdCloud to K-20. We anticipate developing partnerships with industry cloud providers including AT&T, IBM, Amazon, Google, and Microsoft.

6. Implementation Plan

See Section 4 above.

7. Implementation Timeline



8. Funding and Sustainability

We request \$16,500,000 in support of the NC Education Cloud deployment initiative. \$12.8M of the \$16.5M requested (78%) is direct expense encumbered against commercial cloud service provider charges. Ten percent of the funding supports program planning – including site surveys for all public school districts. Beginning in year 2 state of NC appropriated funds support an expansion of MCNC Client Network Engineering support services. Beginning in year 3 LEA's begin to fund NCEdCloud operations with an aggregate \$1.5M annually. Allocation of NCEdCloud costs will be usage-based (not per ADM). LEA fees will be paid to MCNC in lieu of supporting infrastructure locally and will be a fraction (we are targeting half) of the legacy infrastructure support costs. Cost savings realized through the NCEdCloud program can be allocated to the support of new programs specified in this proposal.

DRAFT NCEdCloud Pro Forma, 4-Year View

	Year 1	Year 2	Year 3	Year 4
Funding:				
ARRA Appropriation	\$ 16,500,000			
LEA NCEdCloud User Fee			\$ 1,500,000	\$ 1,500,000
State Appropriation from SCI		\$ 500,000	\$ 500,000	\$ 500,000
Carry Forward		\$ 8,350,000	\$ 5,350,000	\$ 2,150,000
Total Funding	\$ 16,500,000	\$ 8,850,000	\$ 7,350,000	\$ 4,150,000
Operational Expenses:				
Staff				
Program Director [NCDPI]	\$ (100,000)	\$ (100,000)	\$ (100,000)	\$ (100,000)
LEA Technology Support [NCDPI]		\$ (100,000)	\$ (100,000)	\$ (50,000)
Contracted Services				
MCNC - Client Network Engineering	\$ (400,000)	\$ (500,000)	\$ (500,000)	\$ (500,000)
Site surveys - 115 @ \$10K each	\$ (1,150,000)			
MCNC - NCEdCloud Operations	\$ (500,000)	\$ (1,000,000)	\$ (1,500,000)	\$ (1,500,000)
Supplies and Materials				
Miscellaneous				
Travel				
Administrative				
Outreach				
Cloud Provider				
One-time infrastructure payments	\$ (6,000,000)			
One-time migration fees		\$ (1,800,000)	\$ (3,000,000)	\$ (2,000,000)
Total Operating Expenses	\$ (8,150,000)	\$ (3,500,000)	\$ (5,200,000)	\$ (4,150,000)
Net Income (Loss)	\$ 8,350,000	\$ 5,350,000	\$ 2,150,000	\$ -

9. Research and Evaluation

The NC Education Cloud will be instrumented for measurement and monitoring of reliability, performance, and usage characteristics. Data collected is used to manage service levels, to size resources for new services, and to provide usage data as an input to emerging information systems.