Core Technology Services

Functional Consolidation Report
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1 Executive Summary

The 64th Legislative Assembly passed HB 1003 during the 2015 session. Section 8 of that bill creates a new section to chapter 15-10 of the North Dakota Century Code:

Each institution and entity under the control of the state board of higher education shall obtain electronic mail, file server administration, database administration, research computing, storage, application server, and hosting services through a delivery system established by the board. The board shall establish policies and guidelines for the delivery of services, including the transition from existing systems to functional consolidation, with consideration given to the creation of efficiencies, cost-savings, and improved quality of service.

This is the same language put into the Information Technology Department’s Century Code to enact functional consolidation of state systems.

Core Technology Services (CTS) has been working with the 11 institutions to identify which systems at each campus could potentially provide the greatest benefits if consolidated, what risks are involved in consolidating those systems, and what challenges need to be overcome in order to consolidate.

Policies and Guidelines

The State Board of Higher Education (SBHE) has developed a formal policy as required by the statute. The policy authorizes the chancellor to develop procedures for handling these services and requires development of an exemption process. This aligns with the state’s Information Technology Department processes. The State Board of Higher Education passed the policy at its November 2016 meeting. The Chancellor approved the procedure in December 2016. The Policy and Procedure are attached as Appendix A & B.

Systems

The first step CTS took in the process was to ask campuses to identify all IT systems on the campus. Campuses identified more than 1775 servers (both physical and virtual) that could be impacted. We broke these down into 12 categories and the chart below shows the number of systems by category.

![Figure 1: Servers by Category]
You can find more information in regarding each system in Section 2 of this report.

A number of the items are listed as “Exempt” because as we reviewed each institution’s infrastructure, we identified that there are some systems that would have some significant risk in consolidation. For the initial pass, CTS will grant a temporary exemption until we feel comfortable we can mitigate these risks. One example is safety and security systems, such as door access systems. Other examples are desktop management, systems with medical records, and systems that perform credit card transactions requiring PCI standards.

There are a number of unknown servers in this list. This is the result of the lack of consolidation of IT services at the campus level. Some departments, colleges, and research groups all have their own IT equipment. While some information from this equipment is identified via an electronic scan, it does not provide enough information for correct categorization.

The complete details on a campus-by-campus basis is available in Appendix C.

**Challenges**

**Network**

The North Dakota state network (STAGEnet) provides statewide connectivity and Internet access to all NDUS institutions and locations. It has provided cost effective and robust services for many years, however, the consolidation of systems into the NDUS data center introduces additional functional and operational risks that need to be addressed.

When the state consolidated services, many state agencies were in Bismarck and already on the metro fiber ring. This provided scalable bandwidth and high levels of redundancy that supported consistent service levels.

In higher education, our locations are distributed across the state and some may have a single physical network connection to the campus. This becomes a potential single point of failure and makes them susceptible to an outage of both NDUS and Internet services. These outages could extend for multiple days depending upon severity and the availability of repair crews in each community.

CTS has developed a business case to mitigate the network risks and improve the "last mile" connection to many of our campuses.

**Funding**

The budget cuts over the last year have had a significant impact on our ability to carry out consolidation. While we would like to think infrastructure could just be physically moved from one site to another, this plan is prevented by a number of factors. They include:

- Many of the systems have hardware that is approaching end-of-life. Moving this equipment has a higher risk of a component failing and doesn’t provide a significant level of value for that risk.
- In order to ensure service levels are met, hardware must meet Tier 3 standards. This includes hardware that includes redundant power supplies and network ports. Some of the hardware at the institutions do not meet this standard.

These and other factors means that in order to consolidate many of these systems, CTS must upgrade our infrastructure. CTS has developed a business case to request funding to perform many of these upgrades.
Next Steps

Even with the current funding levels, we continue to work with the institutions to be able to provide consolidated services. If a campus needs to replace equipment, we will work with them to determine if that replacement can be brought into the consolidated environment.

Recently Dakota College at Bottineau requested help meeting data storage needs. They contacted CTS to see what we could provide. After discussions with the campus, it was determined that we could meet their needs and were able to provide the needed service within days. Given typical order times for equipment, this was faster than if the campus had deployed the equipment themselves.

CTS looks forward to working with the legislature to identify how we can best leverage the limited funding available and move forward with the consolidation effort.
2 Systems

2.1 General Approach

The first step taken was to gather information from campuses. CTS developed a short survey and sent out a MS Excel worksheet for campuses to complete, listing their equipment, some of the technical specifications of the equipment, and the purpose. After receiving and reviewing the information from the campuses, CTS did site visits at each campus to discuss our approach to the consolidation process, to clarify campus information provided, and to provide assurance that meeting student needs was our top priority.

Another important step was to identify how CTS will deliver the consolidated services. There are many approaches to delivering IT services, and we had to find the right blend of efficiency and customer service. What does “database administration” mean, for example, and what can CTS provide and what can’t we provide? We researched how ITD provides similar services to state agencies as well as how other Higher Education organizations provide centralized IT services. Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS) are standard industry cloud-based models that CTS will need to provide. This research formed the foundation of the NDUS procedure (Appendix B).

As we talked with campuses we began to recognize there were going to be some systems that will need to remain on campus for the time being for varied reasons. We started to look for ways we could bring value to the campuses and still align with the intent of consolidation. One idea we are exploring is to partner with the campus IT organization to provide campus-based CTS managed systems. The physical hardware would remain at the campus and CTS would manage the hardware & operating systems. We want to note this is only about 20% of the total servers in the current plan. As some of the risks noted below are resolved, most of these systems could be brought into the CTS datacenter.

This also brought the need to develop a process to determine how systems would be identified as exempt from consolidation. CTS chose to adopt ITD’s process for exemption from consolidation and included it as part of the NDUS procedure (Appendix B).

2.2 Common Risks

CTS has identified three common risk areas for consolidation of campus IT. They are: health and safety, loss of network, and transmission latency.

Health and Safety

More and more functions are becoming IT-based. For example, keys once opened locked doors. There are a number of systems that directly impact the health and safety of students, faculty and staff at a campus. CTS will be very careful about impacts to these systems. We really don’t want an internet issue to prevent campus facilities staff to be able to deal with a heating issue in a dorm on a cold February night. These types of systems account for almost 40% of the exempt servers. Prior to consolidating these systems, further investigation is needed to ensure that there is not a major impact to campuses. For example, we would need to ensure that door-access controllers store information so that they continue to function during a network outage.

Loss of Network

Our focus is to ensure campuses can continue to provide quality education to their students. Information Technology is an important component to today’s teaching. As noted in the introduction, many of our sites have a single connection into the campus. This makes them very susceptible to an internet outage due to a fiber cut. These outages could extend for multiple days depending upon the severity and availability of repair crews. Our four core points within STAGEnet also have some vulnerabilities to outages and while we have alternate routes if one of the quadrants fails, if it is the Grand Forks quadrant (containing the data center) or the quadrant the campus connects to fails, none of the services that consolidated would be available. Most of the time these core outages last less than a day but that could still have a significant impact during finals week or other critical times for campuses.
We will discuss our plan to mitigate these risks in Section 3 of this document.

*Transmission Latency*

The third risk we have to guard against is transmission latency. That is “IT-speak” for how long it takes the bits and bytes to move from one place to another. For most things, this is not an issue because this is typically measured in milliseconds. Most people wouldn’t know if the web page took 3 ms or 15 ms to show up. However, when you start dealing with large data sets this could be the difference of taking 2 minutes or taking 15 minutes to load. Also, some systems are sensitive to latency. For example, many systems do not like to have the application server separated from the database server. These two pieces of equipment need to communicate so much that even small delays will quickly back up and slow the processing down. There are a number of ways to resolve this issue, but all have a cost component that must be taken into consideration. After all, cost savings is part of why we are consolidating in the first place.

Both loss of network and transmission latency play a role in why most of the rest of the items are listed as exempt. It isn’t that these can’t be overcome, but these will need careful review on how to mitigate or eliminate the risks.

### 2.3 Summary Data

Below is a summary table of server counts by category.

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The full by-campus data can be found in Appendix C.

### 3 Challenges

There are three primary areas of challenge for CTS to meet the mandated consolidation of services. These are: the network, funding, and security.
3.1 Network

We have already noted the risks the network presents when consolidating services. CTS, working with ITD, has put together a plan that can help mitigate those risks.

Recommandation 1: NDUS and ITD, in collaboration with individual institutions, will evaluate the bandwidth and redundancy needs at each institution and develop new network architectures and funding to support improvements in both areas.

Our intent is to ensure that bandwidth at each institution can effectively handle additional network traffic created by moving servers to offsite data center(s). The goal is to have peak usage of campus STAGEnet links at under 80%.

Currently some NDUS institutions have a single local link to STAGEnet that creates a single point of failure for network traffic. This creates additional risk for interruptions in services to faculty, staff and students. The target is to provide redundant and diverse STAGEnet connections for all NDUS institutions.

Recommandation 2: NDUS will work with ITD to fund, purchase and implement consistent DNS/DHCP and firewall/IPS/IDS systems for each NDUS institution.

There is no standard solution for providing DNS/DHCP services or firewall/IPS/IDS services to NDUS Institutions. Moving to a single solution that is delivered to campuses as part of STAGEnet services will provide consistency across HE, K12 and State Government, and will provide a more stable transport service for functionally consolidated systems.

This plan is presented as an optional funding request this legislative session.

3.2 Funding

The legislation mandating functional consolidation did not come with a fiscal note. In order to provide the mandated services, CTS will need to invest in additional infrastructure. The datacenter was designed to be able to expand into this role, but the existing IT systems do not have extra capacity. We need to be able to respond to requests quickly in order to meet campus needs.

As noted previously, unfortunately, it isn't just a matter of shutting things off at the campus, shipping them to Grand Forks, and turning them back on. We have to determine if the equipment meets the specifications of the datacenter, add electrical and network capacity if necessary, and adjust network routing so computers can find the equipment in the new location, etc.

Some of the equipment is at or past its replacement date. With budget cuts this year and into the next biennium, replacement equipment is hard to justify. Just moving this equipment increases the risk of a component failing. Some of this equipment has hardware and software that is unfamiliar to our staff and additional training may be needed. A primary benefit of functional consolidation is to leverage the technical knowledge of a small group of individuals to provide service to the larger organization and having widely disparate hardware and systems would not provide staffing efficiencies.

The NDUS datacenter was built to Tier 3 standards to be able to minimize outages. This means the equipment installed must have things like redundant power supplies and networking. Some of the hardware at the institutions do not meet this standard and moving it into our datacenter does not allow us to meet our service level standards for the campuses.

The NDUS data center is currently using about 40% of the available raised floor space, 50% of the electrical and cooling capacity, and 80% of the technical capacity. The immediate need would be to build additional technical capacity (compute, storage, network) so that more systems could be virtualized and moved to the NDUS data center.

This plan is being presented as an optional funding request this legislative session.

3.3 Security

Security is one of the most important reasons to consolidate services. Having a group of individuals with the primary focus of ensuring the latest patches and updates are applied to reduce known vulnerabilities
is an important feature. But, some data requires extraordinary care. This includes health (HIPAA) and credit card (PCI) data. Very specific and unique rules apply to the transmission of this data. Systems containing this type of data need to be reviewed very closely. Again, it is not that we can’t consolidate, but our approach is to keep these systems at the campus level for now until a review can be completed. Then we will revisit and determine how we can best provide service to systems transmitting this type of data.

4 Governance

Governance is a critical part of being able to successfully offer consolidated services. CTS already utilizes the CIO Council to discuss campus and system IT issues. That group already has developed security and networking subcommittees that provide campus guidance to CTS staff in those areas. We will continue to use and expand upon this successful structure. We see additional standing and ad-hoc committees being formed depending on need. For example, an ad-hoc committee might be formed to discuss the timing of testing and rollout of the newest windows server operating system.

![Figure 3: High-Level Org Chart]

5 Next Steps

CTS will continue to work with campuses to identify where we can make progress in consolidation. As equipment fails or is replaced, we will work with the campuses to see if we can migrate that to CTS or at a minimum ensure the equipment purchased meets our datacenter standards so that it can be moved in the future without as much risk.

We will try to identify systems that fit well into a consolidated environment and move them as equipment becomes available in the datacenter. When possible, we will recycle campus equipment that meet the datacenter specs. We will continue to identify possible consolidations that don’t require significant funding.

Clearly, much is dependent upon the funding available in the next biennium. While we recognize that the current budget crisis the state is in may limit how quickly things can move, we believe that progress can be made regardless. We will continue work in partnership with campuses to fulfill this mandate.
6 Appendix A: SBHE Policy 1200.0

NORTH DAKOTA STATE BOARD OF HIGHER EDUCATION
POLICY MANUAL

SUBJECT: INFORMATION TECHNOLOGY     EFFECTIVE:

Section: 1200.0 Consolidated IT Services

1. Policy
The State Board of Higher Education shall provide centralized IT services to all entities
under its control.

2. Purpose of Policy
The IT resources of the NDUS support the academic, research, instructional, outreach, and
administrative activities of the University System. It is the responsibility of all entities under
the State Board of Higher Education to provide these services in an efficient, cost-effective
manner with a high level of quality of service.

3. Definitions

4. Policy Details
1. All institutions shall obtain the following IT services through Core Technology Services.
   i) electronic mail
   ii) file server administration
   iii) database administration
   iv) research computing
   v) storage
   vi) application server
   vii) hosting services
2. The chancellor shall adopt procedures and guidelines for deploying and managing these
   services to the institutions.
3. The chancellor shall adopt procedures for requesting waivers to these mandated services.

5. Contacts

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<th>Phone</th>
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<td>Policy Questions</td>
<td>NDUS Core Technology Services (CTS) Office of the CIO</td>
<td>(701) 777-3587</td>
<td><a href="mailto:ndus.cts.p3m@ndus.edu">ndus.cts.p3m@ndus.edu</a></td>
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N.D.C.C. §15-10-44.1, NDUS Procedure 1200.0

HISTORY:
7 Appendix B: NDUS Procedure 1200.0

NORTH DAKOTA STATE BOARD OF HIGHER EDUCATION
POLICY MANUAL

SUBJECT: INFORMATION TECHNOLOGY EFFECTIVE:

Section: 1200.0 Consolidated IT Services Procedure

1. Procedure
Core Technology Services shall provide the following centralized information technology (IT) services with consideration given to the creation of efficiencies, cost savings, and improved quality of service.
   b) electronic mail
   c) file server administration
   d) database administration
   e) research computing
   f) storage
   g) application server
   h) hosting services

2. Purpose of Procedure
The State Board of Higher Education Policy 120X.X requires the chancellor to adopt procedures for deploying and managing centralized IT services. It also requires the chancellor to adopt procedures for requesting waivers to these mandated services.

3. Definitions
   a. Electronic Mail Service – A single email service provided to all institutions by NDUS. This is currently the NDUS tenant of Microsoft Office 365. Email accounts are available for students, faculty and staff. Accounts include email, calendaring, contacts and more. Current email offerings also provide services for instant messaging, desktop sharing, cloud storage and video/audio conferencing.
   b. File Server Administration Service – A file server’s primary purpose is to provide a location for shared file access, i.e. share storage of computer files (such as documents, sound files, photographs, movies, images, databases, etc.) that can be shared over the network. IT is designed primarily to enable the rapid storage and retrieval of data and share this information with others. CTS will offer a tiered file server service to all institutions. The tiers will include cloud, standard and high speed solutions. Also see Storage & Backups.
   c. Database Administration Service – CTS offers a variety of database administration services for the NDUS community. This includes technical planning and implementation, logical configuration, and ongoing management of databases and related software to support local and enterprise-wide applications. Services provide operational stability, integrity, and security of databases, database management
software, and interfaces to that software. 24x7 support is provided for production environments. Platforms supported are Oracle, MSSQL (Microsoft SQL Server), and MySQL. All platforms can be supported in standalone or clustered configurations for high availability or specific performance needs.

d. Research Computing Service – The NDUS will provide resources for the coordinated use of high performance computing resources for all institutions.

e. Storage Service - CTS offers several levels of storage services, including automated backup services. Tapeless backup and tape storage are available for all disk storage. Tiered Solutions
   - Basic Storage: Designed for non-critical data that does not require high performance or high availability.
   - File Share Storage: Designed for critical documents, images, other non-transactional data that requires high performance and high availability.
   - Premium Storage: Designed for critical database and transactional data that requires high performance and high availability.

f. Application Server – A tiered application server service provided to all institutions of the NDUS using IaaS, PaaS and/or SaaS methodology. The tiers will include virtualized shared, virtualized dedicated, and dedicated hardware.

g. Hosting Services Service – CTS provides tiered hosting utilizing the NDUS data center to maintain servers and applications. Supported operating systems include Windows OS and RedHat Linux OS. All servers will be subject to security/vulnerability scanning and will be required to run only operating systems and software that have security patches provided by the vendor. Servers located in the NDUS data center benefit from redundant power (UPS and generator), cooling, and network. Each option may be provided utilizing a physical or virtual environment depending on the needs of the campus. CTS will determine if the server is located on campus or in the NDUS data center (minimum specs required). To gain efficiency of management and support, a virtual environment is the preferred deployment methodology.

h. IaaS – Infrastructure as a Service – Allows campuses to manage the operating system and application while CTS manages the hardware, storage, and virtualization.

i. PaaS – Platform as a Service – CTS installs and maintains the hardware and operating system level software. The institution installs and maintains the application level software.

j. SaaS – Software as a Service - CTS installs and maintains the hardware, operating system and application level software.

4. Procedure Details

   1. CTS shall establish chargeback services or develop a central funding for each service
   2. CTS shall establish service definitions and expectations for each centralized service. This process shall include:
      a) Office 365
      b) File Server Administration
      c) Database Administration
      d) Storage Services
      e) Application Servers
f) Hosting Services

3. CTS shall adopt a process for institutions to request a waiver for centralized services. The process shall include:
   a) A procedure for initiating the request
   b) A procedure to process the request
   c) Guidelines for completing requests

5. Contacts

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N.D.C.C. §15-10, SBHE Policy 1200.0

HISTORY:
8 Appendix C: Detailed Data

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