



To Consolidate or Embed: Improving the Infrastructure of Small Data Centers

Tuesday, May 16

11:15 AM – 12:30 PM

Panelists

- Jay Taylor, Schneider Electric
- Monica Witt, Los Alamos National Laboratory
- Bill Lakos, Michigan State University
- John Clinger, ICF, Moderator

Jay Taylor

Schneider Electric

Schneider Electric Data Center Consolidation

Better Buildings Challenge, Data Center Challenge, US Department of Energy

Jay Taylor

Director Global Standards, Codes and Policy

Life Is On



Global Participation



Chairman ISO/IEC JTC1 SC39 Sustainability for and By IT
WG1 Global Data Center Key Performance Indicators
IEC 30134-2 PUE

USNC Co-Chair IEC TC22H UPS Systems
IEC 62040-1, -2, -3, -4

Schneider Electric EPA ENERGY STAR Program Signatory

The Green Grid – Liaison Committee Chairman

Schneider Electric Data Center Consolidation

Goals

- Consolidate NA Data Center Space from ~ 20,000 SqFt to 5,000 SqFt by 2022
- Drive Continuously Reducing Footprint in 20 Separate Data Center Locations Across North America

Outcome To Date

- Through the Decommissioning, Consolidation, and Virtualization This Effort Reported 61% Energy Savings, Almost Double out Original Estimates by End of 2016.

Challenges

- As Decommissioning, Consolidation, and Virtualization Effort Occurred Keeping the Business Units Operational with Adequate Redundancy
- Developing Realistic Energy Savings from Soon to Be Decommissioned Sites, or Reduced Activities
- Accurate Campus Shared Location Energy Consumption Estimates

Monica Witt

Los Alamos National Laboratory

To Consolidate or Imbed: *Improving the Infrastructure of Small Data Centers*



Monica Witt

Laboratory Sustainability Officer
Program Manager, Utilities & Institutional Facilities



Operated by Los Alamos National Security, LLC for the U.S. Department of Energy's NNSA

LANL Infrastructure Statistics



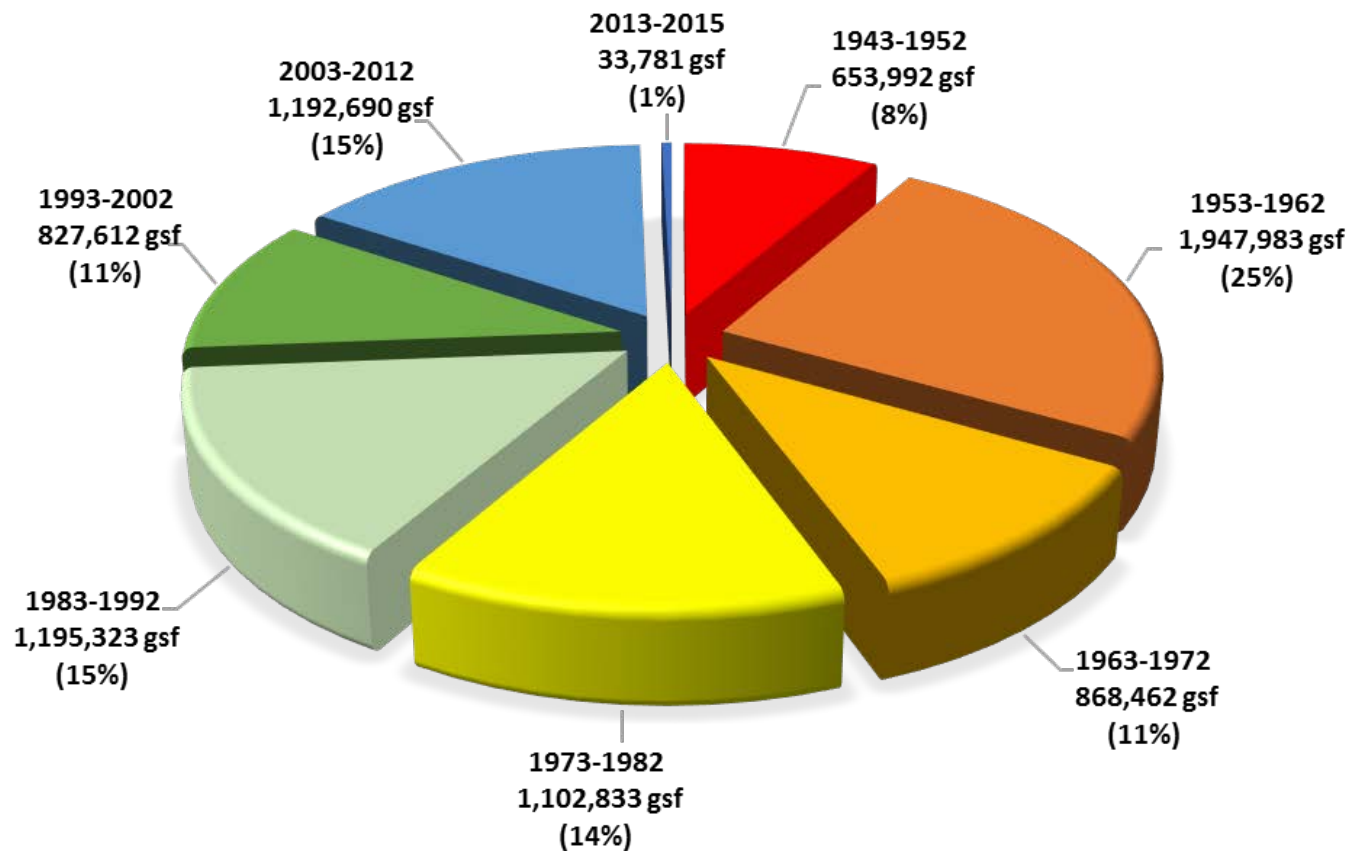
- ~40 square miles
 - 7,500 ft. elevation
 - 13 nuclear facilities
- 920 owned buildings with 8.2M gross sq. ft. (owned)
 - 50% more than 40 years old
 - 295 occupied buildings
 - 0.43M gross sq. ft. of leased properties
 - 0.35M gross sq. ft. shutdown assets
- Roads
 - 22 miles of primary roads
 - 62 miles of secondary roads
- Utilities
 - 32 miles of primary power lines
 - 166 miles of secondary power lines
 - 57 miles of gas distribution lines
 - 109 miles of water distribution lines (fire and potable)
 - 28 miles of steam lines
 - 63 miles wastewater



Land comparison of Washington, D.C.
and the Los Alamos National
Laboratory Site

UNCLASSIFIED

Age of LANL Operational Buildings by Decade



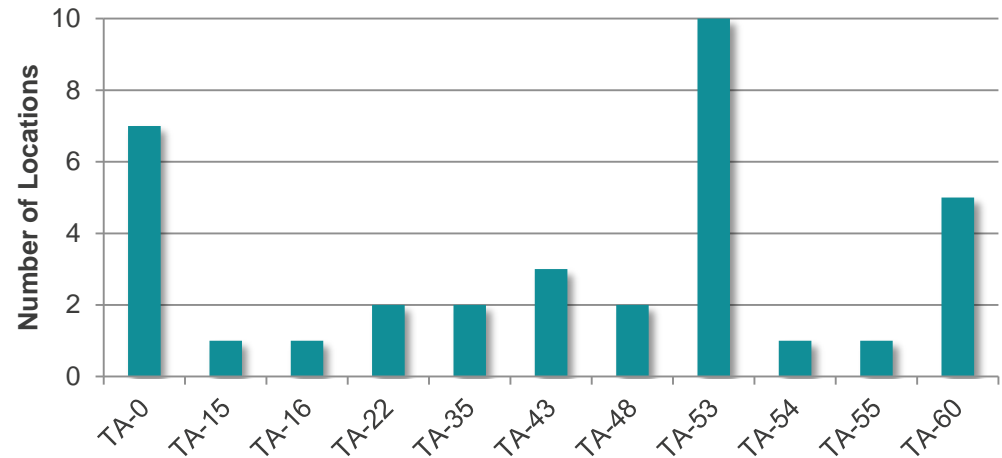
Step #1: Know Your Target

Laboratory organizations operate a significant number of separate data centers/server rooms located in TA-3 and across the larger campus

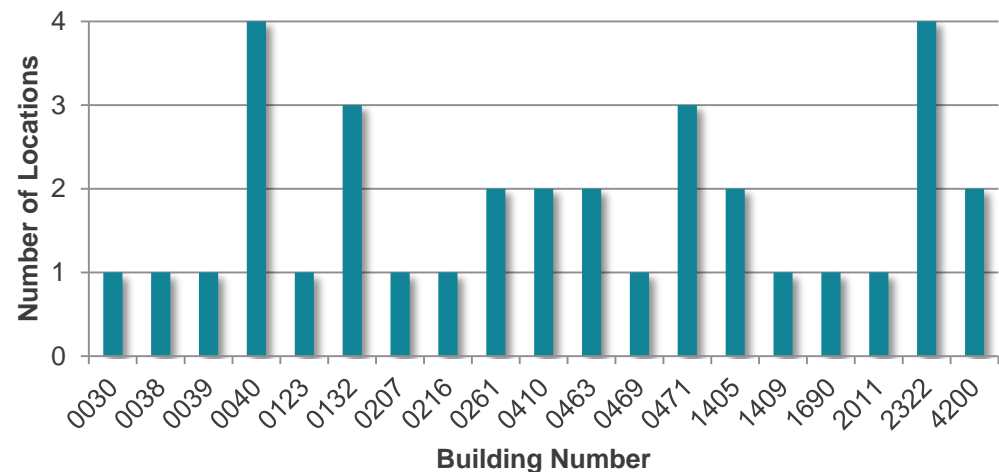
A summer 2013 study examined systems identified as “servers” in the Laboratory’s Host Master database. Limiting the analysis to those locations with five or more servers, the study found that these systems were located in 86 separate locations, including 51 locations alone at TA-3. The charts to the right summarize the locations identified in the study.

The study found another 14 separate locations that each housed between one and four servers, ranging from offices to additional small computer rooms.

Server Locations (Excluding TA-3)



**TA-3 Server Locations
(Excluding SCC, LDCC and CCF)**



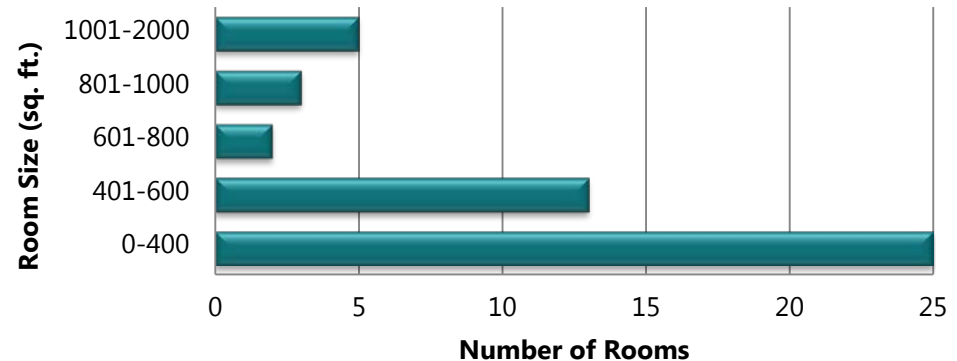
Many, many, many Small Data Centers

Each data center/server room has it's own dedicated infrastructure, often including power distribution, cooling, fire suppression, etc.

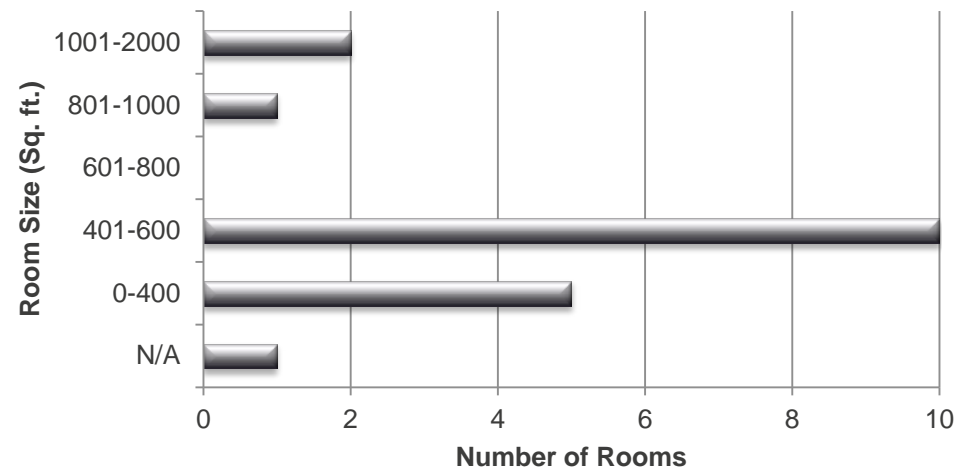
Excluding classified and large data centers from the 86 server locations identified in the study leaves some 48 locations, of which approximately one-half are less than 400 square feet in size. The unclassified data centers total almost 24,000 square feet of space. Excluding large data centers and SCIF infrastructure, the study found some 19 smaller classified data centers, totaling almost 10,000 square feet in size.

An April 2014 review of Host Master data found all these data centers still in use, with only a slight change in number of servers at any location.

Unclassified Machine Room Size



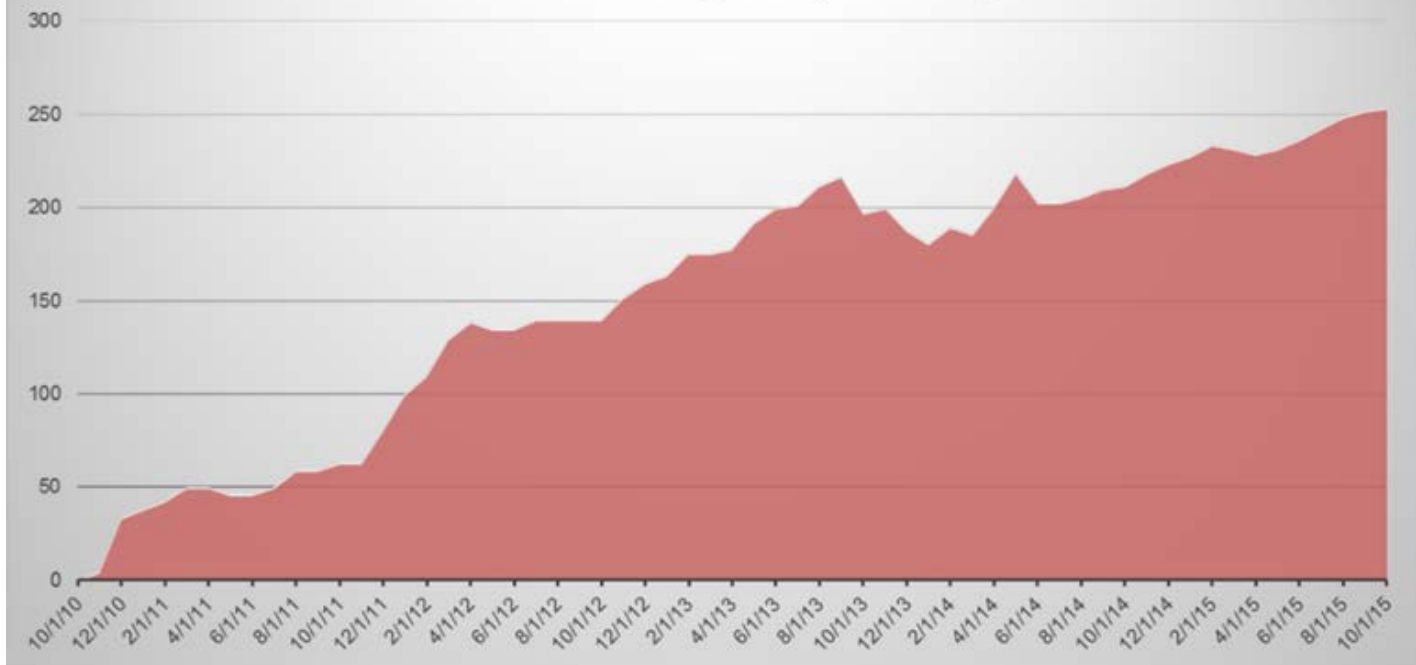
Classified Machine Room Size



Step #2: Virtualize, virtualize, virtualize

- Migrating physical servers over to virtual machines and consolidating them onto far fewer physical servers' means lowering monthly power and cooling costs in the data center.
- In addition to saving more of LANL's funding for science with a smaller energy footprint, our server consolidation with virtualization also reduced the overall footprint of the entire data center.
- As technologies like Software Defined Data Centers continue to mature it will become possible to move a virtual machine from one data center to another no matter the network latency involved.
- As the public cloud matures, and the technology around it advances the next step is plan and architect moving data out of the data centers and into a cloud hosting facility, LANL will be well positioned towards that goal.
- **Recommendation #5**
Take Advantage of Equipment and Personnel Moves

Oracle Cloud FY11 - 15 Growth in Adoption (# of VMs)



- **Virtualization has been in data centers for several years as a successful IT strategy for consolidating servers.**
- **Virtualization can also provide the basic building blocks for LANL's private and hybrid cloud environment to enhance agility and flexibility.**
- **In FY15, NIE created 311 VMs and decommissioned 150. The annual growth rate in FY15 was 13.74% and had similar growth in FY16.**
- **This continuing growth makes cloud computing an obvious next step for many organizations.**
- **The virtualized infrastructure that is deployed today at LANL will eventually evolve into a flexible and scalable hybrid cloud infrastructure.**

Step #3:

What does Success Look Like?

A “Smart Lab” should be:

- **Effective:**
 - Support research and development
 - Flexible to change
- **Safe:**
 - Protect people from exposure
 - Compliance with standards
- **Efficient:**
 - Minimum energy consumption
 - Minimum operating costs
- **Sustainable:**
 - Maintainable with Long Lifecycle
 - Minimum Carbon footprint
 - Return of Investment



Bill Lakos

Michigan State University

Data Center Consolidation in Multi-Use Environments

Bill Lakos

Building Automation Systems / Energy Analyst
MSU IPF Energy and Environment

May 16, 2017

2017 Better Buildings Summit



Background Information

Michigan State University – East Lansing, MI

Mission:



Michigan State University Spartans work every day to advance the common good in uncommon ways. Together we tackle some of the world's toughest problems to find solutions that make life better.



Background Information

Michigan State University – East Lansing, MI

Statistics:

- 49,350 Students
- 11,110 Faculty & Staff
- 5,200 acre campus with 2,100 acres in existing or planned development
- 538 buildings, including 95 academic buildings
- Own and operate 100MW co-generating power plant (steam and electricity)



Background Information

Michigan State University – East Lansing, MI

Better Buildings Challenge Data Center Commitment:

- Two major facilities
- 5,900 Sq. Ft.-700kW Total Load
- Campus Administration
- High Performance Computing Center
- Back Up Facility

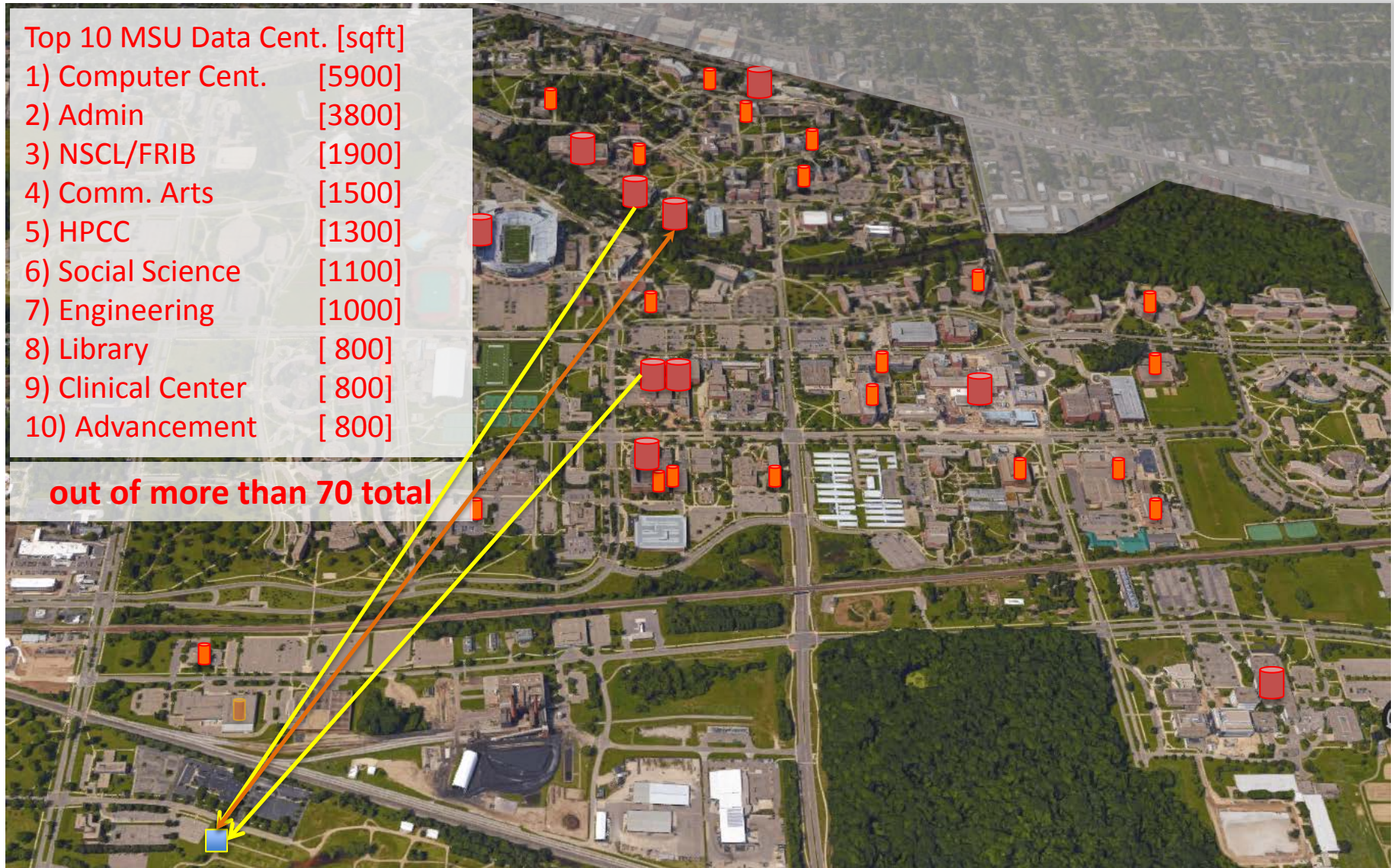


Existing Landscape:

Top 10 MSU Data Cent. [sqft]

- | | |
|--------------------|--------|
| 1) Computer Cent. | [5900] |
| 2) Admin | [3800] |
| 3) NSCL/FRIB | [1900] |
| 4) Comm. Arts | [1500] |
| 5) HPCC | [1300] |
| 6) Social Science | [1100] |
| 7) Engineering | [1000] |
| 8) Library | [800] |
| 9) Clinical Center | [800] |
| 10) Advancement | [800] |

out of more than 70 total



MSU Campus (consumes 28-61 MW electricity, total annual energy input: ~ 6 BCF gas)

What's the problem with having many server rooms?

- Server Utilization
- Energy Efficiency (PUE)
- Cooling Systems
- Staffing
- Consistent Standards
- Backup of Data
- Backup Systems/Continuity of Operations



Department creates a space for service



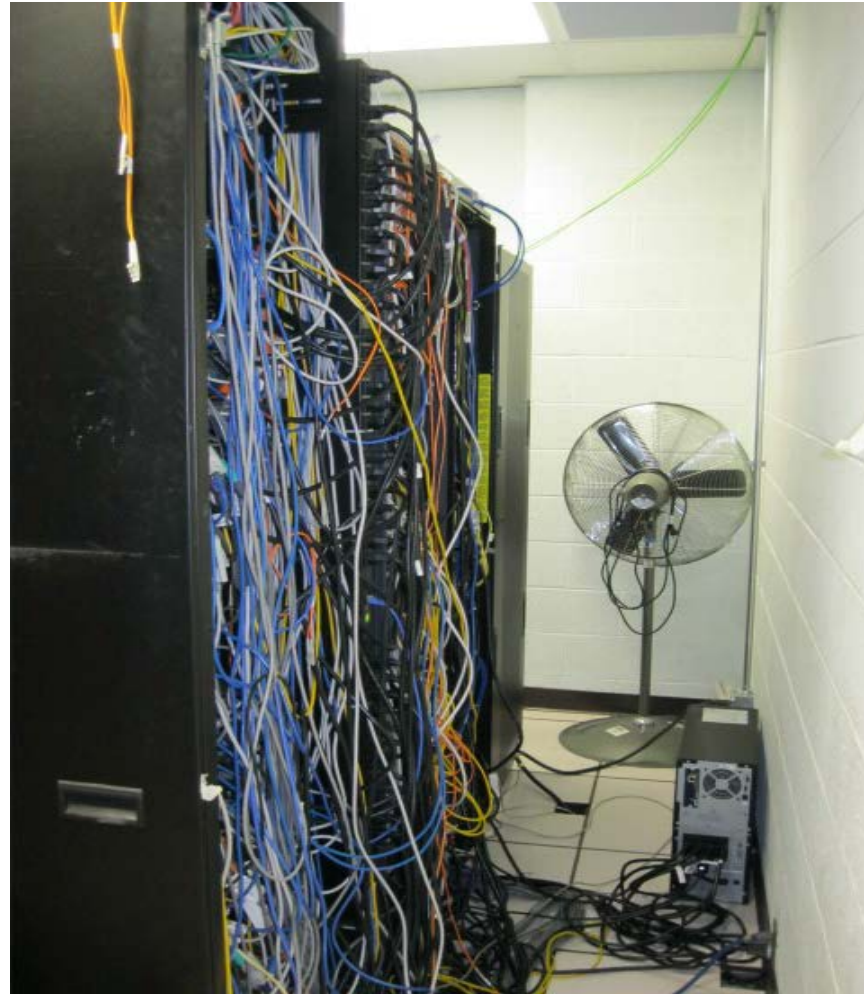
Clever (?) “free cooling” option



Clever (?) solution for heat rejection



A real server room mess



University Goal

Centralized Solution (first step):

- Combine two major data centers into a single purpose-built facility
- Determine the optimal mix of local, remote, and cloud based IT solutions
- $PUE < 1.5$



Project Details



Infrastructure Planning and Facilities
MICHIGAN STATE UNIVERSITY

CP13308

Data Center – Business Continuity and High Performance Computing

CONSULTANT: CH2M, Englewood, CO

CONTRACTOR: Holder Construction Company, Atlanta, GA

PROJECT MISSION

The approximately 25,000 gross square foot data center includes 10,600 square feet dedicated to rack/server space that will house about 300 server racks, a work room, toilet room, secure storage, and significant mechanical space. An external equipment yard will house necessary electrical and cooling equipment and utility extension from the T.B. Simon Power Plant to the new building. Initial computing power will be 2.5 megawatts (MW) expandable to 5 MW with additional 5 MW possible predicated on building expansion; 10 MW total. This project will allow for consolidation of the two enterprise data centers as well as the current 70+ centers distributed across campus, including High Performance Computing.



Project rendering



University Goal

Project Status:

- Scheduled Completion December 2017

Challenges/Barriers

- Balance future operation cost savings with need for initial investment
- Create trust relationships between Administration, Facilities, Academia, and IT



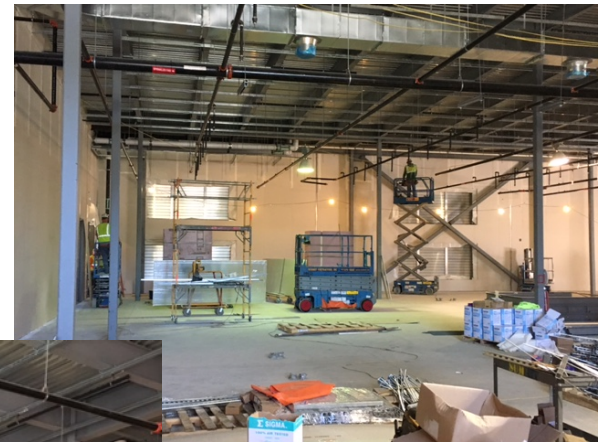
Construction – May 12, 2017



Construction – May 12, 2017



Construction - May 12, 2017



Construction – May 12, 2017



Construction – May 12, 2017



Anticipated Outcome

- Target PUE < 1.2 from current > 2.2
- Reduction of energy use by 40%
- Avoided consumption of 10,000+ MWh per year
- Utility savings of approximately \$1 million
- Avoid outages due to failures
- Future integration opportunities with additional data centers on and off campus (other universities, State of Michigan, etc.)



**But, for servers that aren't
contained**



Basic containment.



Virtualization and temperature set



78 degrees F



IPF Datacenter Power Consumption

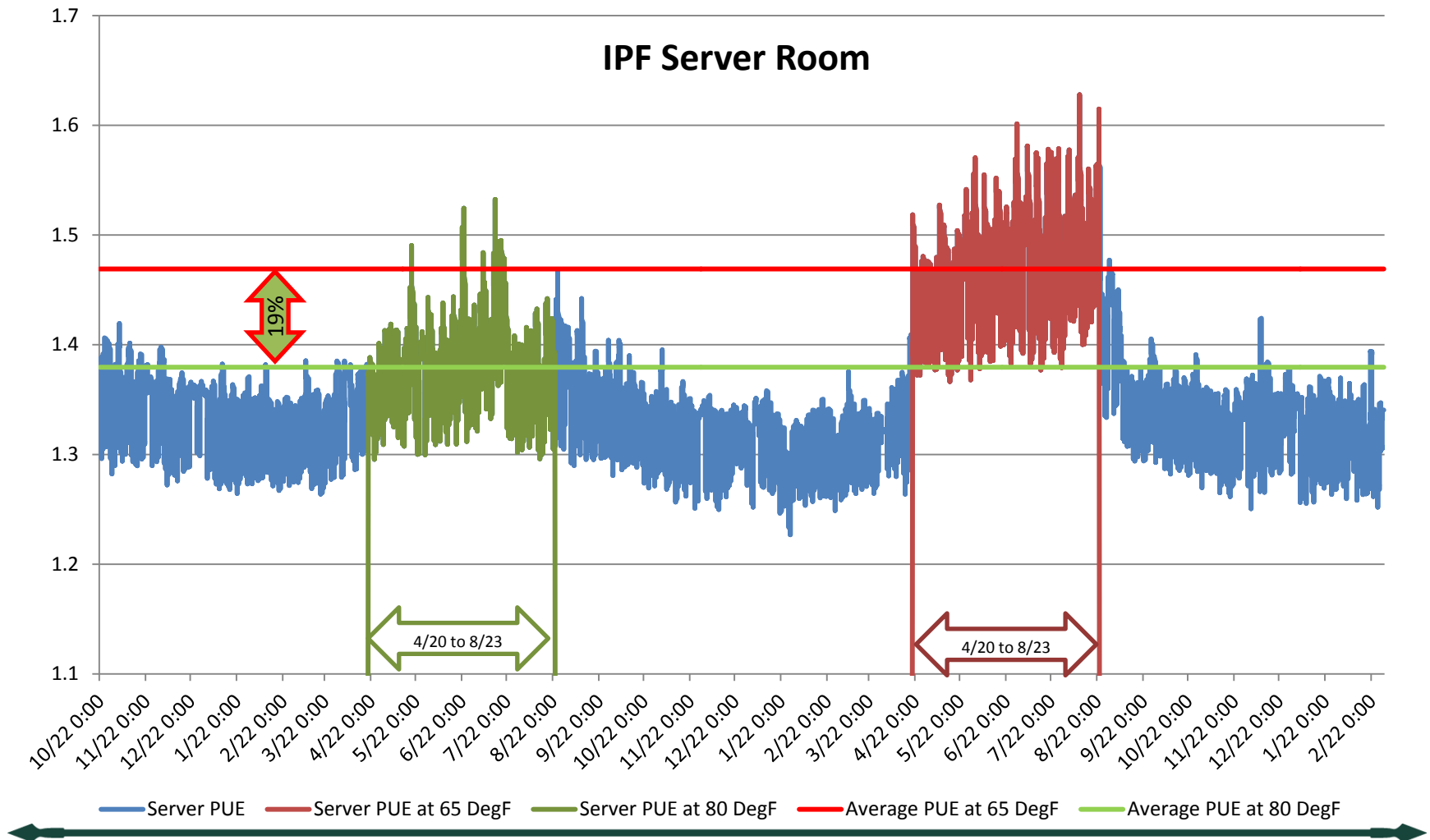
	2008	2012	2016
Total Servers	27	61	121
Physical Servers	27	14	10
Virtual Servers	0	47	111
Power Consumption	~10 kW	4.5 kW	3.5kW

- 448% increase in server count
- ~65% reduction in IT power consumption
- 2008: 370W per server
- 2016: 29W per server



Impact of server room temperature on PUE

IPF Server Room




Thank you!

Questions?

Jay – 

Monica – 

Bill – 

John – 



Thank You

Provide feedback on this session in the new Summit App!

Download the app to your mobile device or go to **bbsummit.pathable.com**

