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March 31, 2015

To: Mayor Michael D. Antonovich
Supervisor Hilda Solis
Supervisor Mark Ridley-Thomas
Supervisor Sheila Kuehl
Supervisor Don Knabe

From: Richard Sanchez
Chief Information Officer

COUNTYWIDE DATA CENTER CURRENT STATE ASSESSMENT AND FUTURE STATE REQUIREMENTS

This is in response to the September 30, 2014, joint Board Motion by Supervisor Ridley-Thomas and Supervisor Don Knabe, wherein the Board directed the Chief Information Office (CIO) in coordination with the Chief Executive Office and Internal Services Department (ISD) to:

1. Identify and contract with, under an existing Master Services Agreement (MSA), an independent third-party agency or firm with a physical presence in the region that specializes in data center design and implementation in order to provide the Board of Supervisors with a written report within 120 days, with a comprehensive and realistic recommendation regarding the County's current requirements for total and raised floor space, power and utility needs for a data center. The recommended scope should:

    a. Reflect the replacement of ISD's Downey data center;

    b. Ensure that the same data center is ready to consolidate most of the County's 65 data centers; and

    c. Accommodate future growth and consolidation, factoring in virtualization and anticipated changes in data center and information technologies.

2. Instruct the CEO to contract with a second independent third-party agency or firm to assess and analyze the short and long-term financial, logistical, and operational impacts associated with acquiring, leasing, or constructing a data center that meets the needs defined above. The selected agency or firm should be experienced and

familiar with California's building code requirements for data center design and construction, possess a deep and practiced understanding of the County's real estate market, and provide a recommendation of the most beneficial and cost effective option. The recommended scope should:

a. Consider the range of options to satisfy the County's needs including leasing, purchase, or construction of a new facility.

b. Identify a County site that will best accommodate current needs and future growth, if construction is recommended; and

c. Compare the benefits and drawbacks of constructing a new facility at the Rancho Los Amigos south campus versus another vacant site.

3. Adopt a policy direction to consolidate departmental data centers in a virtualized centralized model; and

4. Instruct the CEO, CIO, ISD's Information Technology Services, and Departmental CIO's to form a committee and report back in writing to the Board within 90 days with a countywide consolidation policy, five-year consolidation roadmap, and an operations governance process for the new data center.

On November 12, 2014, your Board authorized the CEO to execute a Work Order with Gartner Consulting under the Strategic Planning MSA to:

1. Conduct an assessment of the Downey Data Center (DDC), the Local Recovery Center (LRC) and approximately 65 Departmental computing centers to document the computing requirements to support the development of a data center consolidation strategy; and

2. Develop a data center consolidation strategy that takes into consideration the replacement of the DDC, consolidation of most of the County's approximately 65 departmental data centers, and industry best practices to accommodate growth and contemporary computing technologies.

CURRENT STATE ASSESSMENT AND FUTURE STATE REQUIREMENTS

The Current State Assessment included meetings with Departmental IT leadership, and site visits to 49 Departmental data centers. This number is significantly less than the 65 data centers identified in the Board Motion because of on-going virtualization and consolidation efforts, which have led to decommissioning of several data centers over the past five years. In summary, Gartner collected information regarding mission critical applications, square footage occupied by data centers, power provisioned and consumed, servers, and storage.

The Future State Requirements for a consolidated data center were developed by analyzing the Current State Assessment, key industry best practices, costs, risks, and new technologies. Gartner also used their capacity model to forecast the County's needs over the next 10 years. The recommended future data center vision for the County is guided by the following principles: Active-Active Computing, Disaster Recovery Planning, Essential Facility Specifications, Tier III Reliability, Operational Excellence, Dedicated Facility, Energy Efficiency, and Modular Build.

The detailed findings regarding the Current State Assessment and Future State Requirements are documented in Gartner's Summary Report and Attachments A-E. This material has been submitted to the CEO for the next phase of the effort which is to contract with a second independent third-party agency or firm to assess and analyze the short and long-term financial, logistical, and operational impacts associated with acquiring, leasing, or constructing a data center that meets the needs defined above. The CEO's staff has indicated this process will be completed within sixty (60) days of receipt of the Gartner materials.

A second report from Gartner will be submitted on April 15, 2015, which will include the new data center Governance Model and five-year Consolidation Roadmap.

If you have any questions or require further information on this matter, please contact Peter Loo of my staff at 213-253-5627 or PLoo@cio.lacounty.gov.

RS:PL:pa

Attachments

c: Chief Executive Office
Internal Services Department

Report on LA County's Data Center Strategy

Current State Assessment and Future State Requirements

March 30, 2015

Gartner

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1.0 Background

1.1 Board Motion

In September of 2014, the Board of Supervisors adopted a multi-part motion, the first of which was to:

"Instruct the Chief Information Officer (CIO), in consultation with the Director of the Internal Services Department (ISD) to identify and contract with, under an existing Master Agreement, an independent third party agency or firm with a physical presence in the region that specializes in data center design and implementation in order to provide the Board with a written report within 120 days, with a comprehensive and realistic recommendation regarding the County's current requirements for total and raised floor space, power and utility needs for a data center. If there is not a vendor with the expertise under the existing Master Agreement, the Chief Information Officer and Director of Internal Services should return to the Board with recommended vendors. The recommended scope should:

a) Reflect the replacement of ISD's Downey data center;

b) Ensure that the same data center is ready to consolidate most of the County's 64 data centers; and

c) Accommodate future growth and consolidation, factoring in virtualization and anticipated changes in data center and information technologies.

The CIO contracted with Gartner to develop a currents state assessment and provide recommendations regarding the County's data centers. This report provides the Current State Assessment and the Future State Requirements for the consolidated data center. There will be a second report by April 15, 2015 that will address the Governance Model and five-year Consolidation Roadmap.

1.2 Data Gathering

Gartner, in collaboration with the Office of the CIO, identified forty-nine (49) operating data centers in the County that needed to be assessed. This number is significantly less than the sixty four (64) data centers that was mentioned in the Board Motion due to the on-going consolidation effort that has already resulted in closure or decommissioning of several data centers.

Gartner then prepared application, facility, and IT asset data collection templates that were distributed to all departments with active data center facilities and worked with the Office of the CIO to ensure that all departments provided all requested data.

Gartner also visited and assessed the 49 active data centers (including the Local Recovery Center (LRC) in Orange County). Each site visit consisted of:

- A physical walk-though of the data center
- Collection and review of any supplemental documentation provided by the operating staff
- Meetings with departmental IT leadership, technical staff, network, and operations engineering team members

2.0 Current State Assessment

2.1 Inventory

Through its data collection efforts, Gartner determined the County's current data center inventory, power and space consumption. The main inventory numbers are:

- 430 mission critical applications (as identified by the departments).
- ~ 67,000 square feet of space occupied by data centers.
- 7.49 megawatts of power provisioned and 2.37 megawatts of power consumed for IT equipment (32% of provisioned power is consumed).
- 1,142 racks of IT equipment, including servers, storage, network equipment, etc.
- 6,822 Operating System Instances (OSI), including 1,189 non-virtualized x86 servers, 5,407 virtualized x86 servers, and 226 mainframe and midrange logical servers (IBM Z-series, IBM P-Series, AS-400, HP-UX, and Tandem platforms).
- 14,891 Terabytes of raw storage.

The County's primary data center at Downey has the highest percentage of each of these inventories:

- 26% of occupied space
- 20% of provisioned and 26% of consumed power
- 22% of racks
- 27% of OSI (another 7% at LRC)
- 27% of raw storage (another 22% at LRC)

The Department of Health Services (about 10%) and the Sheriff department (about 15%) also account for a large percentage of the County's inventory.

See Attachment B for a two (2) page Data Center summary inventory which lists the key attributes (size, contents, etc.) of each active County data center.

2.2 Assessment

For each department, Gartner provided a report with schematics of its data center(s), summary of departmental inventory, data center reliability (based on an industry standard tier system, explained on page 23 of Attachment A) and observations. These reports were validated with the Departments. As an example, the report for ISD's Downey facility is provided as Attachment C.

The departmental assessments were then used to summarize the key findings for the County as a whole. The primary findings where:

- The County has already made significant strides to consolidate their systems, reducing the number of County data centers from 64 a few years ago to 49 today. This reduction is partially due to departments moving to ISD's environment and partially due to department level consolidations. Despite these efforts, the County's data center environment is still largely decentralized with 24 departments still operating at least one departmental data center.

- The County's virtualization efforts have led to significant decreases in data center capacity needs as more servers can consume less physical space and power. As a result, the County is currently under-utilizing its space, cooling, and power capacity, with many data centers using less than 50% of the available capacity (the County average for utilization of provisioned DC power capacity is 32%, see above).
- ISD's eCloud offering provides a solid foundation for building a consolidated, virtualized, and shared environment. This is especially due to a variety of self-service options, price levels and disaster recovery capabilities. ISD should continue cost reduction efforts to make eCloud more attractive to departments.
- None of the data centers operated by the County can be considered a dedicated data center facility (a facility that is only used for data center purposes). The only dedicated DC site is LRC, which is operated by Orange County. All other data centers are in multiuse facilities (office spaces, communications centers, hospitals, etc.) and many are in repurposed or multiuse rooms (storage closets, break room, office space, etc.).
- Nearly all data centers lack best practice degree of reliability that is expected for hosting mission critical applications. Only one data center (DHS MLK) can be considered a Tier III data center (best practice reliability for mission critical applications). There are 11 Tier II facilities and 37 Tier I facilities. Both Downey and LRC data centers meet some but not all the requirements of a Tier III data center, and are therefore considered Tier II data centers.
- County Departments are focused on maintaining their current facilities and do not have formal strategies for their data centers or adequate disaster recovery capabilities. DHS has made some significant recent investments in their data centers at LAC-USC and MLK, and the Sheriff department has made significant recent investments at their data center in the Sheriff Communications Center (SCC). Besides ISD's LRC in Orange County, none of the departments have hot site disaster recovery, which is best practice for mission critical applications.
- All of the County's data centers, including ISD's disaster recovery site in Orange County, are subject to seismic risk. An earthquake could affect the County's ability to maintain current IT operations. Only four data centers are base isolated or have seismically reinforced buildings (Sheriff SCC, DHS LAC-USC, CEO Emergency Operations Center, and Fire).

See Attachment A for a more detailed description of Gartner's Assessment of each of the County's Active Data Centers.

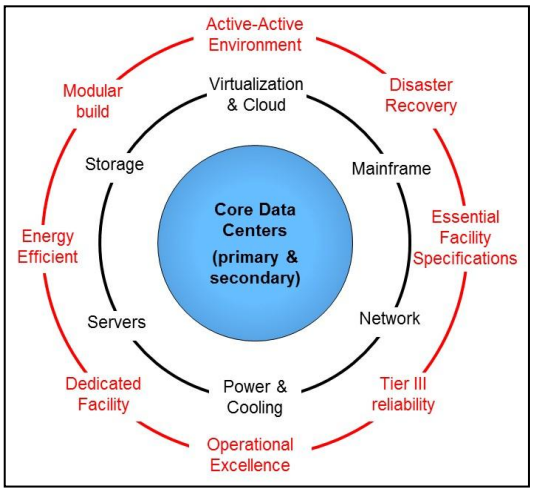
3.0 Future State

3.1 Current Industry Trends and Data Center Best Practices

While the current needs provide a critical input into the capacity needs for the future, key industry practices and trends are also important factors in determining the County's Future State needs. Gartner discussed and reviewed the following trends with CIO, CEO and ISD stakeholders for inclusion into the vision:

- Cost and risk pressures are forcing most organizations to fewer, higher quality data centers. Reducing the number of data centers allows organizations to be more efficient in their use of space, power, cooling and staff and focuses security efforts to a few locations.

- The same cost and risk pressures are forcing organizations to rethink long held data center strategies around ownership, geographic distribution, co-location with people/corporate campuses, redundancy levels and use of cloud technologies as an alternative to data centers. Most favor a few highly redundant (Tier III) data centers in separate disaster strike zones. Many organizations are considering not owning their data center, but rather leasing space in a co-location facility and/or using cloud solutions.
- While the Public Sector lagged behind the Private Sector in adopting data center consolidation strategies, many government agencies have now implemented consolidating policies. New York City and San Francisco City/County (the closest municipalities in terms of size) are both undergoing consolidation efforts. Additionally, almost all States have or are consolidating (due to its size and federated government structure LA County is comparable to State governments).
- Virtualization technologies and the continued forward march of "Moore's Law" (observation by the Founder of Intel that processing power for computers will double every two years) will make future data centers "hotter and smaller". New data centers will be able to support exponentially increasing computation needs through linear increases in power needs and little increase in space needs.
- As business processes become completely dependent on the IT systems, more robust disaster recovery solutions will be required for most applications. Continuously available, active-active environments are becoming the norm as the business side becomes more and more reliant on IT 24/7.
- Most public sector data center organizations have implemented private clouds, but will need to turn these into hybrid cloud solutions to remain competitive. Hybrid cloud solutions merge an organization's private cloud with public cloud offerings to reduce costs, provide additional agility and scalability and increase disaster recovery capabilities.



3.2 Future State Vision

Based on the County's current environment, market practices and trends, Gartner created the following Future Data Center Vision for the County:

- **Active-Active Environment:** LA County should plan for two consolidated County data centers capable of operating in an active-active configuration with a maximum latency of 10ms between data centers.
- **Disaster Recovery:** Primary and secondary data centers shall not be within the same earthquake fault zone, unless mitigated by a third facility.
- **Essential Facility Specifications:** The Data Center building shell shall comply with the International Building Code (IBC) Essential Facility specifications.
- **Tier III Reliability:** To enhance availability and manage risk, consolidated data centers shall comply with TIA-942 Tier III specifications, and be able to pass formal certification if so desired by the County.

- **Operational Excellence:** Facilities and IT operational maturity and excellence shall be assessed, monitored, and improved.
- **Dedicated Facility:** The data center building shall only house data center and associated support services such as a Network Operations Center (NOC).
- **Energy Efficient**: Energy efficiency is of great importance. Every effort should be made to design or select a facility for optimum energy efficiency. Total facility Power Usage Effectiveness (PUE) shall not exceed 1.4. The PUE is a metric used to determine the energy efficiency of a data center. PUE is determined by dividing the amount of power entering the data center by the power used to run the computer infrastructure within it.
- **Modular Build:** In order to satisfy future demand, while managing initial cost, data center power and cooling infrastructure shall be modular with ability to increase capacity without outage to any operating IT infrastructure.

See pages 2-18 of Attachment D for a more detailed description of the County proposed Data Center Future State vision.

3.3 Capacity Needs

Gartner developed a capacity model to forecast the County's needs over the next 10 years. The model incorporates the County's current inventory, the expected technical environment of a new primary facility, future growth estimates, estimated adoption of eCloud by consolidating departments and contingency for space and power needs. Below are the key assumptions applied in the Capacity Model:

- Full consolidation of departmental systems in the new data center. Only systems at LRC and some departmental systems that are disaster recovery and would migrate into LRC (or another secondary site) will not migrate.
- The server and storage equipment purchases will align with ISD's technology purchases over the last two years.
- Servers will grow at a 10% rate year over year, with 20% growth in the first year and 12% in the second to account for increases as departmental systems move to a new environment.
- 70% of departmental systems that are currently not on eCloud will consolidate to eCloud. The other 30% will be managed in an environment similar to their current configuration in a co-location space.
- The model has a 30% contingency built in for both space and power to provide a margin of error.

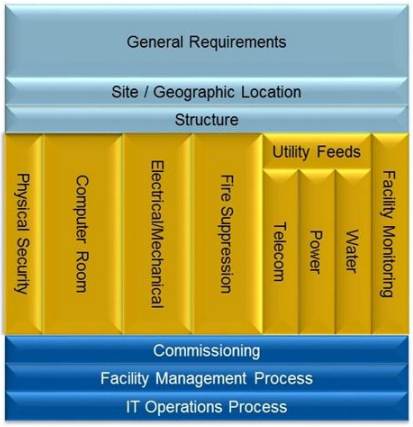
Sensitivity analysis was conducted on each of the assumptions. Based on the analysis, the County's forecasted capacity is most sensitive to growth forecasts, departmental participation and technology purchases. Due to this analysis, some additional contingencies were added to both space and power.

The County's new data center should eventually be able to accommodate a maximum of 2.1MW of power and 14,000 ft^2 of space over the next 10 years. If not all departments participate, the maximum capacity may be less.

More details regarding the results of the Data Center capacity modeling exercise and the inputs and assumptions which drove these results is contained in Attachment D.

3.4 Requirements

Gartner developed a framework to define the County's future state requirements in terms of site requirements, tier level, facility management and other areas depicted in the figure to the right. These requirements provide the basis for selecting a data center to replace Downey, consolidate most of the County's data centers, and provide for the County's future business and growth needs. The detailed requirements are provided Attachment E. The framework for organizing these requirement is illustrated at the right and described below:



- **General Requirements:** Overall key requirements which drive the overall data center vision.
- **Site / Geographic Location:** Guidelines and requirements of the geographic location and site (e.g. land) where the data center will be located.
- **Structure:** Guidelines and requirements regarding the construction and layout of the building which will contain the data center.
- **Physical Security:** Requirements for physically securing the data center facility.
- **Computer Room:** Guidelines and requirements for the computer room including both features and capacity.
- **Electrical/Mechanical:** Guidelines and requirements for the heating, cooling and power distribution/transformation infrastructure required to support the computer room.
- **Fire Suppression:** Requirements regarding fire detection and suppression systems.
- **Utility:** Requirements regarding utilities (telecom, water, and power) including water storage and telecom/power diversity.
- **Monitoring and Control:** Requirements for systems to monitor the health and usage of the various power, cooling, hazard detection, security and other facility related systems.
- **Commissioning:** Requirements for a) testing and validating that the facility and its electrical and mechanical components perform and function as designed, b) documenting and testing all the operating procedures, and c) ensuring that facilities staff are trained in those operating procedures.
- **Facilities and IT Operations Processes:** Requirements for processes, skills and staffing levels required to manage a critical facility and IT Operations.

See Attachment E to review the actual recommended future state data center requirements

4.0 Attachments

4.1 Attachment A – Current State Assessment
4.2 Attachment B – Data Center Inventory
4.3 Attachment C – ISD Assessment Report
4.4 Attachment D – Future State Vision and Capacity Model
4.5 Attachment E – Future State Requirements

Report on LA County's Data Center Strategy

Current State Assessment and Future State Requirements

Attachment A- Current State Assessment

March 30, 2015

Prepared for: Los Angeles County

GARTNER CONSULTING

Project Number: 330025627 Version #1

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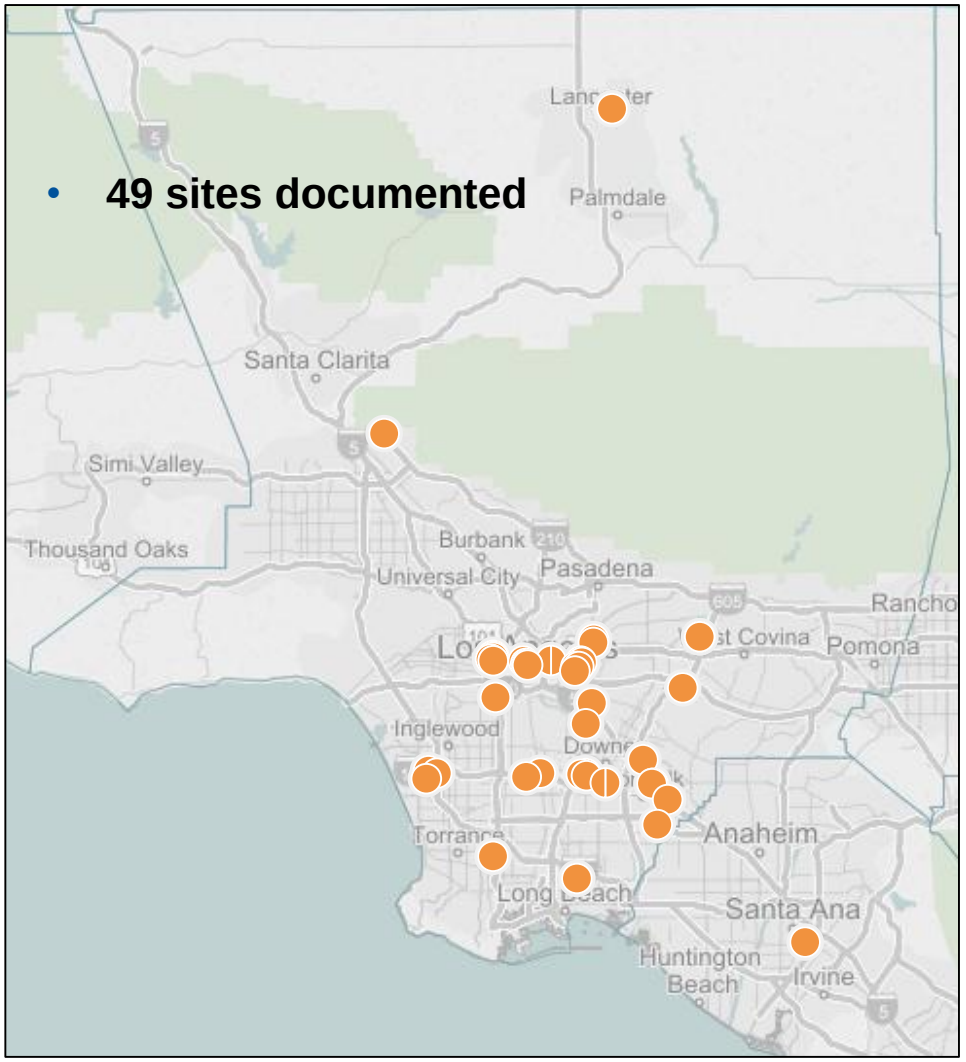
Background and Methodology



Background:

In September of 2014, the Board of Supervisors adopted a motion for the Chief Information Office (CIO), in consultation with the Director of the Internal Service Department (ISD) to contract with a consulting agency to provide the Board of Supervisors with a current, comprehensive, and realistic recommendation of the County's requirements for total and raised floor space, power and utility needs for a data center.

Methodology:

This summary of the current state has been prepared based on the data collected during the following activities:

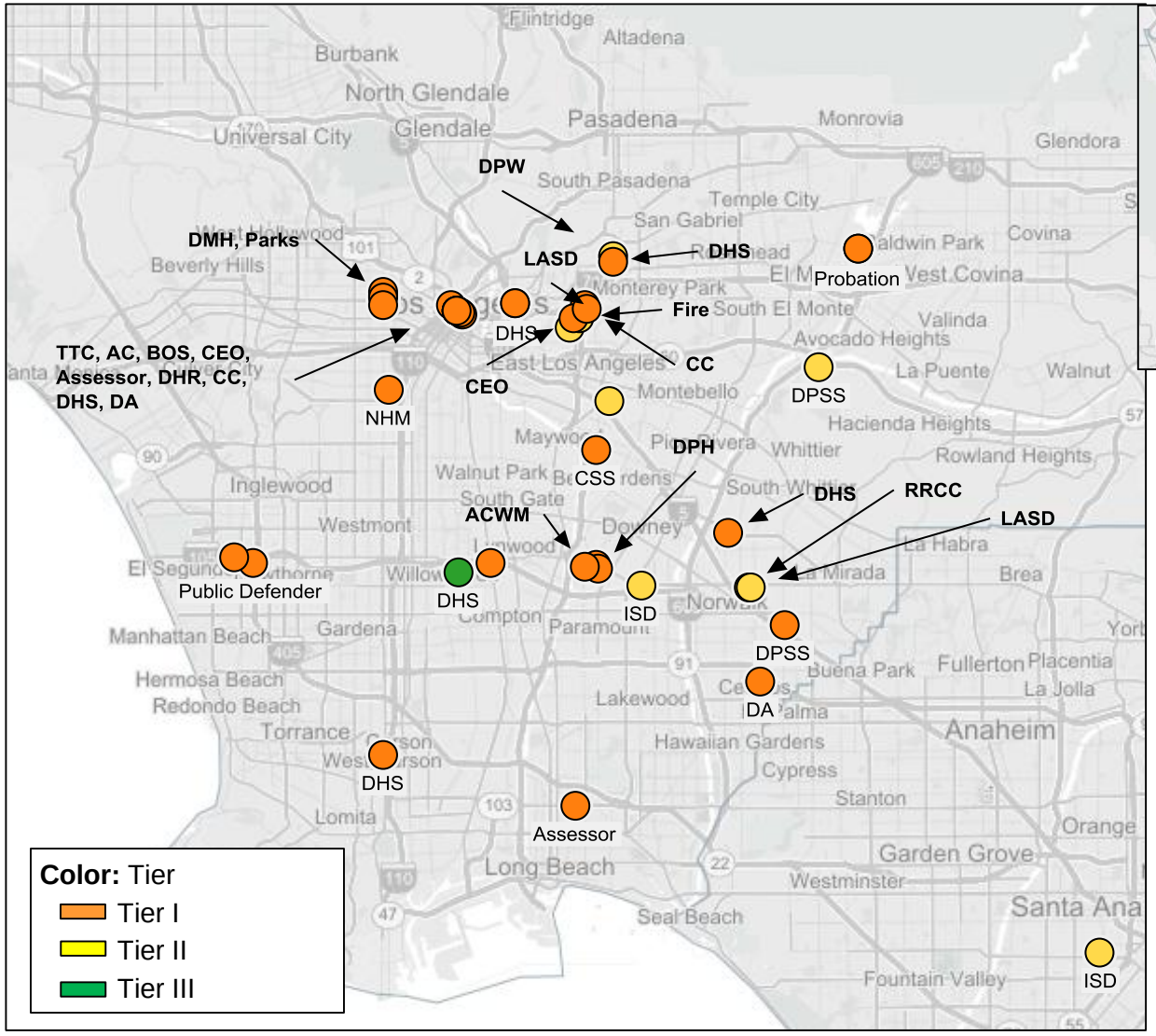
- site visits for the purpose of physical walk-though of each data center.
- Data collection documents provided by the IT and operational staff for each data center.
- Discussions with IT leadership during walkthroughs.

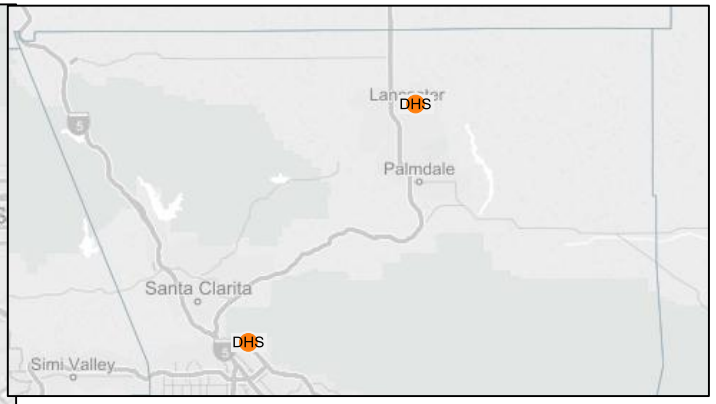
Current State Assessment

Overall Themes

- The County has already made significant strides to consolidate their systems; however, 24 departments still have at least one departmental data center.
- Virtualization efforts have led to significant decreases in data center capacity needs. As a result, the County is currently under-utilizing its space, cooling and energy consumption, with many data centers using less than 50% of the available capacity.
- ISD's eCloud offering provides a solid foundation for building a consolidated, virtualized, and shared environment.
- None of the data centers operated by the County can be considered a dedicated data center facility. Only LRC is a dedicated site which is operated by Orange County.
- Only one data center (DHS MLK) can be considered a Tier III data center. Most sites are Tier I with a few Tier II facilities. Both Downey and LRC data centers are Tier II facilities.
- County Departments are focused on maintaining their current facilities and do not have formal strategies for their data centers or adequate disaster recovery capabilities.
- All the County's data centers, including its disaster recovery site in Orange County, are subject to seismic risk. Only four data centers are base isolated or have seismically reinforced buildings.

Reliability of County Data Centers:
Only one (1) of the County's data centers is Tier III (which is best practice for mission critical applications); another 11 are Tier II, including ISD Downey.





Data Center	Tier II	Tier III
ISD Downey	√	
ISD LRC	√	
BOS	√	
DHS LAC-USC (DNT DC)	√	
DHS MLK		√
DHS LAC-USC DNT Building	√	
Fire	√	
Department of Public Health (Commerce)	√	
Department of Public Social Service (Crossroads)	√	
Department of Public Works	√	
Registrar Recorder / County Clerk	√	
Sheriff - Eastern	√	
All other Data Centers are Tier I		

New or Recently Retrofitted Data Centers (Less than 2 Years)

Data Center / Server Room	Comments
Department of Health Services (DHS) - MLK	This new Tier III data center is located in the older section of the MLK hospital which was recently retrofitted. Data center is less than 2 years old with ample space and power capacity. DHS plans to leverage this site as a focal point for consolidating its other departmental data centers. Approximately 7 Racks in one corner is dedicated to the Department of Mental Health.
DHS - High Desert DC	This Tier I data center is less than two years old and I used as the central IT hub for all the DHS High Desert health care facilities.
DHS – Harbor UCLA	The retrofit of this facility is a work in progress. Construction was on-going during our visit.
Sheriff - Eastern (Sheriff Communication Center)	This data center is located in Sheriff Communication Center. A portion of data center was recently retrofitted with new UPS and cooling systems. This site will be used for consolidation of the Sheriff's Monterey Park facility. An older section of the computer room is also due to be retrofitted soon.
Board of Supervisors (BOS) – Hall of Administration	This newly retrofitted data center is located in the Hall of Administration. Data center has new UPS, HVAC, and in-row coolers installed. Power utilization of this site is near capacity for maintaining the Tier II redundancy requirements.

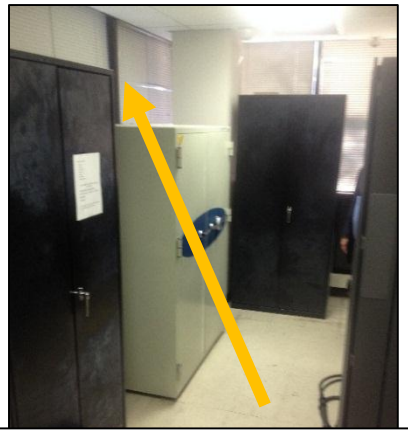
Data Centers to be Decommissioned in 2015

Data Center / Server Room	Comments
Alternate Public Defender (APD) – Hall of Record	APD is maintaining a few tower servers in an office environment at this location for Active Directory, DNS, DHCP and file and print services. APD is planning to relocate to a building across this street. Plans are to consolidate Active Directory and print services to ISD.
Auditor Controller – 500 W. Temple	This site has already been decommissioned and all servers powered down. However racks and servers are still in place and have not been removed.
Child Support Services Department (CSSD) – 5500 S. Eastern	This server room is located in a vacated leased building. CSSD plans to move all the equipment to their other facility at 5770 S. Eastern Ave. across the parking lot.
Department of Human Resources – Hall of Administration	Only one rack with active equipment is at this location. Plans are to decommission this site by end of 2015.
DHS – HSA 313 N. Figueroa St.	This site will be decommissioned by end of March 2015.
Parks – 433 S. Vermont	Parks has consolidated most applications to eCloud at ISD. Only a few local file, print, and active directory services remain which will migrate soon. Some e-mail and application servers were still running for historical or archival reasons. These will also be decommissioned.
Parks – 510 S. Vermont	See above.
Sheriff – Monterey Park	Sheriff will be consolidating this location into their recently retrofitted Sheriff Communication Center at 1277 Eastern Ave. by end of 2015
DPH, 5555 Ferguson Dr, Commerce, CA	DPH shares this data center with DHS through connected but separate spaces. DHS portion of this site has been decommissioned. However some racks and equipment are still active in the DHS space. There are also several network racks for fiber connection points in the DHS space that remain active. DHS space is also used for storing decommissioned equipment.

Data Centers Under Construction or With Planned Retrofits

Data Center / Server Room	Description
ISD - Downey	There are plans to add a second reserve UPS-R2. This unit will provide backup for UPS E.
DHS Harbor UCLA	This site was under construction when we visited. It will receive new UPS, HVAC, and Power Distribution Units.
ISD – Local Recovery Center, Santa Ana	This site which is owned and operated by Orange County will receive a $6M upgrade in 2015 which will include an additional 2500KW generator, and replacement of old chillers, pumps, and cooling towers.
DHS – Rancho Data Center	Current plans include addition of a new 30KVA UPS and the associated PDU.

All of these data centers are in shared facilities (there are non-IT functions and personnel in the building) and many are repurposed or multi-use rooms



Also used as a storage room with windows

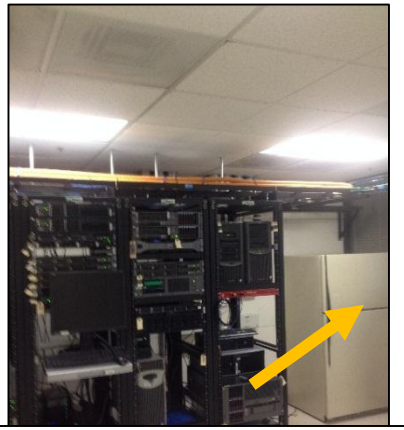
Requires portable AC units

Boxes of storage in Data Center

Located in the back of an IT manager's office

Aging equipment in aging facilities

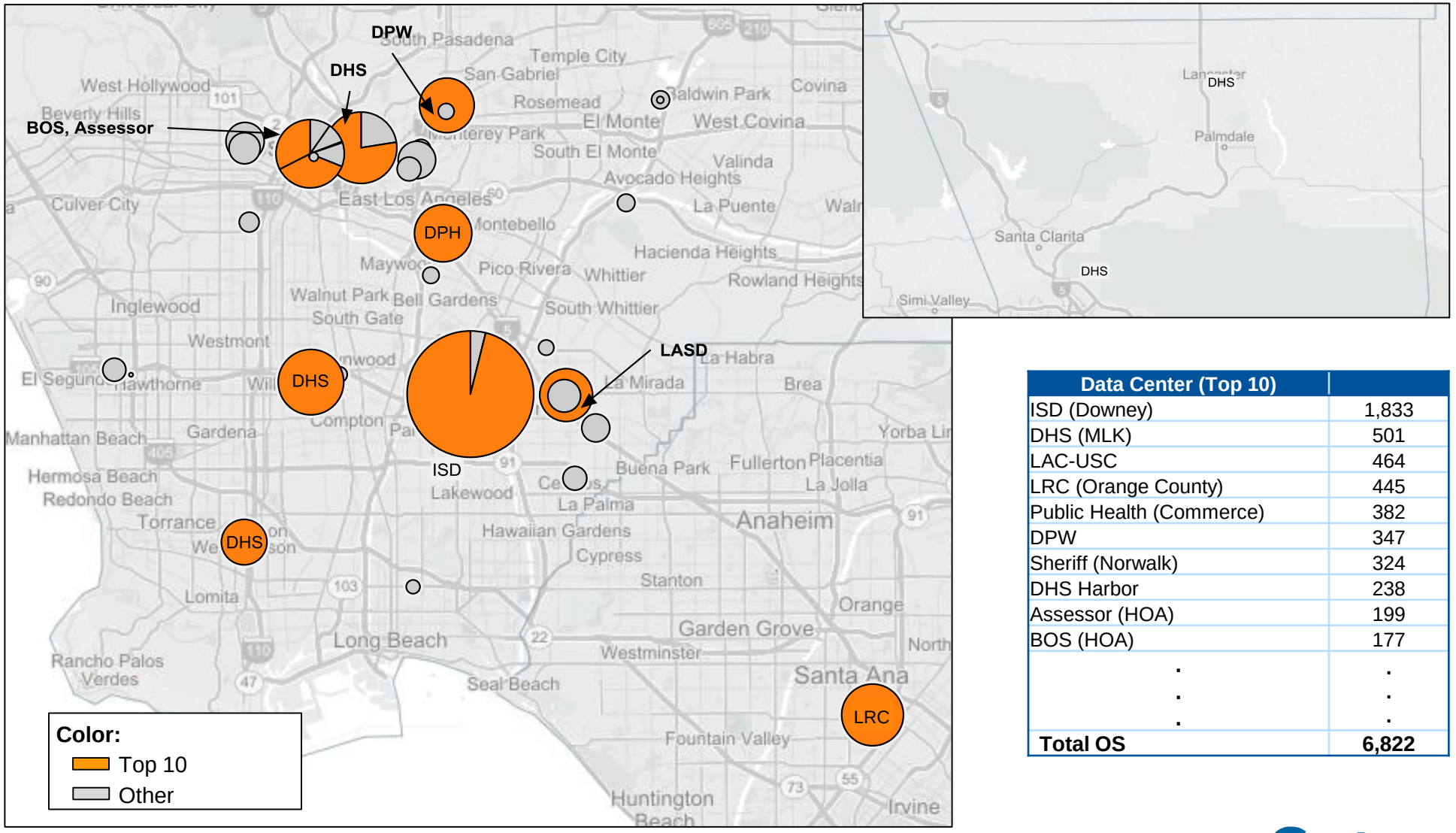
Carpeted storage closet



Also used as a break room with a refrigerator

Distribution of OS Instances in County Data Centers:

27% of the County's OS instances have been consolidated into ISD's data center at Downey and another 7% at LRC



Data Center (Top 10)	
ISD (Downey)	1,833
DHS (MLK)	501
LAC-USC	464
LRC (Orange County)	445
Public Health (Commerce)	382
DPW	347
Sheriff (Norwalk)	324
DHS Harbor	238
Assessor (HOA)	199
BOS (HOA)	177
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Total OS	**6,822**

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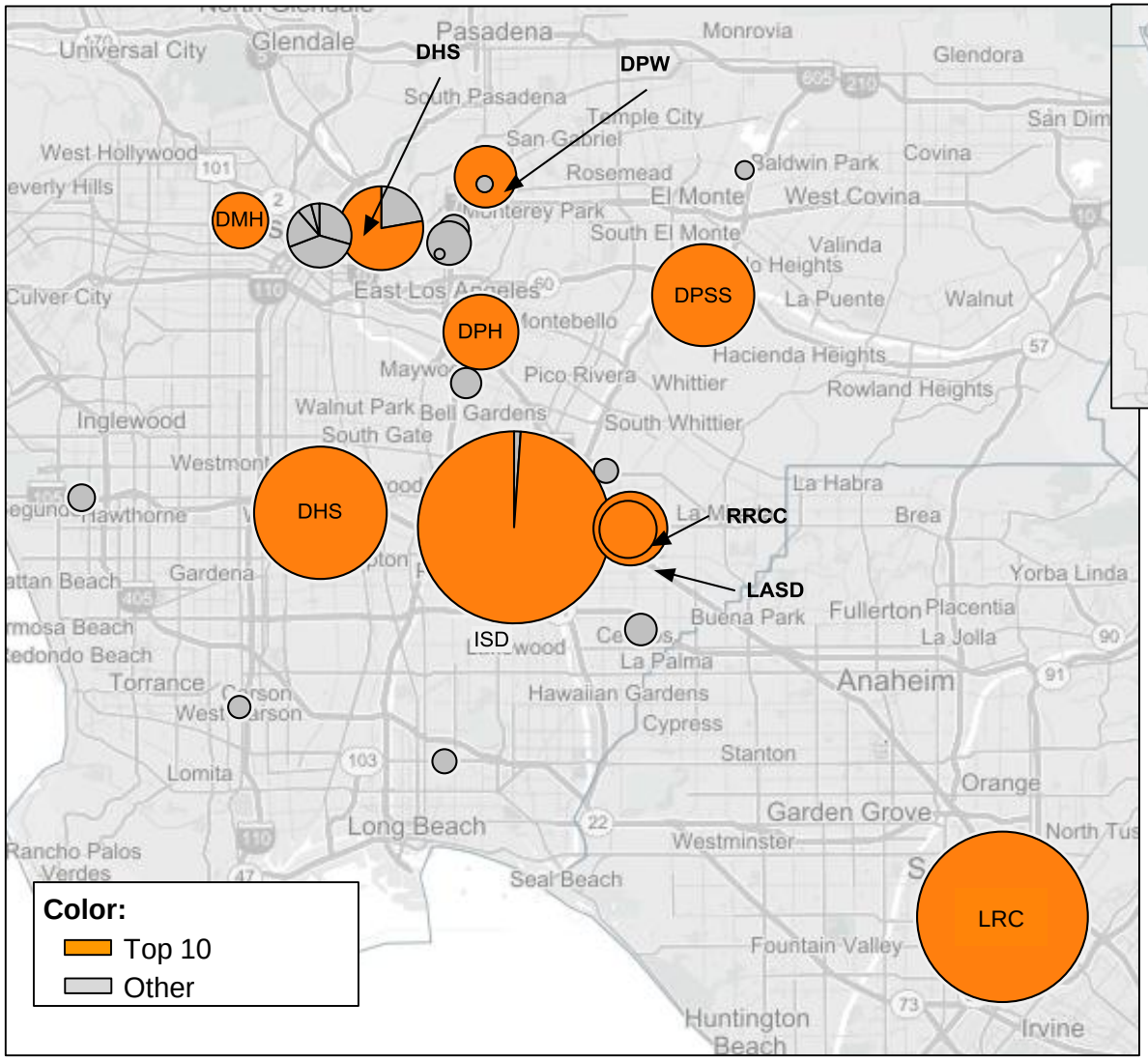
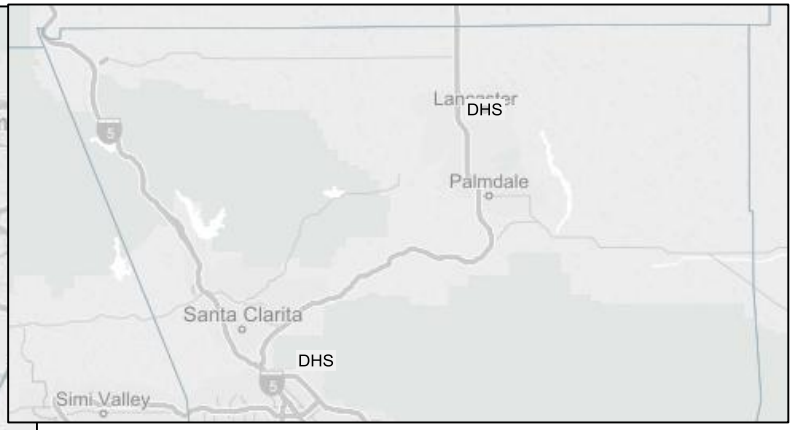
Distribution of TB of Raw Storage in County Data Centers:

27% of the County's raw storage consolidated into ISD's data center and another 22% is at LRC





Data Center (Top 10)	
ISD (Downey)	4,056
LRC (Orange County)	3,230
DHS (MLK)	1,936
DPSS (Crossroads)	1,138
Public Health (Commerce)	604
LAC-USC	591
Sheriff (Norwalk)	586
DPW	405
RRCC	347
Mental Health (HQ 550)	327
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Total TB of Storage	**14,891**

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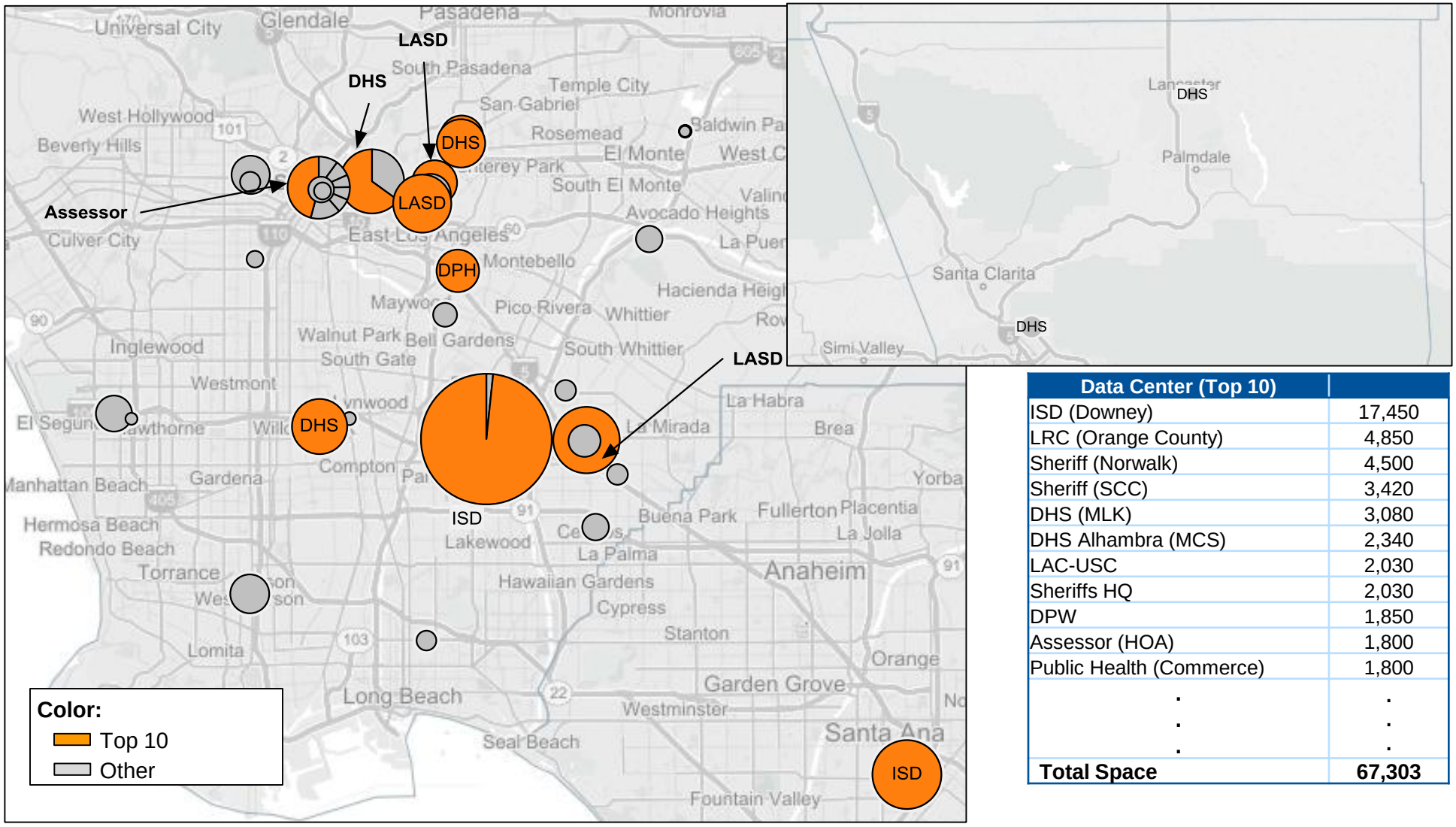
Distribution of Space in County Data Centers:

24 departments still maintain at least one data center, resulting in the County data centers using 67,000 sq. ft. of space



Data Center (Top 10)	
ISD (Downey)	17,450
LRC (Orange County)	4,850
Sheriff (Norwalk)	4,500
Sheriff (SCC)	3,420
DHS (MLK)	3,080
DHS Alhambra (MCS)	2,340
LAC-USC	2,030
Sheriffs HQ	2,030
DPW	1,850
Assessor (HOA)	1,800
Public Health (Commerce)	1,800
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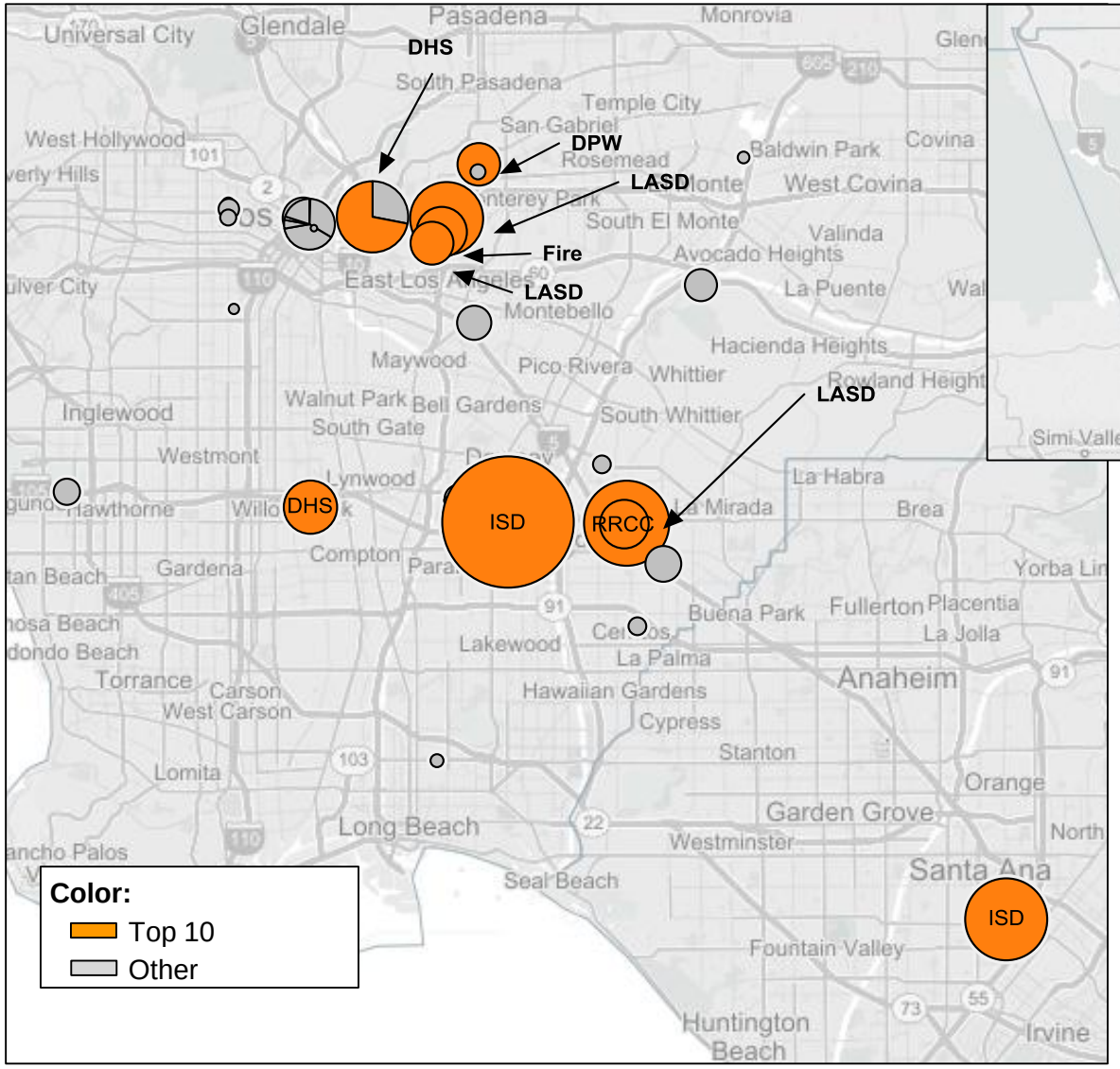
Total Space	**67,303**

Distribution of Utilization of Power in County Data Centers:

The disperse County data centers utilize 2.4MW of power, which is above the needed power when consolidated



Data Center (Top 10)	
ISD (Downey)	626
Sheriff (Norwalk)	260
LRC (Orange County)	241
Sheriffs HQ	190
LAC-USC	140
Fire	89
RRCC	83
Sheriff (SCC)	64
DPW	63
DHS (MLK)	63
.	.
.	.
.	.
Total Utilized Power	**2,373**

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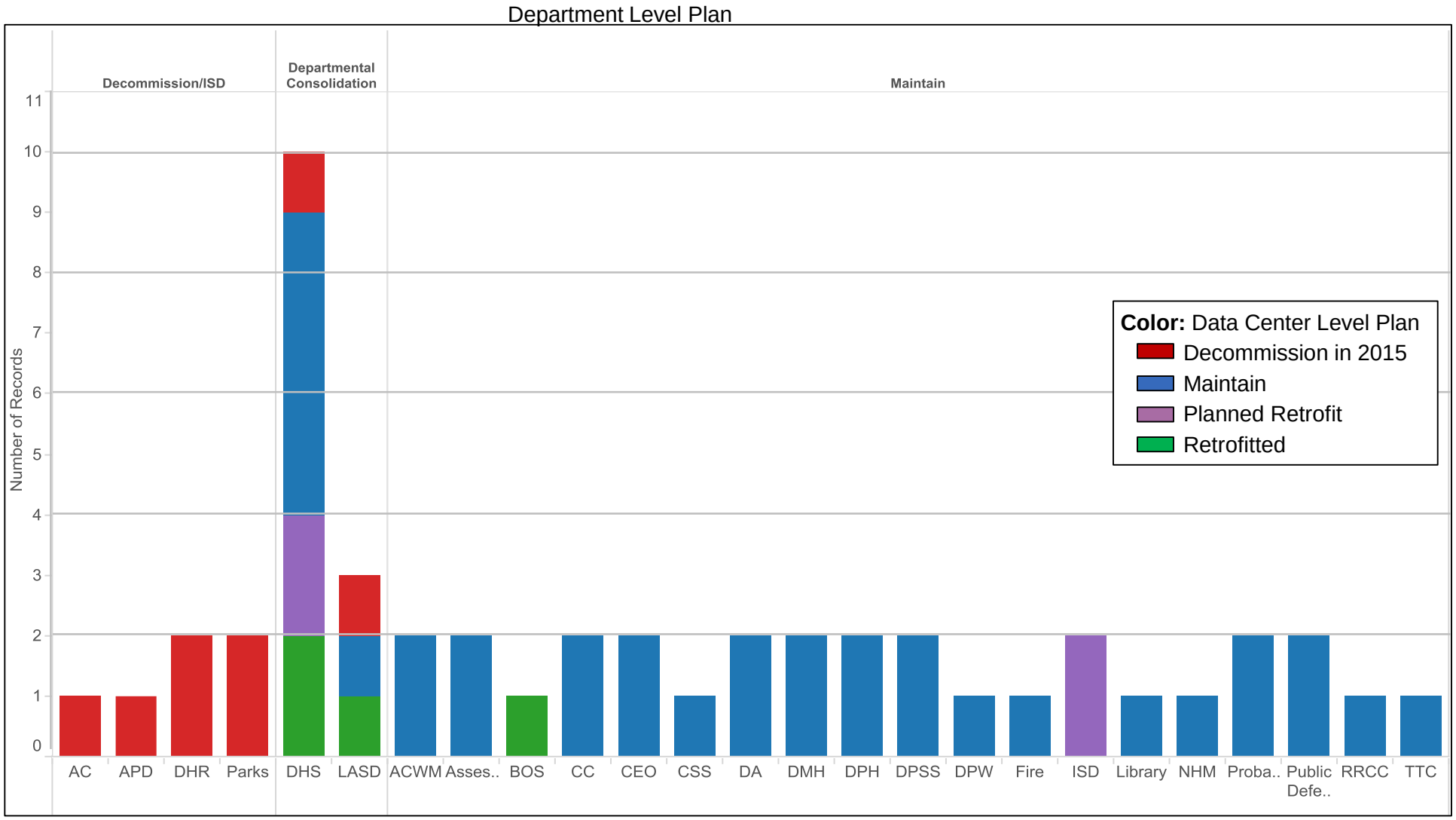
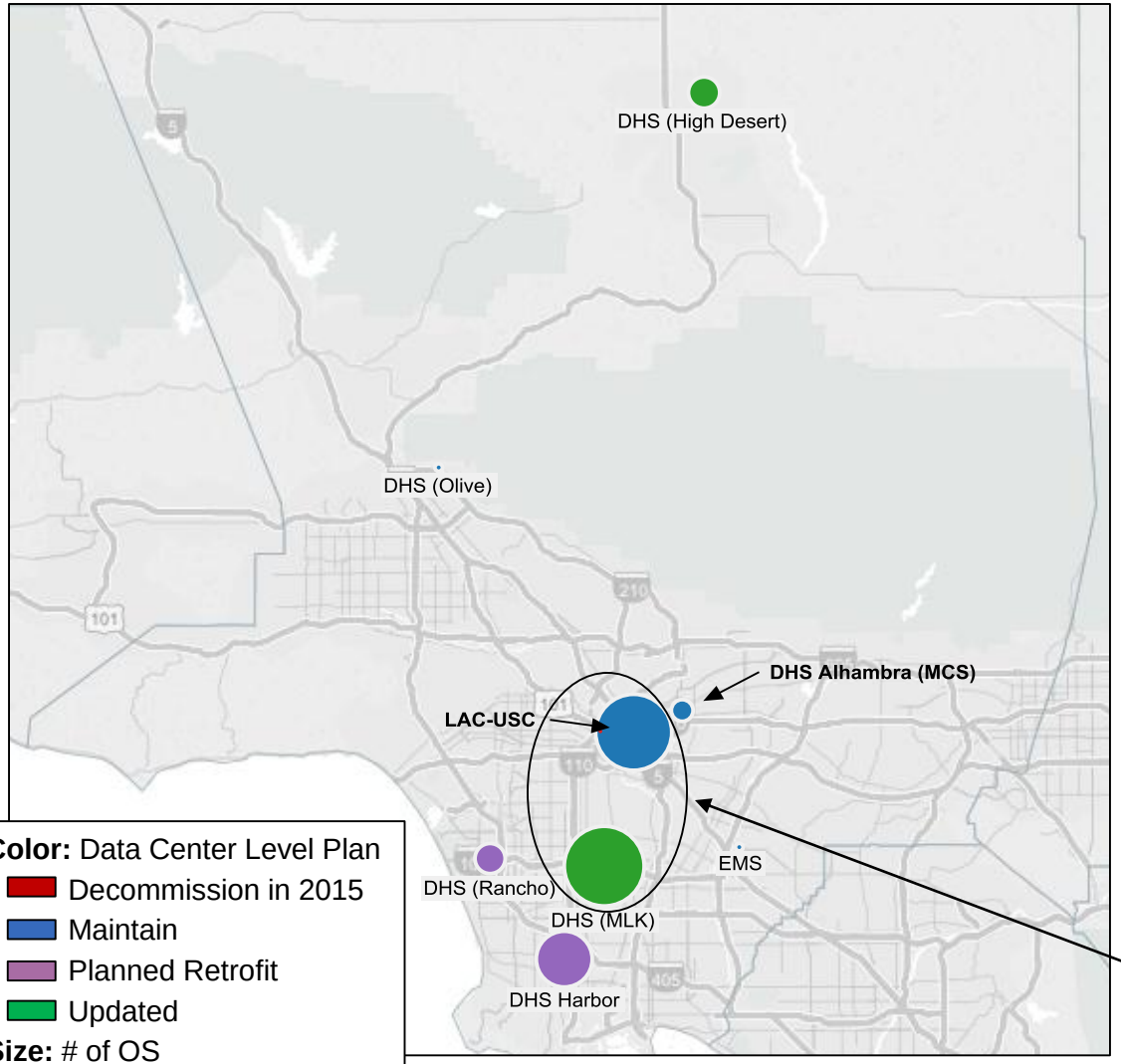
Departments are focused on maintaining their current facilities, and do not have formal strategies for their data centers



*Further details on decommissioned, retrofitted and planned retrofit data centers in appendix

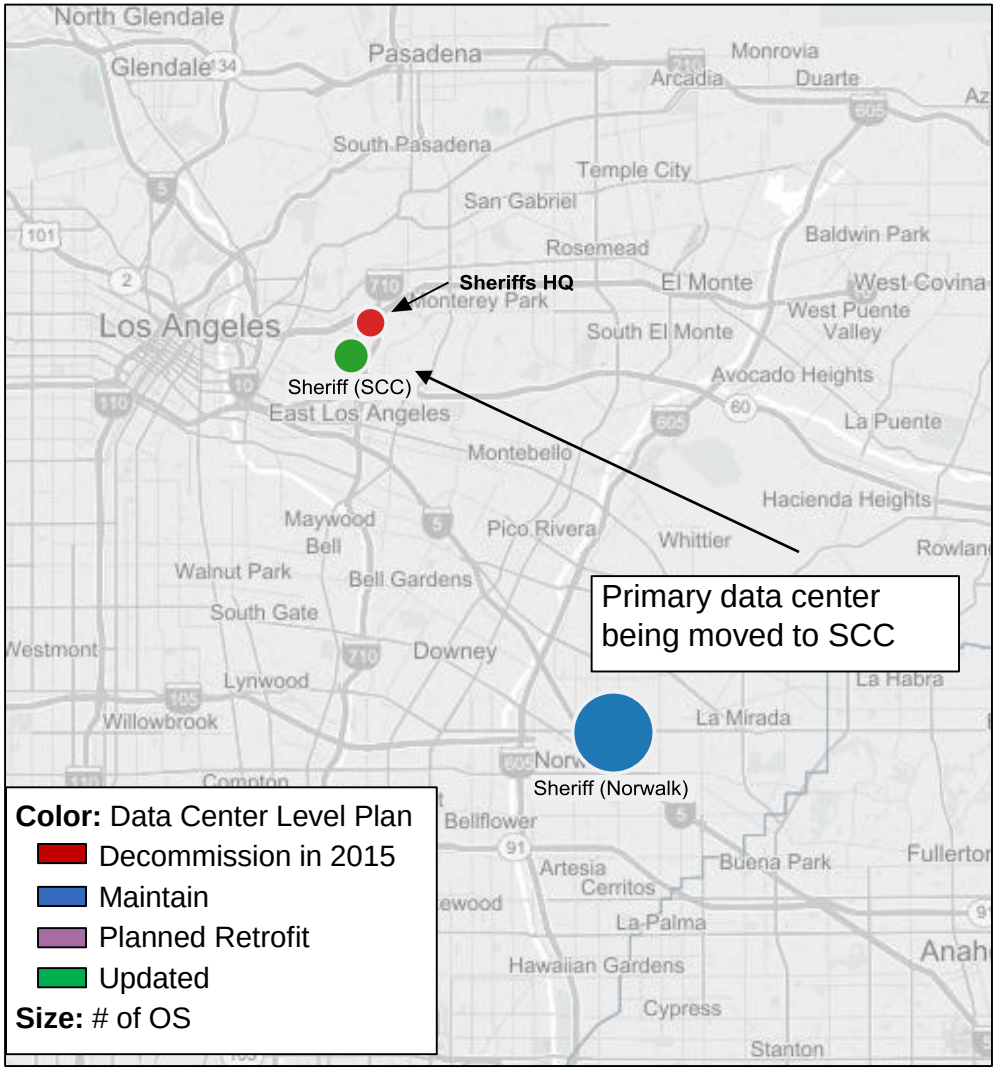
Department of Health Services (DHS) plans to consolidate most of their assets to LAC-USC and MLK, while maintaining a few additional data centers



Data Center	Description of Action
MLK	This new Tier III data center is located in the older section of the MLK hospital which was recently retrofitted. Data center is less than 2 years old with ample space and power capacity. DHS plans to leverage this site as a focal point for consolidating its other departmental data centers. Approximately 7 Racks in one corner is dedicated to the Department of Mental Health.
High Desert	This Tier I data center is less than two years old and I used as the central IT hub for all the DHS High Desert health care facilities.
Harbor UCLA	Retrofit of this facility is work in progress. Construction was on-going during our visit. It will receive new UPS, HVAC, and Power Distribution Units.
Rancho	Current plans include addition of a new 30KVA UPS and the associated PDU.
HSA	This site will be decommissioned by end of March 2015.
Olive View, LAC-USC & MCS	Are being maintained in current configuration

Eventually plan to operate as two main data centers

The Sheriff's department is closing down their data center at the department's headquarters and will use their upgraded data center in the Communications Center as their primary facility



Data Center	Description of Action
Eastern (Sheriff Communication Center)	This data center is located in Sheriff Communication Center. A portion of data center was recently retrofitted with new UPS and cooling systems. This site will be used for consolidation of the Sheriff's Monterey Park facility. An older section of the computer room is also due to be retrofitted soon.
Norwalk	This data center is being maintained in its current configuration and the assets would likely consolidate to the new County data center
Monterey Park (HQ)	Sheriff will be consolidating this location into their recently retrofitted Sheriff Communication Center at 1277 Eastern Ave. by end of 2015

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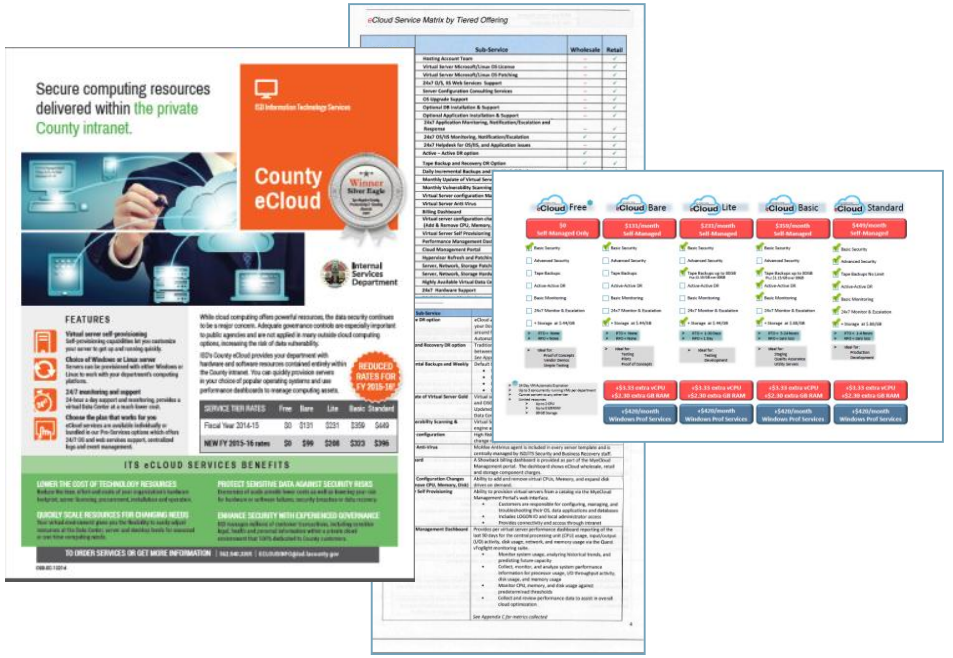
ISD's eCloud offering provides a solid foundation for building a consolidated, virtualized, and shared environment

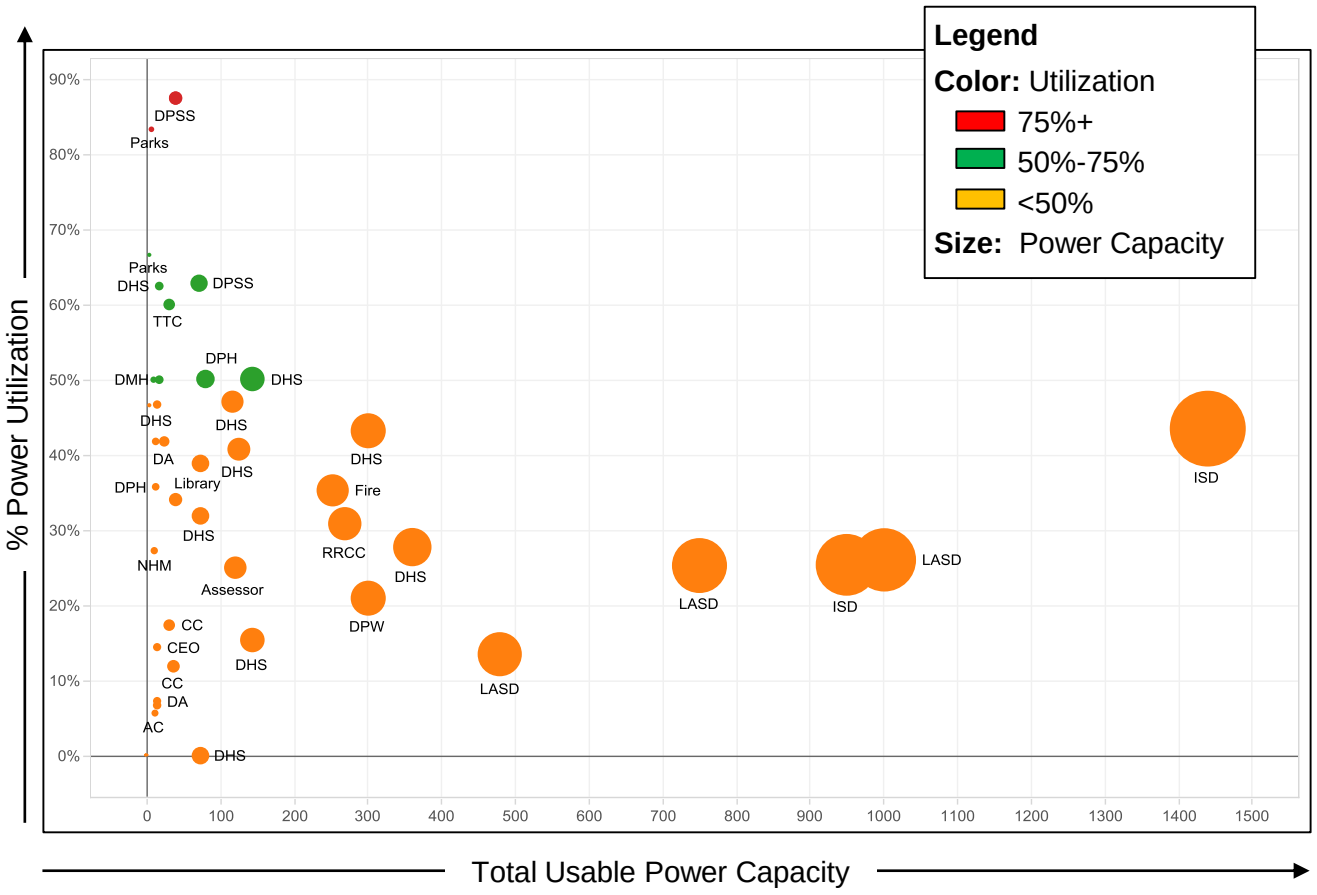
- ISD's eCloud is a well-constructed private cloud environment that can and should be leverage to consolidate into a virtualized and shared environment:
  - Currently running 1,700 virtual machines
  - Provides various self-service options
  - A range of price points
  - Various disaster recovery levels

- ISD has made strides in reducing their costs and needs to continue to make the eCloud offering more attractive to departments.



Service Tier Rates	Free	Bare	Lite	Basic	Standard
FY 2014-15 Rates	$0	$131	$231	$359	$449
New FY 2015-16 rates	$0	$99	$208	$323	$396

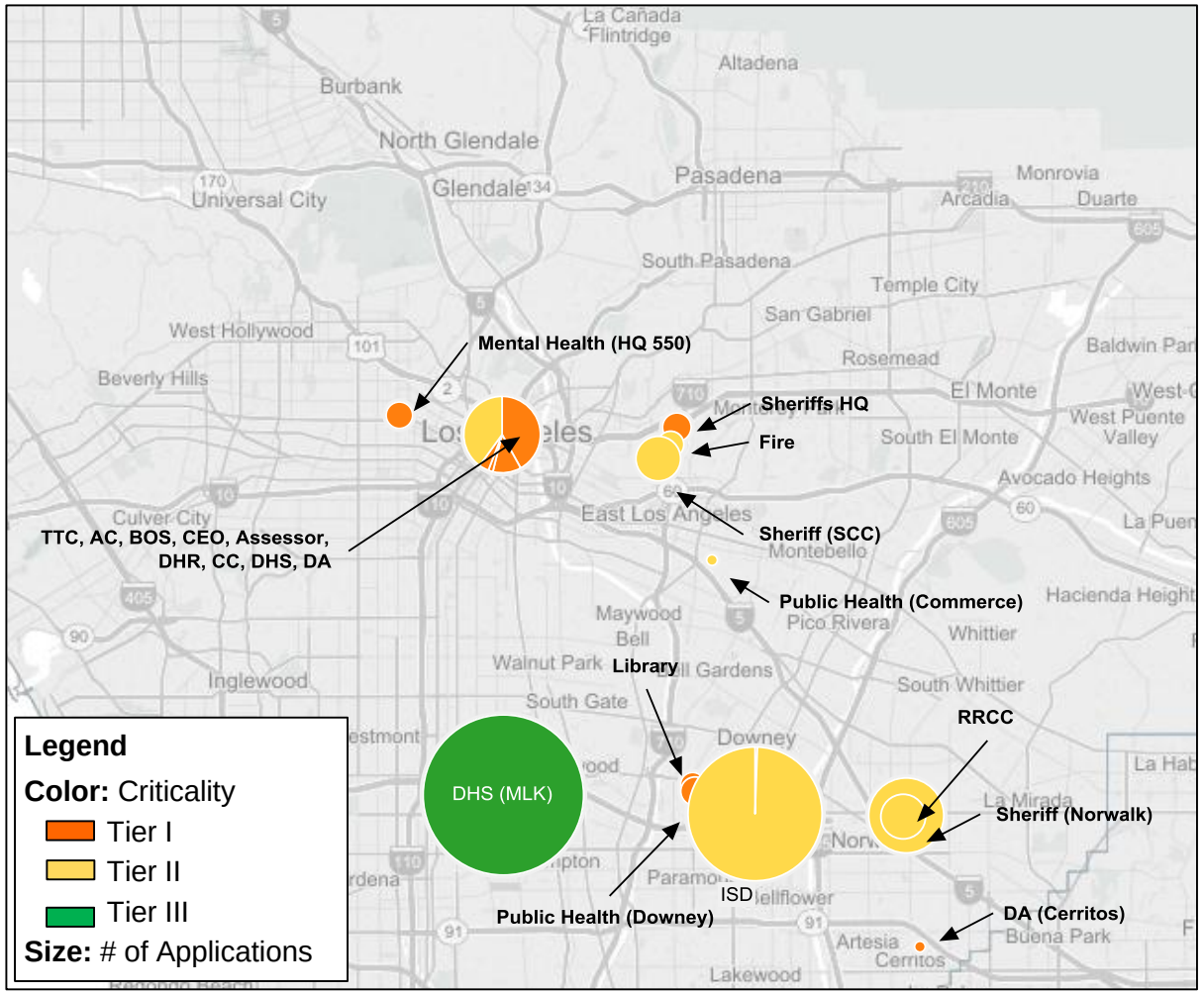
Virtualization efforts have significantly reduced power capacity requirements resulting in most facilities using less than 50% of their available capacity



Data Center (Top 10)	Capacity (in KW)	Usage (in KW)	Util. %
ISD - Downey	1440	626	43%
Sheriff – Norwalk	1000	260	26%
ISD - LRC	950	240	25%
Sheriff – Monterey Park	750	190	25%
Sheriff – Eastern	480	64	13%
DHS MLK	360	100	28%
DHS LAC-USC	280	140	50%
DPW	300	63	21%
RRCC	270	83	31%
Fire	200	89	45%
.	.	.	.
.	.	.	.
.	.	.	.
Total Power	**7,536**	**2,448**	**32%**

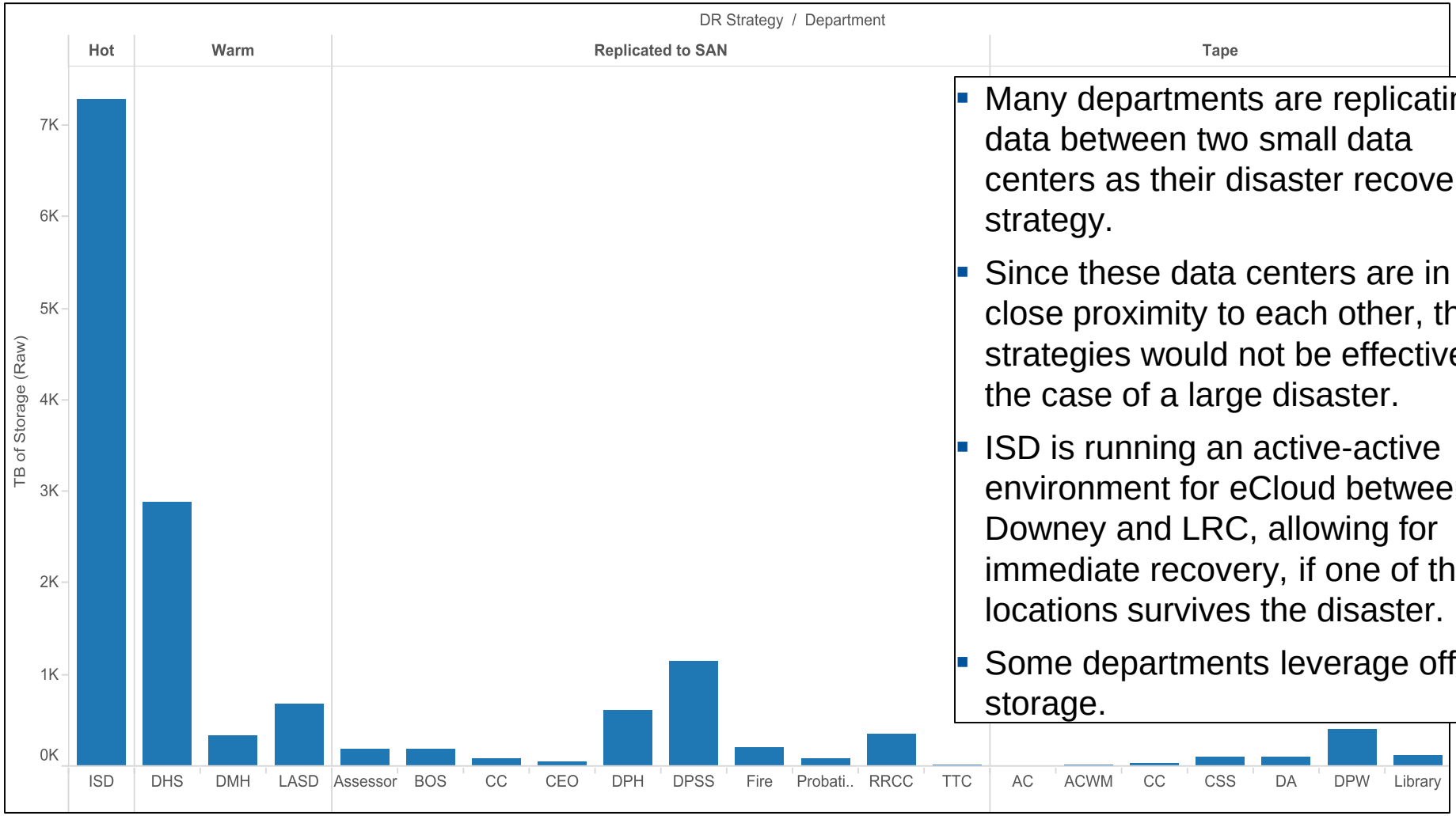
- Only two data centers are at or near capacity (75%+ utilized)
- It is inefficient to have and maintain more than 40 underutilized power systems and associated cooling systems and data center space. Further consolidation efforts would reduce this inefficiency.

The current reliability of the County's facilities does not meet best practices for highly critical, high business impact applications



- Best practice for business critical and mission critical applications is a Tier III facility.
- The only Tier III facility in the County is MLK, where DHS is moving most of its mission critical applications.
- The rest of the County's critical applications are in Tier II or Tier I facility.
- Some departments (e.g. DHS, DPSS) have moved applications to vendor facilities for better reliability.

All sites have at least a tape (cold) disaster recovery strategy, with a few having warm or hot sites available, but only ISD has a hot recovery – best practices for mission critical applications



- Many departments are replicating data between two small data centers as their disaster recovery strategy.
- Since these data centers are in close proximity to each other, these strategies would not be effective in the case of a large disaster.
- ISD is running an active-active environment for eCloud between Downey and LRC, allowing for immediate recovery, if one of the locations survives the disaster.
- Some departments leverage offsite storage.

Conclusion

- The County's consolidation and data center strategic efforts must improve the reliability, cost-effectiveness, and agility of its IT assets.
  - Reliability: Provides an opportunity to move all assets into a primary data center that is a dedicated, Tier III facility and create a DR strategy that accounts for the seismic instability of the Los Angeles basin by planning for a disaster that affects the entire basin.
  - Cost-Effective: Reduces the excess space, power and cooling capacity, and allows departments to repurpose current spaces.
  - Agility: Allows the County to easily change its offerings as new opportunities (such as cloud-based options) present themselves.

- The County has made significant strides towards consolidating that will ease the transition to a new strategy. Any additional efforts in the interim will be beneficial.

- Departmental concerns need to be addressed either in the consolidation strategy and the accompanying governance model.

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Appendix

Data Centers are Ranked According to Their Reliability

The Uptime Institute is a global international standards organization that created the following tier system to rank data centers according to their reliability

	Description	Common Usage Models
Tier I: Basic	• Single points of failure exist which can result in unscheduled outages. • Single path for power and cooling distribution will require scheduled outages for maintenance • No redundant components, therefore replacement of parts can prolong outage	• Non critical systems • Test and development • Disaster recovery • High Performance and Scientific Computing where downtime can be tolerated • Applications that are distributed among multiple data centers such as internet search engines
Tier II: Some Redundant Components	• Redundant components can reduce time to recovery • Not all single points of failure are eliminated, therefore unexpected outages are still possible • Single path for power and cooling distribution will require scheduled outages for maintenance	• Critical systems that are active/active at more than one DC • Disaster recovery • Engineering and product development • Local manufacturing sites • Satellite data centers
Tier III: Concurrently Maintainable	• Multiple power grids or continuous on-site generation capability • Multiple power and cooling distribution paths, but only one path may be active • Redundant components and distribution paths are configured as concurrently maintainable, thereby eliminating any scheduled outage for maintenance.	• Mission critical applications • E-Commerce sites • Co-location and managed services with contractual SLAs • Primary corporate data centers • Global centers where downtime cannot be scheduled
Tier IV: Fault Tolerant	• Multiple power grids or continuous on-site generation capability • Multiple active power and cooling paths • Redundant components are concurrently maintainable and fully fault tolerant.	• Extensive financial transactions • Large financial institutions • Insurance industry • Some co-location and managed services providers

Application Criticality Defined

Class	Impact Summary	Example Applications or Service Impacts	Typical Service Characteristics	Typical Recovery Needs in the Event of Complete System Failure or Disaster
Mission Critical	Safety and security of public is compromised Safety of County employees is jeopardized Lifeline services for vulnerable populations are disrupted Peoples' health and lives may be at stake	Police/Fire related 911/Dispatch/Radio/Incident Related Systems; Jail Management Emergency Management/Communications Systems Criminal/Child Abuse Information Systems Traffic Management Systems, Health Care Delivery Related Systems	Hours of Operation: 24/7/365	RPO: <1 hours RTO: <1 hours
Business Critical	Public's access to information/transactions disrupted High impact or time-critical County internal services disrupted Critical direct services to the public disrupted	Public websites for information, transparency and transactions Email, Payroll, Accounts Payable, Cash Management, Time Entry, Labor Scheduling Benefit Eligibility, EBT/Checks , Health Services, Permitting, Revenue Collection, Case Mgmt Elections; Courts	Hours of Operation: 24/7/365 (except for scheduled downtime)	RPO: < 8 hours RTO: 8-24 hours
Important	Delivery of services to the public delayed or degraded Efficiency/effectiveness of very large workforce (750+) degraded Transparency/accountability of government degraded	Takes longer for services to be delivered due to lack of systems and automation Workers not able to perform their duties (e.g. data entry, answer call center calls, etc.) Video access to public meetings and other venues	Hours of Operations: 6 x 16	RPO: 1 business day RTO: 72 hours to 1 weeks
Standard	Delivery of services to internal constituents are impacted County record keeping and compliance tracking are impaired Efficiency/effectiveness of large workforce (250-749) degraded	Budget/Financial Tracking; HR Systems; Administration Systems Compliance Tracking, Auditing, Maintenance Records, Backend Data Capture Systems Departmental or divisional systems affecting productivity of particular user groups and services	Hours of Operations: 5 x 10	RPO: 1-2 business days RTO: 2-3 weeks
Limited	Little or no material impact on the ability to conduct normal business	Small departmental applications used by or affecting only a small number of users (<25) Applications with light usage Applications whose functions are duplicated by other systems Applications which can be easily replaced by another system or manual efforts Applications which are no longer used or relied up	Hours of Operations: 5 x 10	RPO: Depends RTO : 1 month or greater

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Report on LA County's Data Center Strategy

Current State Assessment and Future State Requirements

Attachment B – Data Center Inventory

March 30, 2015

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Summary Data Center Server / Storage Inventory

The table below summarizes the data centers' server and storage inventory, per site visited:

Data Center Site Location	IT Racks	Physical Server Inventory			Logical Server Inventory		Data Storage (TB)	
		X86 Servers (OSI*)	X86 VM Hosts	Unix and Midrange Systems	X86 Based VM (OSI*)	Midrange LPAR or OSI*	Raw Capacity	Allocated Capacity
ACWM (Arcadia HQ)	2	1	6	0	33	0	8	4
ACWM (South Gate)	1	1	2	0	14	0	2.7	0.3
Alternate Public Defender	0	4	0	0	0	0	0	0
Assessor (Signal Hill)	4	0	4	0	19	0	56	24
Assessor (HOA)	20	6	11	2	191	2	130	90
Auditor Controller (HOA)	3	0	0	0	0	0	0	0
BOS (HOA)	8	43	35	0	134	0	175	102
CEO (HOA)	3	14	3	0	38	0	32	20
CEO (OEM)	3	2	1	0	7	0	24	8
Child Support Services Department	12	3	3	0	25	0	91.34	19.92
County Counsel (HOA)	3	6	6	0	48	0	84.86	67.76
County Counsel (Monterey Park)	2	5	3	0	24	0	27.64	23.3
DA (Cerritos)	7	13	4	1	48	1	100	100
DA (CJC)	4	7	0	0	0	0	0	0
Fire	36	16	12	1	142	2	198	121
Department of Human Resources (HOA)	2	2	0	0	0	0	0	0
DHS MLK	85	30	47	2	469	2	1936	1046
DHS LAC+USC (DNT)	72	115	40	13	336	13	591	329
DHS LAC+USC (OPD)	23	67	11	21	42	27	170	121
DHS HSA	34	5	2	1	4	1	-	-
DHS Harbor	37	214	5	6	18	6	46.84	16.94
DHS (Rancho)	27	5	15	0	53	0	70	54

Data Center Site Location	IT Racks	Physical Server Inventory			Logical Server Inventory		Data Storage (TB)	
		X86 Servers (OSI*)	X86 VM Hosts	Unix and Midrange Systems	X86 Based VM (OSI*)	Midrange LPAR or OSI*	Raw Capacity	Allocated Capacity
DHS MCS (Alhambra)	9	16	0	5	0	10	24	12
DHS EMS	7	24	0	0	0	0	56	30
DHS High Desert	28	5	10	0	58	0	0	0
DHS Olive View	16	98	18	2	61	2	0	0
ISD	247	0	139	14	1771	62	4056	3300
LRC	107	0	30	4	399	46	3230	0
Mental Health (Annex 695)	4	0	5	0	109	0	0	0
Mental Health (HQ 550)	14	2	19	0	164	0	327	295
Natural History Museum	3	2	3	0	40	0	28	11
Parks (433)	2	5	0	0	0	0	0	0
Parks (510)	1	2	0	0	0	0	0	0
Probation (DHQ)	6	47	11	0	28	0	52	27.5
Probation (Riverview)	0	1	2	0	3	0	30	25
Public Defender (Airport)	3	1	0	0	0	0	0	0
Public Defender (Lynwood)	3	4	2	0	21	0	17.6	9
Department of Public Health (Commerce)	20	41	24	0	341	0	604	182
Department of Public Health (Downey)	4	18	1	0	1	0	8	7.5
Department of Public Library	13	17	20	2	86	4	123	60
Department of Public Social Service (ITD)	8	27	8	0	60	0	0	0
Department of Public Social Service (Crossroads)	17	19	9	0	13	0	1138	415
Department of Public Works	37	17	15	13	304	26	405	257
RRCC	30	70	12	2	48	2	347	201
Sheriffs HQ	40	27	3	1	11	2	90.2	73.7
Sheriff (Norwalk)	91	133	12	1	181	10	586	243

Data Center Site Location	IT Racks	Physical Server Inventory			Logical Server Inventory		Data Storage (TB)	
		X86 Servers (OSI*)	X86 VM Hosts	Unix and Midrange Systems	X86 Based VM (OSI*)	Midrange LPAR or OSI*	Raw Capacity	Allocated Capacity
Sheriff (SCC)	39	54	0	8	0	8	8	4
TTC (HOA)	5	0	3	0	63	0	18	11
Total	**1,142**	**1,189**	**556**	**99**	**5,407**	**226**	**14,891**	**7,311**

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Summary Data Center Tier Level / Size / Structure / Electrical

The table below summarizes the data centers' tier level(s), size, structural and electrical data points, per site visited:

Data Center Site Location	Tier level	Size (Ft^2)	Structure		Electrical			
			Number of Floors	DC Floor	Capacity (KW)	Utilized (KW)	Redundant UPS	Generator
ACWM (Arcadia HQ)	I	140	2	2	8	4	N	N
ACWM (South Gate)	I	196	1	1	3	1.4	N	N
Alternate Public Defender	I	630	15	1	0	0	N	N
Assessor (Signal Hill)	I	360	4	3	12	5	N	N
Assessor (HOA)	I	1800	8	2	120	30	N	N
Auditor Controller (HOA)	I	400	8	4	10.5	0.6	N	N
BOS (HOA)	II	324	8	B	40	35	Y	Y
CEO (HOA)	I	270	10	7	14	2	Y	Y
CEO (OEM)	I	165	2	2	15	1	Y	Y
Child Support Services Department	I	540	4	1	-	-	Y	N
County Counsel (HOA)	I	250	7	4	30	5.2	N	N
County Counsel (Monterey Park)	I	240	5	1	36	4.3	Y	N
DA (Cerritos)	I	680	6	5	24	10	N	N
DA (CJC)	I	260	1	16	14	1	N	N
Fire	II	1650	2	1	252	89	Y	Y
Department Human Resources (HOA)	I	285	8	5	-	0	Y	N
DHS MLK	III	3080	2	2	360	100	Y	Y
DHS LAC+USC (DNT)	II	2030	5	2	352	130	Y	Y
DHS LAC+USC (OPD)	I	1470	5	B	125	51	N	Y
DHS HSA	I	1540	-	B	-	58.5	-	Y
DHS Harbor	I	1500	8	B	144	-	Y	Y
DHS (Rancho)	I	1280	2	B	72	23	N	Y
DHS MCS (Alhambra)	I	2340	7	1	15	7	N	Y
DHS EMS	I	400	3	2	16	10	N	Y
DHS High Desert	I	1260	-	1	144	22	N	Y
DHS (Olive View)	I	760	6	1	117	55	Y	Y
ISD	II	17450	2	1	1440	626	Y	Y

Data Center Site Location	Tier level	Size (Ft^2)	Structure		Electrical			
			Number of Floors	DC Floor	Capacity (KW)	Utilized (KW)	Redundant UPS	Generator
LRC	II	4850	1	1	950	241	Y	Y
Mental Health (Annex 695)	I	380	17	7	16	8	Y	N
Mental Health (HQ 550)	I	1450	12	4	40	13.6	N	N
Natural History Museum	I	250	5	2	11	3.2	N	N
Parks (433)	I	190	4	3	6	5	N	N
Parks (510)	I	170	2	1	3	2	N	N
Probation (DHQ)	I	320	2	1	-	-	N	-
Probation (Riverview)	I	100	2	1	-	-	N	N
Public Defender (Airport)	I	120	10	1	-	-	N	N
Public Defender (Lynwood)	I	144	2	1	-	-	N	Y
Department of Public Health (Commerce)	II	1800	3	1	80	40	Y	Y
Department of Public Health (Downey)	I	144	1	1	12.6	4.5	Y	Y
Department of Public Library	I	1325	2	1	72	28	N	Y
Department of Public Social Services (ITD)	I	400	4	1	70	44	Y	N
Department of Public Social Services (Crossroads)	II	280/670	2	1/2	40	35	Y	Y
Department of Public Works	II	1850	4	1	300	63	N	Y
RRCC	II	1000	8	6	270	83	Y	Y
Sheriffs HQ	I	2030	5	B	750	190	Y	Y
Sheriff (Norwalk)	II	4500	8	B	1000	260	Y	Y
Sheriff (SCC)	II	3420	0	0	480	64	Y	Y
TTC (HOA)	I	610	8	4	30	18	Y	N
Total	**-**	**67,303**	**-**	**-**	**7,494**	**2,373**	**-**	**-**

KEY: intentionally blank **or** missing data "—"

Estimate based on other data *****

"B" = basement

"N" = no

Report on LA County's Data Center Strategy

Current State Assessment and Future State Requirements

Attachment C: ISD Data Center Assessment Report

Note: Some confidential information has been redacted from this report. This is only a sample report. A similar report was prepare for each of the County's 49 active data centers.

March 30, 2015

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Table of Contents

1.0 Executive Overview

1.1 Scope of Document

This report summarizes the current state of Internal Services Department (ISD) Downey and Orange County Local Recovery Center (LRC). Areas discussed in this assessment report include:

- Current state of the physical facility (e.g. space, power, cooling, reliability, availability, Tier level)
- IT services provided from this facility
- Inventory of IT assets
- Inventory of critical applications
- eCloud and planned future capabilities

1.2 Methodology

This report has been prepared based on the data collected during the following activities:

- Site visit for the purpose of physical walk-though of the data centers
- Review of documents provided by ISD personnel
- Interviews with ISD Information Technology Services (ITS) Leadership Team, including:
  - Tom Travis, General Manager, Information Technology Services
  - Jac Fagundo, Branch Manager and Chief Technology Officer
  - Robert King, Branch Manager, Network and Telecommunications
  - Dave Wesolik, Branch Manager, Shared Services
  - Debbie Migliaro (Representing Karen Loquet, Branch Manager, Customer Applications)
- Interviews with technical IT, network, and operations engineering team members
- Discussions with LRC operations staff and Orange County CIO

1.3 Facility Overview

The table below summarizes the input received from ISD regarding structural and electrical data related to each of their two (2) sites.

Data Center	Tier level**	Size (Ft^2)	Structure		Electrical			
			Number of Floors	DC Floor	Capacity (KW)	Utilized (KW)	Redundant UPS	Generator
ISD - Downey	II	17,450	2	1	1440	626	Yes	Yes
ISD – Local Recovery Center	II	4,850	1	1	1150*	240*	Yes	Yes

*UPS capacity is shared with Orange County, while utilization reflects power used by ISD only.

**Please refer to Appendix A for definition of DC Tier Levels.

1.4 IT Asset Inventory Overview

The table below summarizes input received from ISD regarding their IT asset inventory located at each of their two (2) sites.

Data Center	IT Racks	Physical Server Inventory			Logical Server Inventory		Data Storage (TB)	
		X86 Servers (OSI*)	X86 VM Hosts	Unix and Midrange Systems	X86 Based VM (OSI*)	Midrange LPAR or OSI*	Raw Capacity	Allocated Capacity
ISD - Downey	247	0	138	23	1771	60	5200	3300
ISD – Local Recovery Center	107	4	30	9	399	39	3230	2584

*OSI – Operating System Instance

In addition these data centers support the following Virtual Desktop Infrastructure (VDI) environment

Data Center	VDI Environment	
	VDI Host Servers	VIDI desktops
ISD - Downey	71	5059
ISD – Local Recovery Center	56	0

2.0 Downey Data Center Facility Overview

2.1 Space, Structure, and Architectural

The facility that houses ISD Downey Data Center is a two story County owned facility was built in 1955. The building is currently housing Internal Services Department (ISD), Probation Department (HQ), and the Auditor-Controller Distribution. The ISD Data Center is located on the first floor of the building with the second floor dedicated to office space.

The building is approximately 300,000 ft^2. The space allocated to data center is 43,541 ft^2 in size with approximately 22,883 ft^2 of raised floor space and the remaining space used for electrical and mechanical equipment that supports the data center. The raised floor space is divided into several rooms as follows:

1. **Enterprise data center** – 9,900 ft^2 space dedicated to enterprise computing and systems that are managed by ISD staff. The raised floor height is 14".

2. **Colocation data center** – 7,550 ft^2 space that is dedicated to co-location services provided to other County departments. The raised floor height is 19".

3. **Media or Tape Room** – 4,470 ft^2 space dedicated to medial storage space savers, tape libraries, as well as some SE and vendor office spaces. The installed tape library space servers in this room are no longer used (see figure). The raised floor height is 14".

4. **Test Lab** – 1,430 ft^2 space dedicated for testing equipment.

5. **Storage, Circulation, and Offices** – As shown below

The building was not designed as an essential facility which is typically required for mission critical data centers. Furthermore, having the data center co-located with office spaces adds additional security and fire risk to the data center.

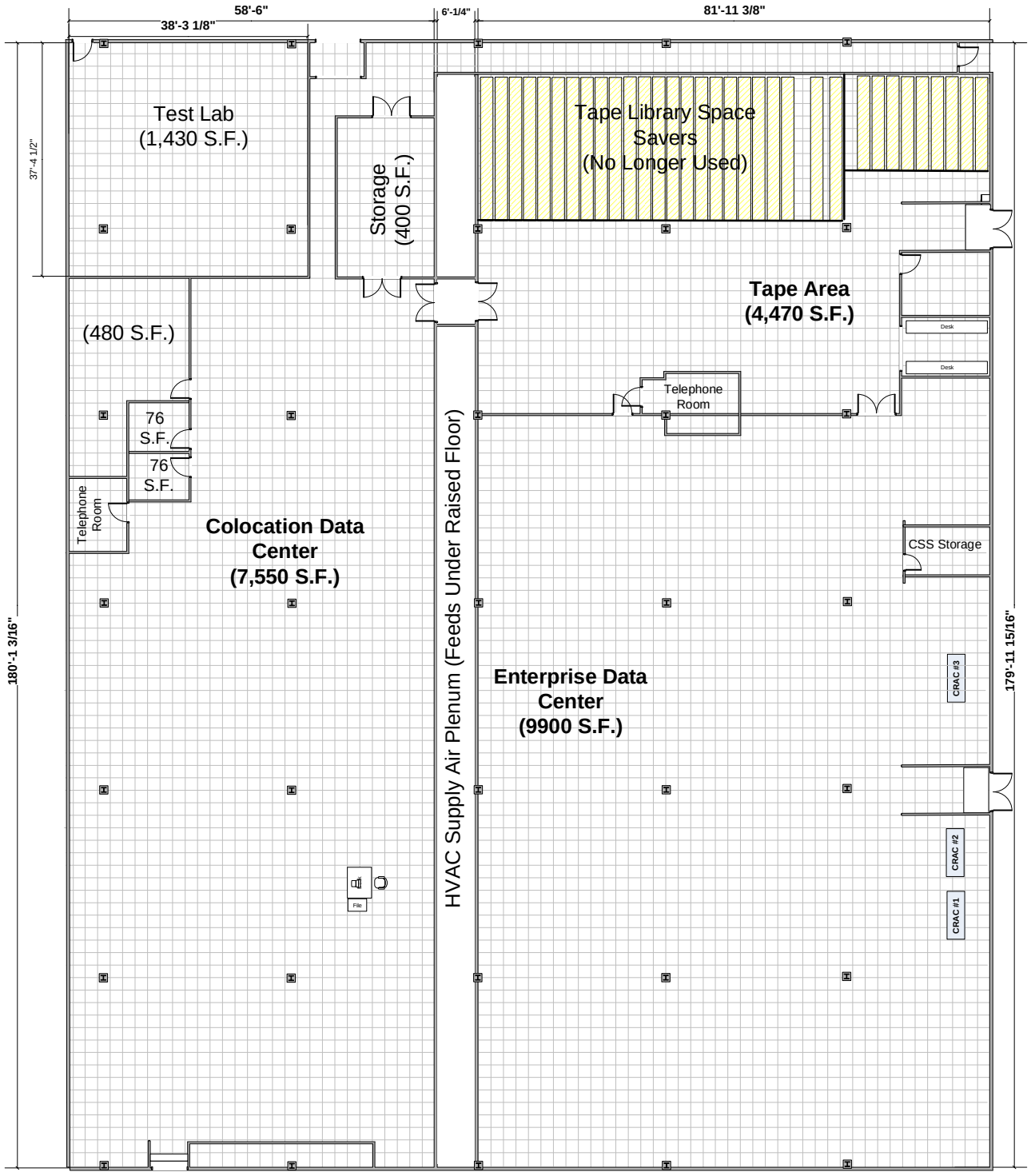

Figure 1 – ISD Downey Data Center Raised Floor Space

2.2 Electrical Infrastructure

The Downey Data Center has an aging electrical infrastructure. This facility has evolved from a mainframe centric data center facility in the 70's to what it is today, over years of incremental additions and renovations, a highly complex and inefficient electrical distribution system. The electrical distribution system provides redundant power from two separate uninterrupted power supply (UPS) systems to each remote distribution panel (RDP) and to each computer cabinet downstream of the RDPs. The electrical distribution system does meet most, but not all, requirements for a Tier III (i.e. concurrently maintainable) facility based on the TIA 942 specifications (see Appendix A). However, the over reliance on a complex maze of aging generators, switchboards, automatic transfer switches to perform during the most critical times poses a great risk to the facility.

Utility Service Entrance:

The service entrance to the facility consists of a single 12KV/1200 AMP circuit from Southern California Edison (SCE). The two service entrance transformers, in the SCE equipment space, step down the voltage from 12KV to 4180V and feed a single distribution bus that also belongs to SCE. Although generators can compensate for the loss of this single utility service entrance and distribution bus, a single service entrance to the facility is considered a risk for highly mission critical data center facilities.

Data Center Substations and Utility Switchboards:

There are five (5) utility entrance substations downstream of the SDE switchboard within, or adjacent to, the building. These substations step down the voltage from 4180 volts to 480 volts for distribution throughout the data center facility and its related mechanical equipment. It appears that each substation was added at a different time based on the power requirements of the facility. These five (5) substations each feed a subset of the UPS systems and mechanical infrastructure that are downstream of these substations.

Generators:

There are six (6) 480v generators that are distributed throughout the facility which have been added over time. There is no preferred or standard vendor of the generators. Most units are over 40 years old which makes it difficult to locate spare parts. Each generator is on a separate output bus and does not synchronize with the other generators. Generator #6 backs up generators #2 and #5 through two (2) separate Automatic Transfer Switches (ATS). Generators #1, #3, and #4 do not have backups.

Generator	Size (KW)	Age (Years)	Fuel Capacity	Runtime Hours
Gen #1	600KW	45	5000	111
Gen #2	600KW	43	5000	111
Gen #3	600KW	45	4000	88
Gen #4	600KW	45	4000	70
Gen #5	600KW	33	4000	88
Gen #6	1000KW	3	1000	25

Uninterruptable Power Supplies (UPS)

The UPS power distribution in the data center consists of six (6) independent UPS systems with each system consisting of a single UPS module. Each UPS has its own separate output switchgear. UPSs A, B, C, D, and E are equipped with a 480v Static Transfer Switch (STS) downstream of each UPS. These transfer switches have a secondary source from UPS-R1

as a backup with the exception of UPS E which has its secondary source from the utility. UPS-R1 does not support any IT load independently and is only used as a reserve UPS system. There are plans to add a second reserve UPS-R2. This unit will provide backup for UPS E.

Due to eCloud and extensive virtualization, IT power consumption at Downey has been on a decline. The current overall power consumption of 626KW represents only 43% of the available UPS capacity. This trend will continue as most IBM P-Series and EMC storage will also be virtualized by end of 2015.

All UPS systems are MGE (now owned by APC, a division of Schneider Electric).

The UPS power distribution at the Downey Data Center is rather complex and has significant dependencies on ATS and STS which under certain conditions could become single points of failure. For instance, while the UPS A and UPS B provide wraparounds for the STS switches during a STS failure or maintenance activity, UPS C, D, and E configurations do not provide this capability and a STS failure could impact all single corded equipment. Regardless, these systems meet the requirements for concurrent maintainability for dual corded equipment.

UPS	Capacity (KW)	Utilization (KW)	Supported Space	Location
UPS-A	450	234	Enterprise DC	UPS Room
UPS-B	450	255	Enterprise DC	UPS Room
UPS-C	180	46	Co-location DC	Co-location DC
UPC-D	180	47	Co-location DC	Co-location DC
UPS-E	180	44	Enterprise DC	Enterprise DC
UPS-R1	450	0KW	Backup for UPS A, B,C, and D	UPS Room
UPS-R2 (Planned)	450		Backup for UPS E	UPS Room
TOTAL	1,440	626		

Rack Power Density

There are 247 computer cabinets and racks installed at the Downey Data Center which are collectively consuming 626KW of power. The average power utilization per rack is 2.53KW across all IT equipment. This, however, may be misleading since equipment in many of the racks have been decommissioned. The five (5) racks supporting the Cisco UCS infrastructure for eCloud and HVD represent the highest rack densities. A pair of three phase 60 Amp circuits are used to provide redundant power to these racks. During our walkthrough of the data center, we recorded sample power readings from the metered power strips in three of these racks. These readings are shown in the following table.

HDV Rack		UCS Rack		UCS Rack	
1.2	1.2	5.8	6.5	7.1	7.2
5.8	5.8	7	7	7.3	7.3
5.5	5.2	1.2	1.3	6.3	6.5
5.3	5.8	6.5	5.9	6.5	6.3
5.1	5.4	4.4	4.4	1.2	1.2
5.3	5.6	5.3	5.4	5.5	5.5
Total AMPS	**57.2**		**60.7**		**67.9**
KW	**20.6**		**21.8**		**24.4**

The above table indicates that the total power consumption of the Cisco UCS racks exceeded the 60 Amps that can be supported by a single circuit. Therefore, failure of either side A or B power to these racks could result in overloading of the opposing side and ultimate failure of the circuit. ISD has indicated that this situation will be addressed as follows:

1. For the eCloud racks, on Thursday March 4th , a 3rd 60 AMP circuit will be added and the chassis power supplies redistributed across the three circuits.

2. For the HVD racks, on Tuesday March 27th, a 3rd 60 AMP circuit will be added and the chassis power supplies redistributed across the three circuits.

2.3 Mechanical Infrastructure

The primary method of air distribution for the Downey Data Center is through the use of a raised floor which supplies air and use of a dropped ceiling which returns air plenum. An air plenum corridor separates the co-location space from the enterprise space. Supply air enters the raised floor plenum through this corridor in both spaces.

There are three (3) auxiliary 20 Ton (70KW) CRAH units located in the enterprise space as shown in Figure 3.

The mechanical infrastructure of the Downey Data Center consists of two (2) independent chilled water systems. The primary system supports the four (4) central air handlers and the UPS room. The auxiliary chilled water plant is dedicated to the three (3) Liebert 20-ton CRAC units that are located in the computer room.

Primary chilled water system consists of:

- Four (4) central air handlers located on the first floor supplying air through the HVAC plenum corridor
- Two (2) 20-ton Stulz CRAC units in the UPS room
- Two (2) 30-ton chillers
- Two (2) 250-ton chillers
- Five (5) chilled water pumps
- Six (6) condenser water pumps
- Three (3) cooling towers

All chillers in this system are on common headers for chilled water supply and return as well as condenser water supply and return. Chilled water supply and return lines have some isolation valves, but we were informed that most valves are frozen due to age of the system. We could not verify if the chilled water distribution supply and return lines are dual ended throughout the system.

Supplemental chilled water system consists of:

- 80-ton York chiller and the associated cooling tower and pumps
- Three (3) 20-ton CRAC units

Each portion of the chiller plant is exclusively supported by only one of the generators #4, #2, or #5. Only generators #2 and #5 are backed up by generator #6. Equipment that is on generator #4 will become unavailable should this generator fail to start.

Due to the light load of the data center, cooling capacity is not a concern at this point. However, lack of consistent airflow containment systems, a regimented hot-aisle/cold-aisle configuration, the age of equipment, and the lack of economization systems makes the

mechanical infrastructure of the Downey Data Center inefficient. Only the five (5) high density UCS blade racks use fully contained chimney cabinets.

We estimate the Power Usage Effectiveness (PUE) of this data center to be close to 2.0. A highly efficient data center will operate at a PUE of about 1.3.

2.4 Fire Suppression

Halon gaseous fire suppression system is used in all raised floor spaces. Cross zoned smoke and heat detection are also used in these spaces. FM200 is used in the UPS room (J119). Gaseous fire suppression systems are backed-up by dry pipe pre-action sprinkler systems.

3.0 ISD Data Center IT Assets and Services

Figure 3 illustrates the layout of the Downey Data Center as of December 2014, whereas Figure 4, illustrates the projected layout by the end of 2015.

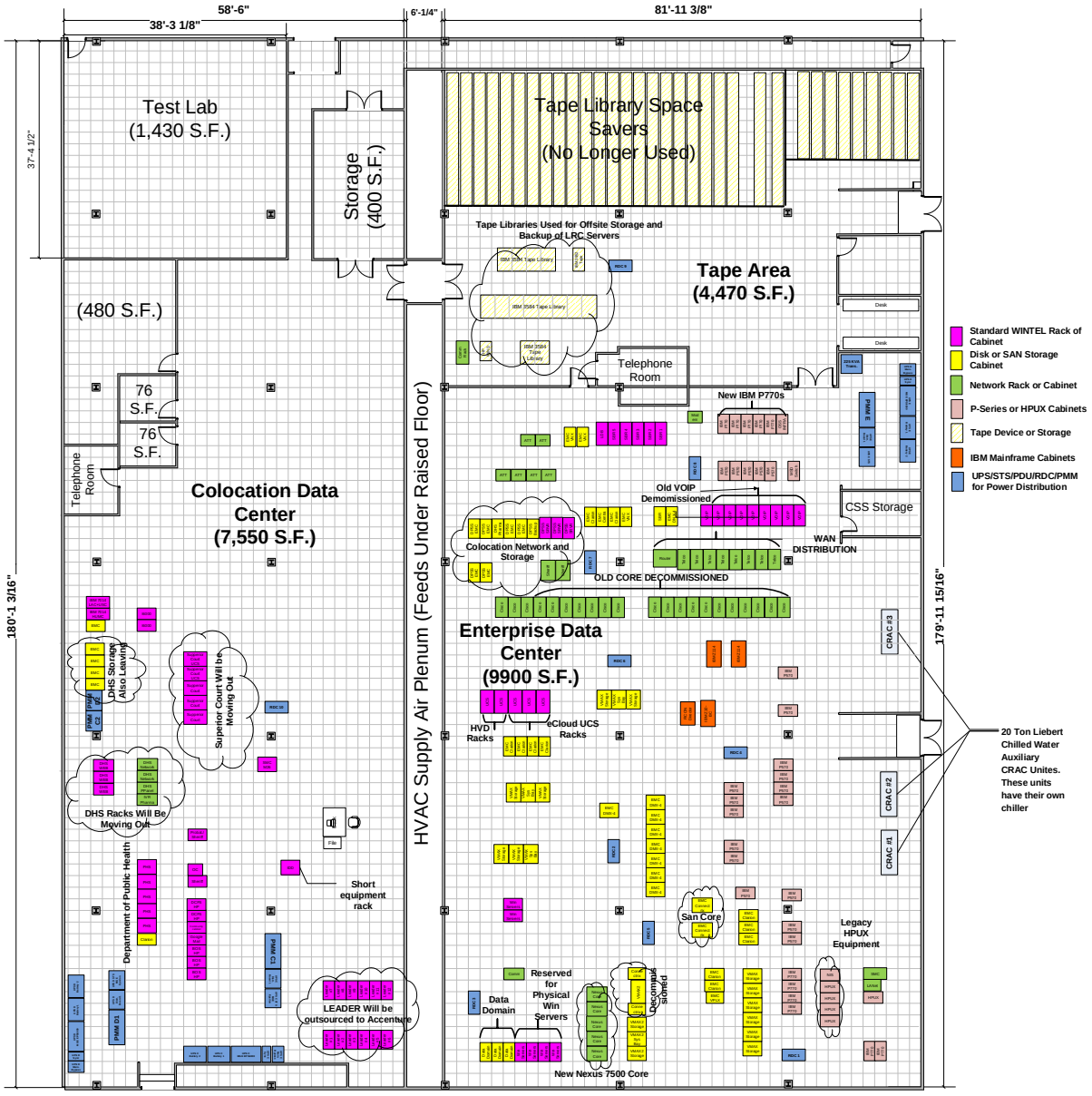

Figure 2 – ISD Downey Data Center Equipment Layout as of 12/2014

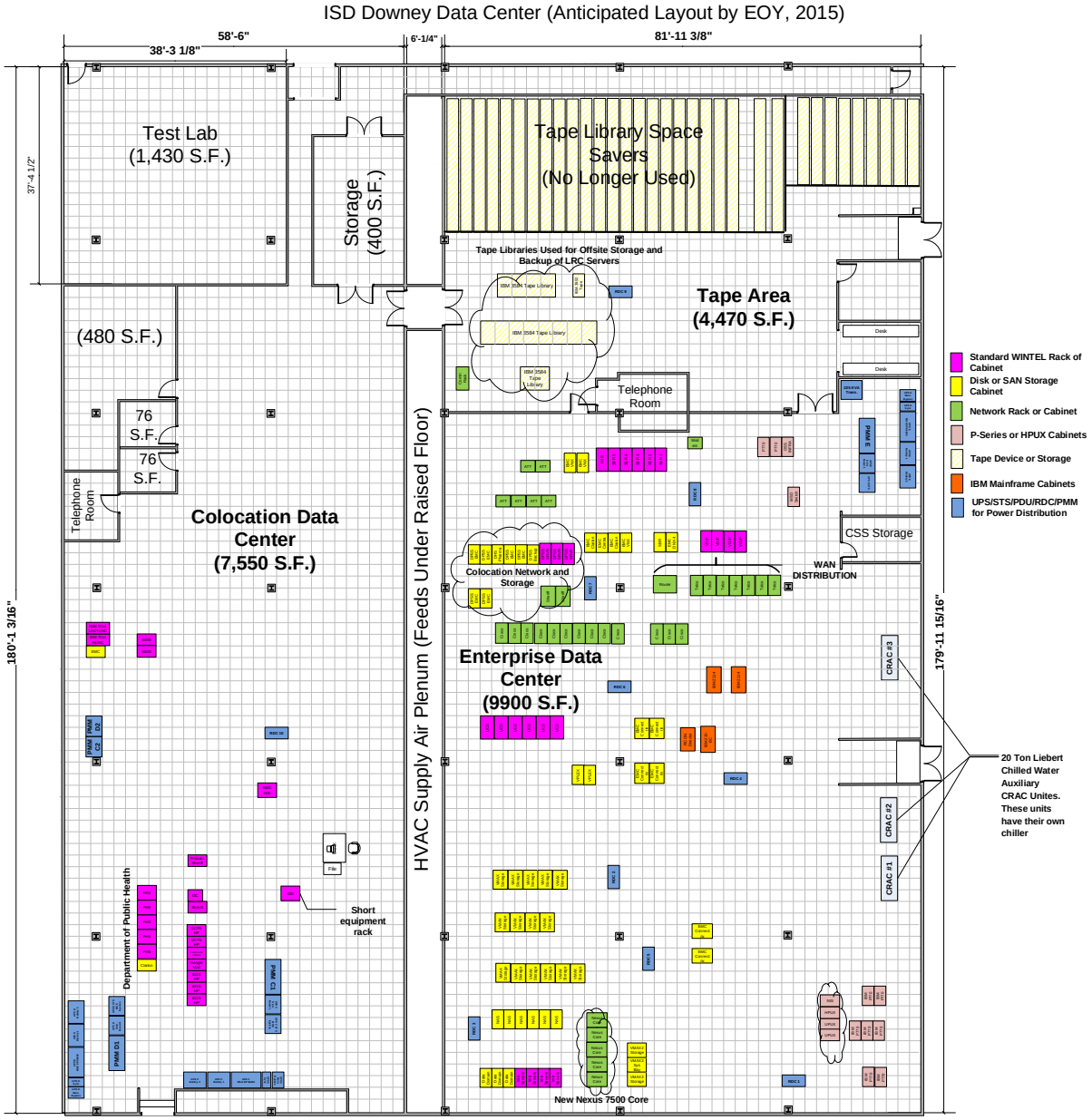

Figure 3 – ISD Downey Data Center Projected Equipment Layout by end of year 2015.

As is demonstrated by the above figures, continued virtualization of the computing and storage environment will have a significant impact on elimination of physical IT assets while maintaining and enhancing IT capacity for delivering services. Furthermore, several co-location customers will also be moving out. Overall the Downey Data Center will experience a reduction of approximately 100 IT cabinets, from the current count of 247 by the end of 2015, leaving the space in both rooms vastly empty.

3.1 Current ISD Service Offerings

Currently ISD provides the following core services to all LA County departments.

- ECloud – X86 based self-provisioned or managed Infrastructure as a Service (IaaS) offering built on Cisco UCS blade, VMware, and EMC platforms. Nearly 2170 virtual servers are supported on 168 physical blade servers across both the Downey and LRC data centers.

- Hosted Virtual Desktop (HVD) – Virtual desktop offering built on Cisco UCS and VMware View. There are currently 5059 virtual desktops supported by 127 physical hosts across both Downey and LRC data centers.

- Microsoft (MS) Exchange – Centralized e-mail for all County departments which is hosted on eCloud. This service offering will be migrated to MS cloud shortly.

- Managed Mainframe, AIX, and HPUX platforms - there are currently 99 LPARs managed across Downey and LRC data centers.

- Co-location – Space, power, and cooling for hosting customer managed equipment. This service offering has been on decline due to adoption of eCloud. This decline is expected to continue in 2015 as some services such as LEADER are transitioned to external providers.

Both eCloud and HVD environments are condensed into nine (9) dense cabinets, five (5) in Downey Data Center and four (4) at LRC. This environment is supported by EMC VPLEX for synchronous data replication between the two sites. ECloud is capable of supporting active-active operation from both data centers.

3.2 Planned ISD Service Offerings for 2015

In 2015, ISD will work to provide a new AIX cloud service called Power Cloud. Plans call for implementation of Power Cloud on eight (8) P770 frames in each data center and eventual consolidation of all the existing P570 and HPUX platforms when possible. Power Cloud will have a self-provisioning capability for ISD AIX administrators only and will continue to be offered as a managed service. It will, however, have all of the eCloud like capabilities such as active-active operation from both data centers. Implementation of Power Cloud will leverage the existing or smaller P770 footprint at the Downey Data Center while eliminating most of the P570 footprint.

Similarly, ISD will be consolidating all the existing storage platforms into a virtualized storage environment leveraging three (3) VMAX 40K frames at each data center. Each frame could support up to 4 petabyte (PB) of storage and up to eleven (11) storage cabinets depending on the disk configuration.

As an extension of desktop virtualization, ISD will also provide application virtualization using VMware ThinApp or similar products.

4.0 Contacts

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Appendix A – Tier Specifications

The Uptime Institute characterizes data centers using four tier classifications as shown in the following table.

	Description	Common Usage Models
Tier I: Basic	• Single points of failure exist which can result in unscheduled outages. • Single path for power and cooling distribution will require scheduled outages for maintenance • No redundant components, therefore replacement of parts can prolong outage	• Non critical systems • Test and development • Disaster recovery • High Performance and Scientific Computing where downtime can be tolerated • Applications that are distributed among multiple data centers such as internet search engines
Tier II: Some Redundant Components	• Redundant components can reduce time to recovery • Not all single points of failure are eliminated, therefore unexpected outages are still possible • Single path for power and cooling distribution will require scheduled outages for maintenance	• Critical systems that are active/active at more than one DC • Disaster recovery • Engineering and product development • Local manufacturing sites • Satellite data centers
Tier III: Concurrently Maintainable	• Multiple power grids or continuous on-site generation capability • Multiple power and cooling distribution paths, but only one path may be active • Redundant components and distribution paths are configured as concurrently maintainable, thereby eliminating any scheduled outage for maintenance.	• Mission critical applications • E-Commerce sites • Co-location and managed services with contractual SLAs • Primary corporate data centers • Global centers where downtime cannot be scheduled
Tier IV: Fault Tolerant	• Multiple power grids or continuous on-site generation capability • Multiple active power and cooling paths • Redundant components are concurrently maintainable and fully fault tolerant.	• Extensive financial transactions • Large financial institutions • Insurance industry • Some co-location and managed services providers

Telecommunications industry Association (TIA) has further refined these recommendations into TIA-942 specifications for structural, architectural, mechanical, and electrical requirements of a modern data center.

Report on LA County's Data Center Strategy Current State Assessment and Future State Requirements

Current State Assessment and Future State Requirements

Attachment D Future State Vision and Capacity Model

March 30, 2015

Prepared for: Los Angeles County

GARTNER CONSULTING

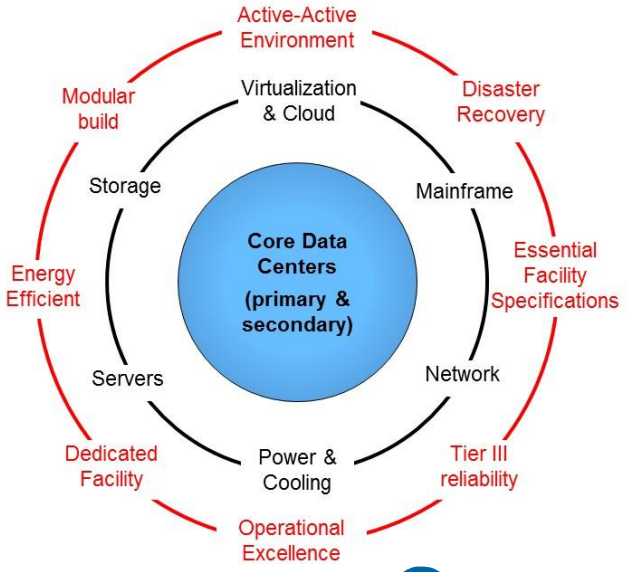
Project Number: 330025627

Table of Contents

Gartner

Executive Highlights

- The County currently has 49 data centers utilizing more than 67,000 ft^2 of space and 2.4MW of power in facilities that are not adequately secured or reliable to meet its business and technical needs.
- The County's strategy to consolidate its IT assets into a new data center is aligned with Gartner best practices and the trend of similar sized government agencies, including the strategy to consider various options.
- Based on its forecasted capacity requirements, the County will need a new facility that eventually can support 2.1MW and 14,000 ft^2 of IT workload over the next 10 years. If not all departments participate, capacity will be less.
- The County should consider a number of other factors (represented in the outer circle in the diagram) in determining its data center strategy and needs going forward.



Executive Summary

The County's consolidation efforts are in line with similarly sized government agencies

Due to its size (~10M people) and governmental structure (federated), LA County is not comparable to most other local governments in the U.S.

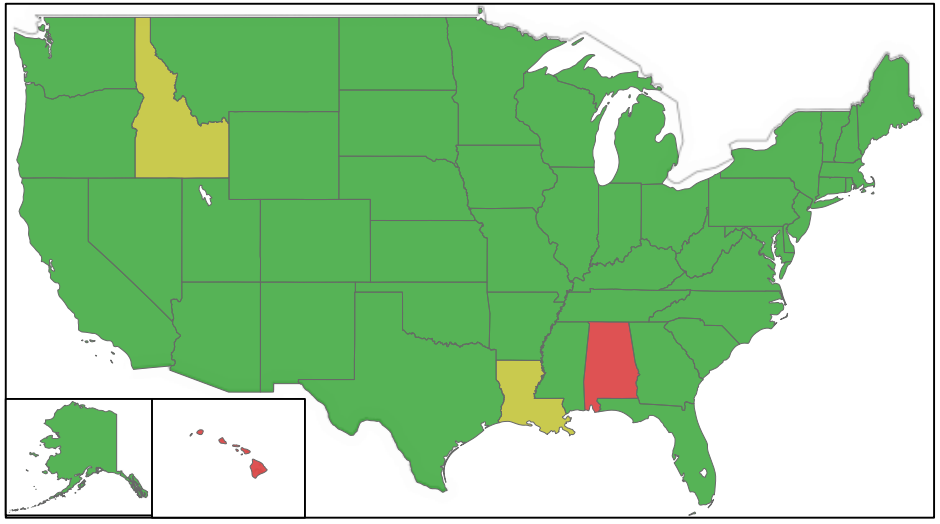
- The exceptions are New York City and San Francisco City/County, which are both undergoing similar consolidation efforts

To find peer government entities, Gartner looked at State government strategies across the Country

- LA County maintains a higher population than 40 states, including the non-consolidated ones.
- Most states have a 2-3 data center strategy with at least one Tier III facility
- Due to the diversity of critical applications, with varying degrees of resiliency and recoverability at the application level, most primary data centers are Tier III facilities.

A number of drivers are leading to consolidation:

- Budget reductions
- Aging distributed data centers that need costly upgrades (or sometimes cannot be upgraded) to meet new security, availability and capacity requirements.
- Difficulty securing data in distributed data centers against natural disasters and cyber or physical (e.g. FAA, Chicago) attacks.



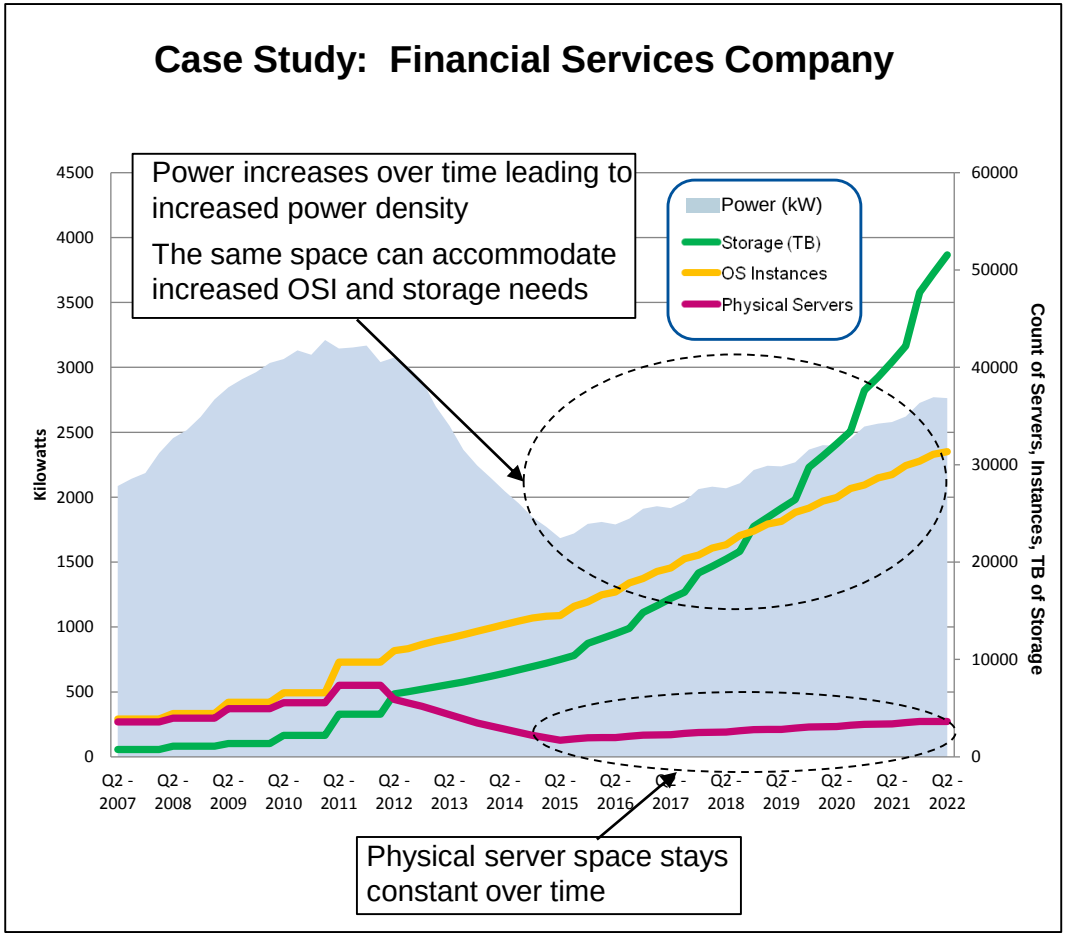
**Based on information found on State websites

Gartner has identified seven leading data center practices that were considered in creating the future state vision and requirements for LA County

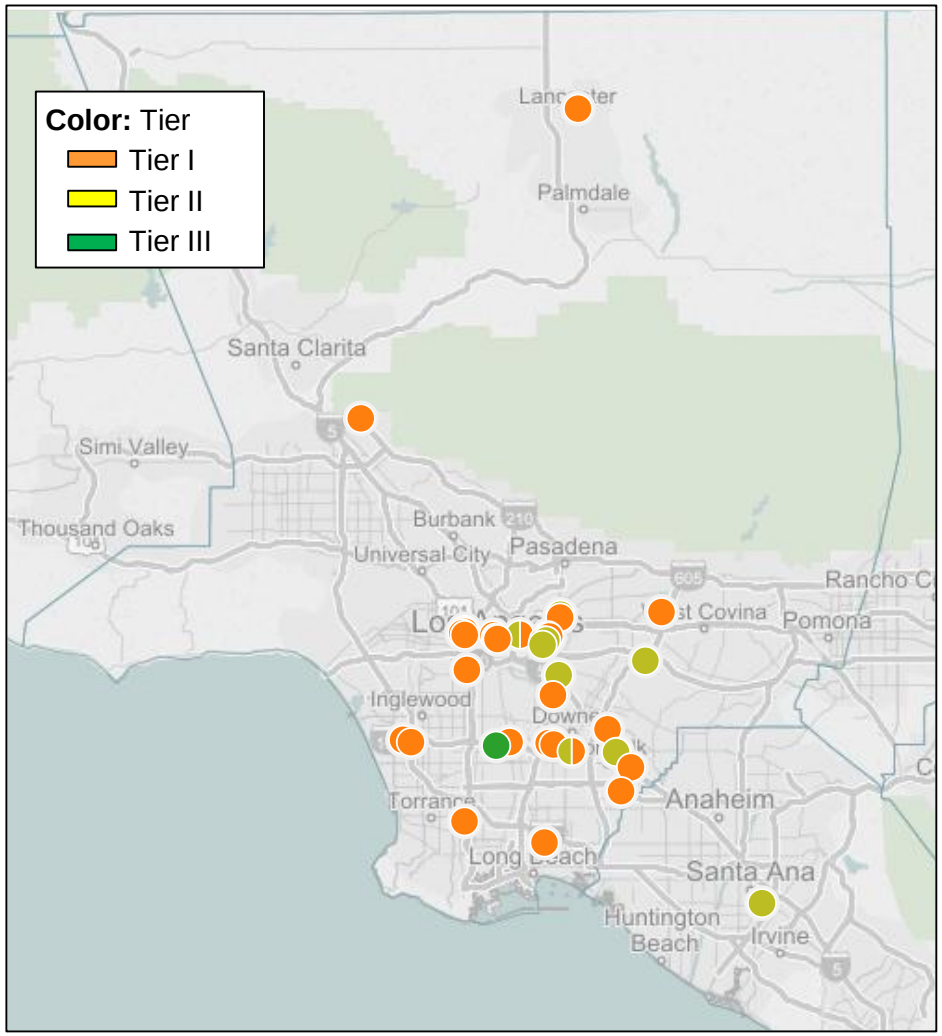
Leading Practice	Description
1. Consolidate and Establish Multi-site Strategy to Manage Risk and Provide Differentiated Class of Service	• Regional organizations require a minimum of two locations to manage risk. National and global organizations may leverage paired regional or continental data center hubs. • Distinction between Primary and Backup data centers are diminishing as active/active and continuous availability requirements increase.
2. Prioritize Mission Critical Applications	• Define discrete criticality levels for applications and align them to DC service classes. For example, mission-critical applications that do not operate in active/active mode from multiple DCs will need to be hosted in Tier III or higher data centers.
3. Support Realistic RTOs and RPOs	• Select data center architectures that support RTOs and RPOs that are in minutes vs. hours to support digitalization of IT and avoid disruptions to critical services.
4. Avoid the same disaster strike zone	• Location of data centers must avoid the same disaster strike zone. Additional considerations must include power cost, personnel availability, network cost, real estate cost, and climate (which impacts energy efficiency).
5. Leverage Cloud Services Where Appropriate	• When appropriate, use cloud services to leverage assets and improve agility, scalability, elasticity, and self-provisioning. SaaS can enhance maturity of service capability. Hybrid Clouds can extend capacity when needed.
6. Avoid DC Ownership to Improve Flexibility and Reduce Investment Risk	• Leased DC space using experienced service providers enables rapid deployment and replication of the DC environment at a much lower investment risk and initial capital than ownership. Furthermore, existing and proven operational best practices can be leveraged.
7. Utilize DC-only Edifices	• Data centers should be located in dedicated data center facilities in order to improve security, reduce environmental risks, and minimize impact of County land management strategies on IT operations.

The leading practices, along with advances in server and storage technologies, have resulted in the following trends that were also considered

- Smaller and Hotter:
  - Over the next 10 years, data centers will get smaller (in terms of square feet) and hotter (in terms of power per square foot).
- The Infinite Data Center:
  - Most organizations will see internal data center space needs stay constant or (more likely) decline over the next decade.
- Virtualized Windows and Linux:
  - While legacy workloads (Unix, Mainframe, etc.) will persist they will become an increasingly smaller footprint in the data center.



In addition to industry practices and market trends, the County's current physical and technical environment was considered in determining its future requirements

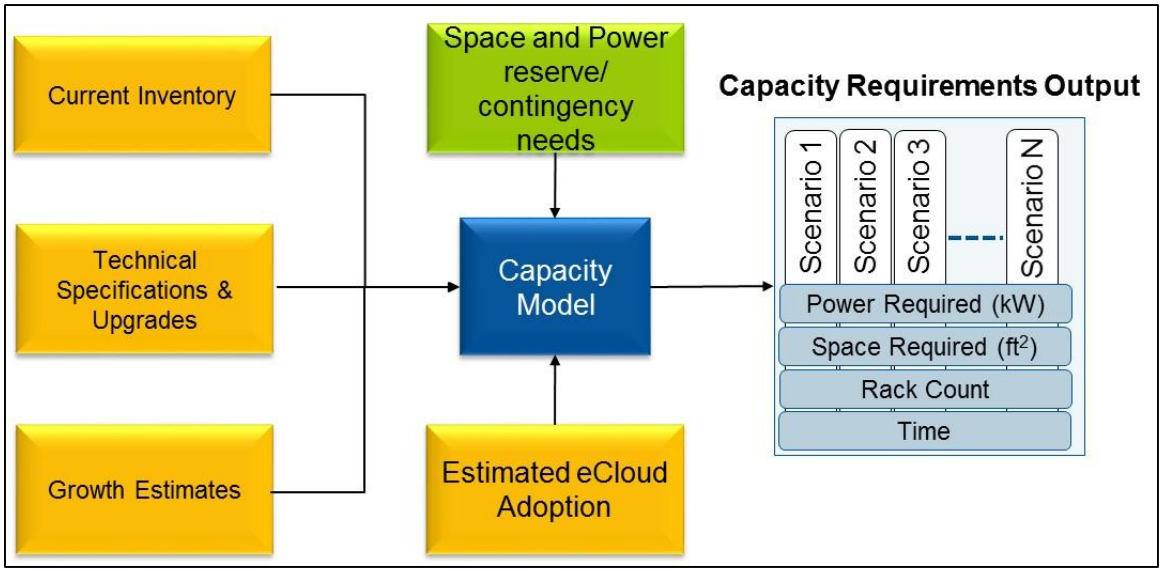


- The Gartner team visited and collected data from 49 data centers. In collaboration with the CIO's office, Gartner determined the assets that will likely be consolidated and which data centers may not initially participate in the consolidation.
- Most recent ISD IT technology and purchase decisions were analyzed.
- The Gartner capacity model was then customized to reflect the County's environment and infrastructure technology decisions.
- Gartner's research and industry knowledge were used to provide inputs into technology inflection points for servers, storage, and cloud services.
- A capacity plan was developed and the County's needs were determined based on various scenarios.

Gartner created a capacity model that combines upgrades in technology, growth estimates and the County's current inventory to forecast capacity needs

Each input on the left is based on consideration of several factors:

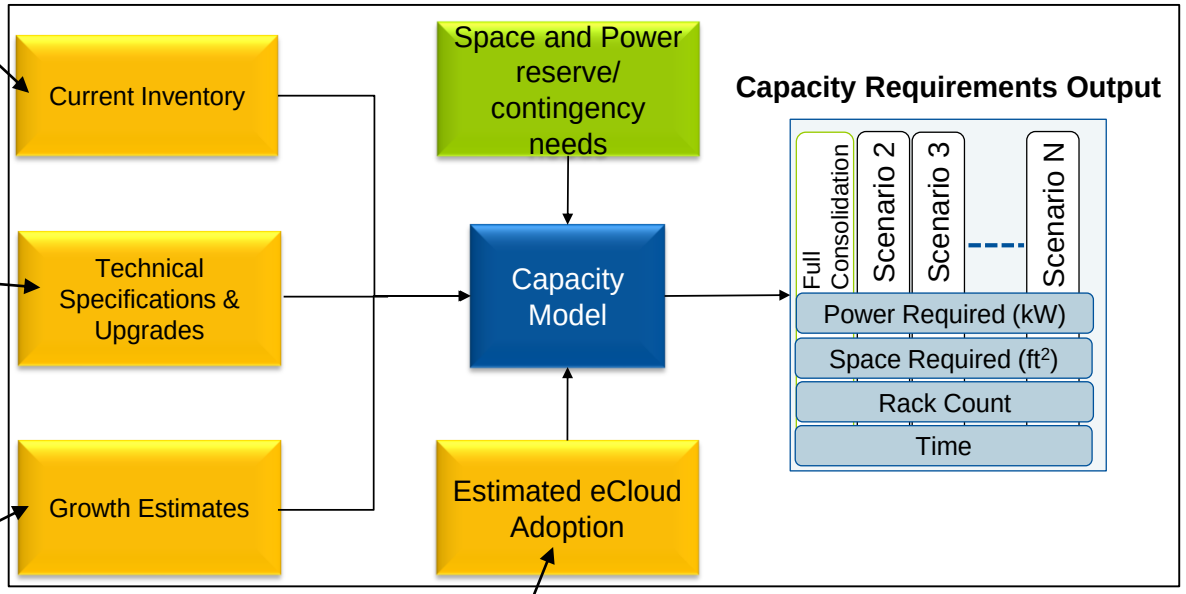
- Current Inventory:
  - Number of IT assets determined during data collection
  - Data center participation in or exclusion from consolidation
- Technical Specifications & Upgrades:
  - Current ISD Equipment
  - ISD Technology Purchase Trends
- Growth Estimates:
  - Past growth
  - Current initiatives affecting growth



A full consolidation scenario was created based on assumptions made due to market considerations and data collection efforts

Full consolidation scenario assumptions

5,700 OS instances, 5,100 VDIs and 10,600 TB of storage are being consolidated into the new data center. The full consolidation scenario assumes all departments participate, but excludes systems at LRC and assumes 30% of DHS and Sheriff's systems are DR that would go to LRC.



The model assumes technical upgrades, including:

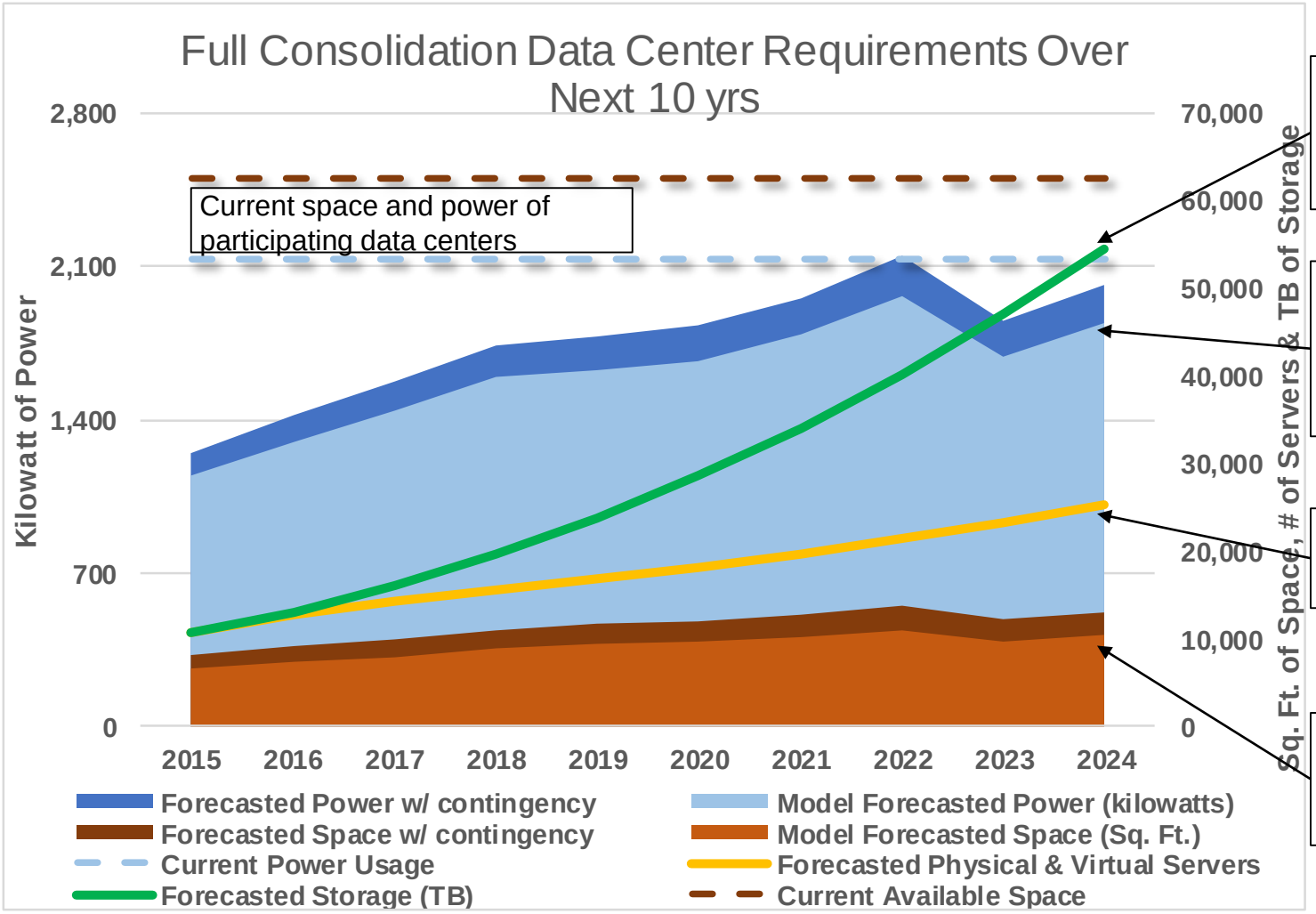
- 24 cores per physical eCloud server (leading to 16 VMs per server)
- 280 TB of storage per cabinet

- Server Growth: 20% for first year, 12% for second year and 10% per year there after
- Raw Storage Growth: 25% per year (slightly declining year over year).

It is assumed that 70% of departmental data center workloads are migrated into the new data center as eCloud workloads. For the remainder the assumption is that they will be managed in a similar environment to their current configuration.

Note: The model does not account for any plans departments might have for major new additions. However some initiatives such as migration of e-mail to Microsoft Cloud, outsourcing of LEADER, and separation of Superior Court were considerations in growth estimates.

The model's full consolidation scenario indicates that the County should plan to accommodate 2.1MW of power and 14,000 ft^2 of space



Storage volume will increase at a close to exponential rate, increasing from 10.6PB to 54.3PB

Power usage will grow faster over time than space leading to a hotter configuration (more power usage per ft^2 over the next 10 years

OS Instances & VDI will steadily grow over time from 10,700 to 25,300

Space usage will not grow nearly as substantially as other metrics, only increasing 4,000 ft^2 over 10 years

Note: Current Space and Power numbers exclude LRC

See Capacity Model Details and Assumptions for additional detail

Gartner

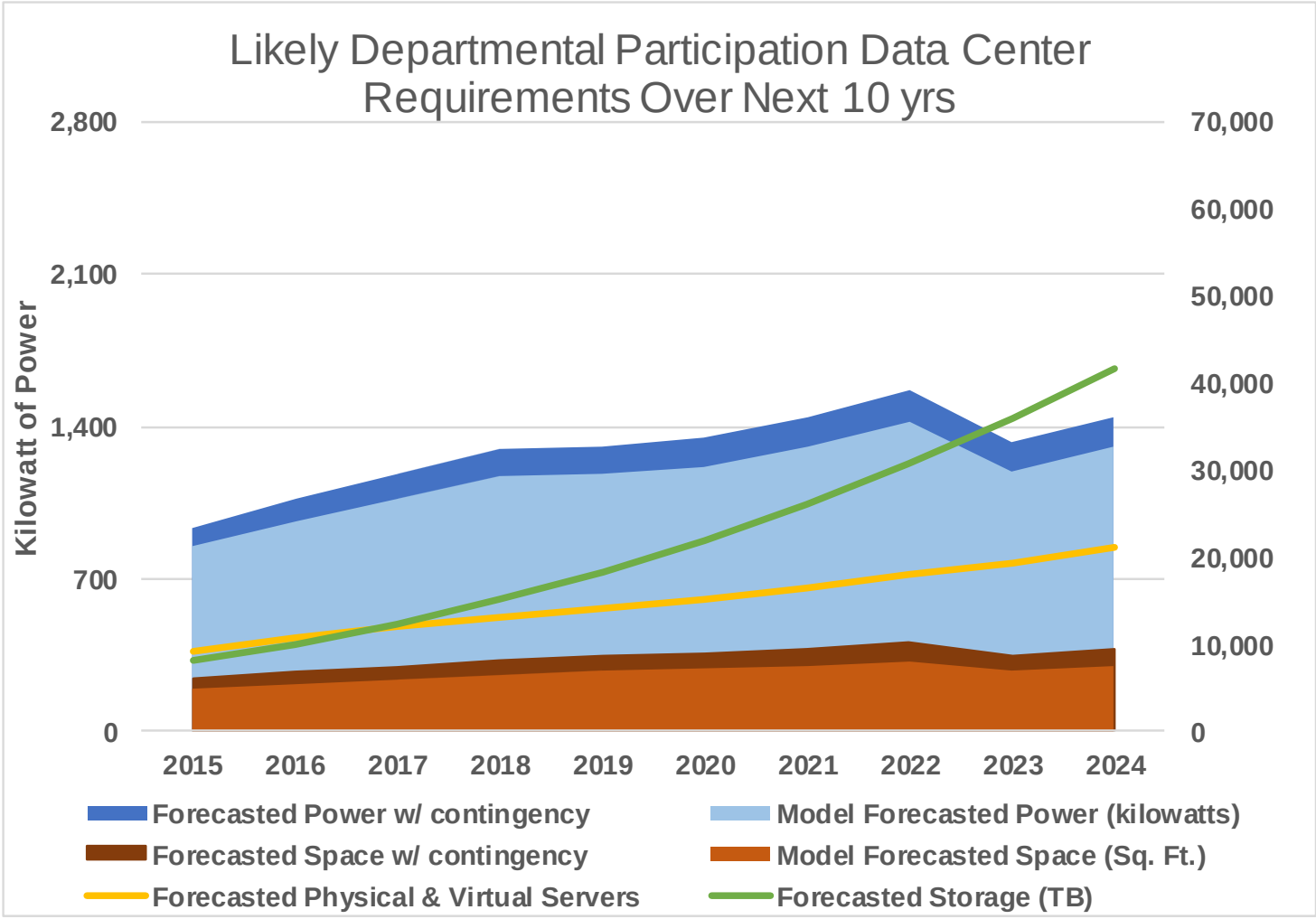
To ensure the validity of the capacity model, Gartner performed a set of sensitivity analyses to see how changing key assumptions would affect the capacity over time

Factors	7 Reduce	Full Consolidation	8 Increase
Server &Storage Growth	2 **Server:** 5% **Storage:** 15%	**Server:** Y1 20%, Y2 12%, 10% after **Storage:** 25% Y1 to 16% Y10	3 **Server:** 20% **Storage:** 30%
Departmental Participation	1 LRC, DHS, Sheriff (SCC), Fire, DMH and DPH (lab) do not participate	All Departments Participate (no LRC)	All Departments Participate (no LRC)
Percent eCloud Adoption	70% adoption	70% adoption	4 20% adoption
Technology Refresh	6 **Storage Density:** 350 TB per cabinet **eCloud:** 32 cores per server	**Storage Density:** 280 TB per cabinet **eCloud:** 24 cores per server	5 **Storage Density:** 124 TB per cabinet **eCloud:** 19 cores per server

Sensitivity Scenarios:

1. Scenario 1: Likely Departmental Participation
2. Scenario 2: Low Server and Storage Growth
3. Scenario 3: High Server and Storage Growth
4. Scenario 4: Low eCloud Adoption
5. Scenario 5: No Technology Refresh
6. Scenario 6: Better Technology Refresh
7. Scenario 7: Lowest Possible demand (combination of 5 & 6)
8. Scenario 8: Highest Possible demand (combination of 1-4)

The full model output for the likely departmental participation scenario is provided as an example scenario

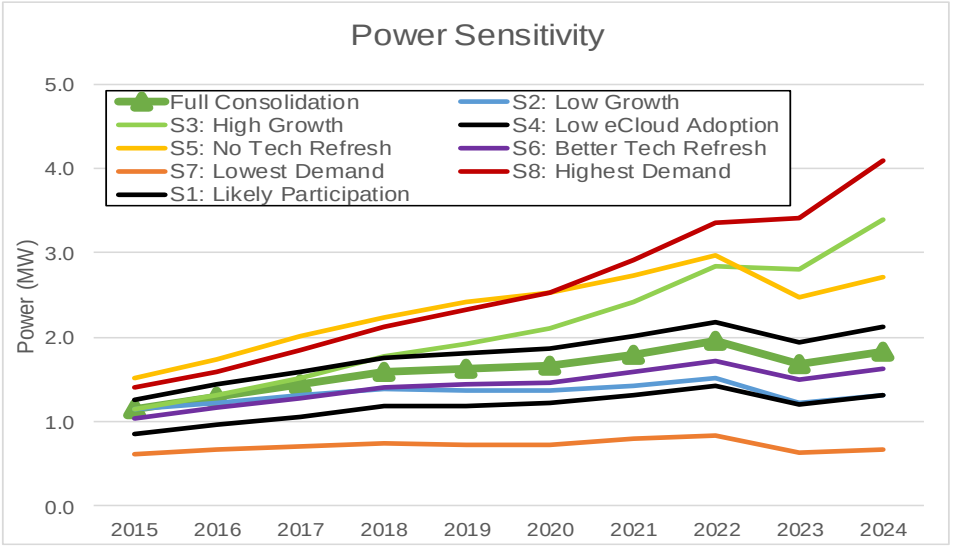


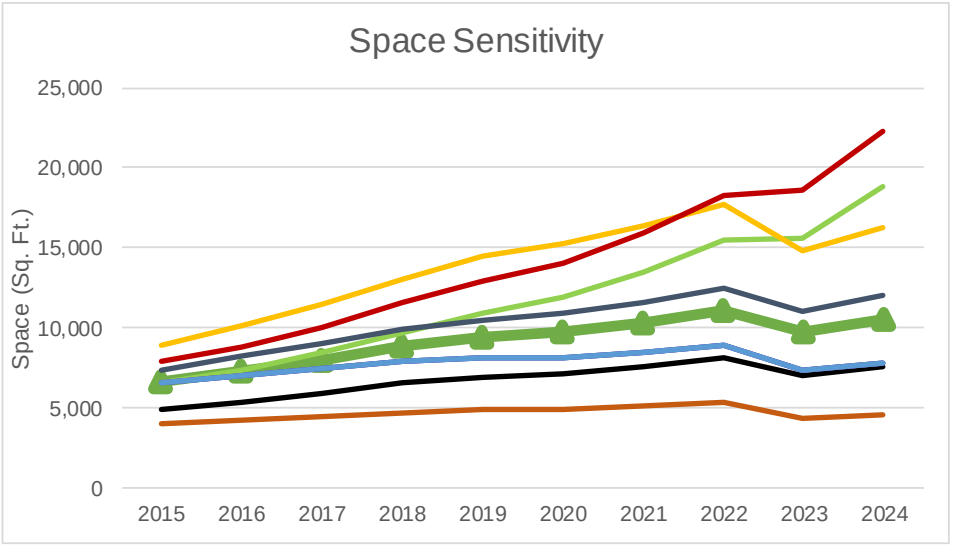
The sensitivity analysis indicates that County's forecasted power capacity is most sensitive to growth forecasts, departmental participation and technology refresh

The model is especially sensitive to server and storage growth, departmental participation and technology refresh.

Although there are some sensitivities that can result in significantly higher capacity requirements these situations are unlikely:

- Technology refreshes will likely occur as part of moving to a new data center.
- Storage and server growth rates are conservative estimates.



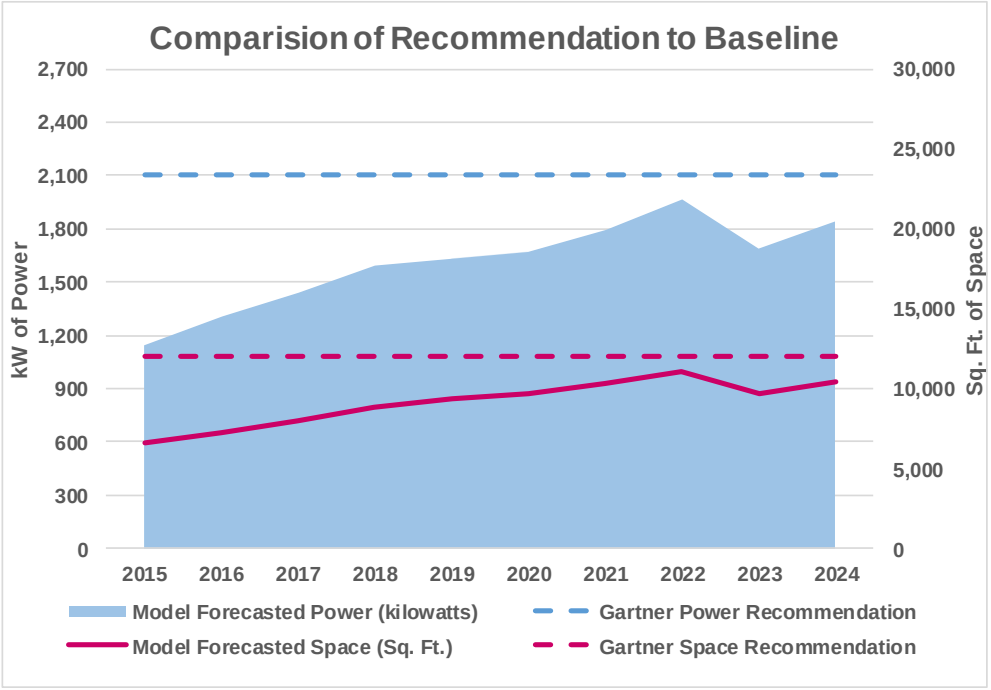


See Appendix C for additional detail

If all departments participate, Gartner recommends that the County's primary data center be able to eventually accommodate 2.1MW and 14,000 ft^2 of IT workload

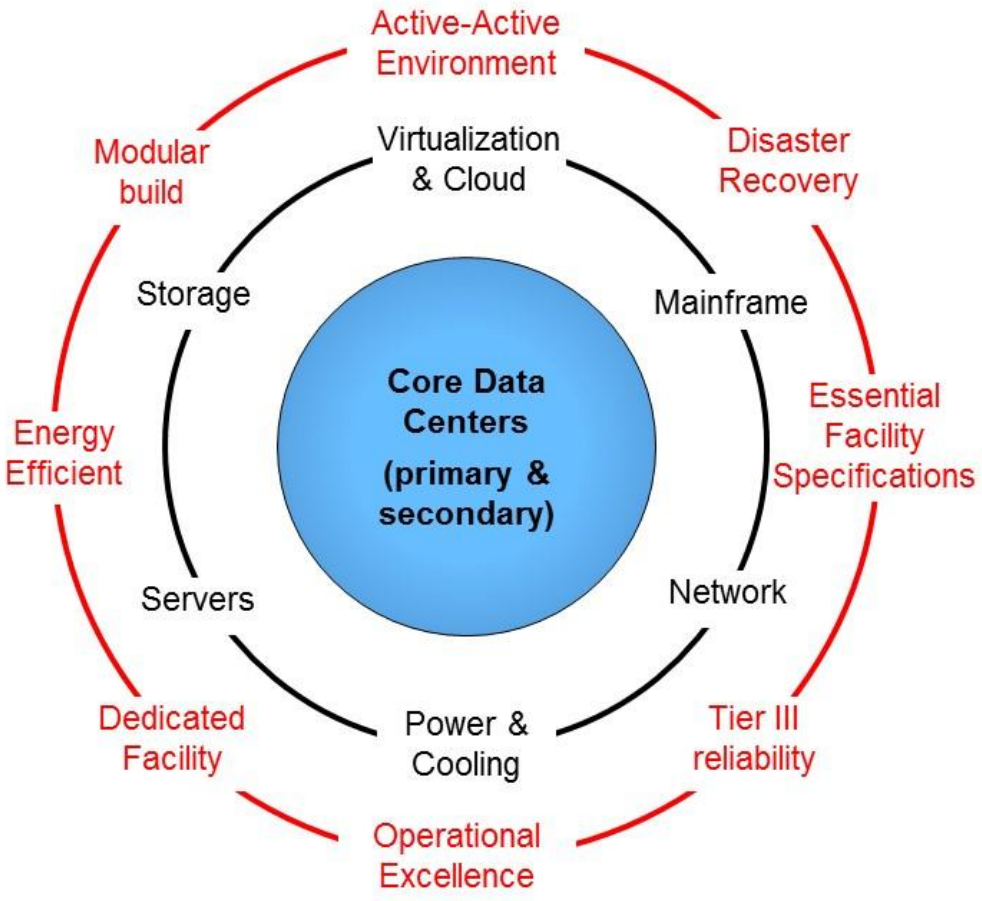
The recommendation for achieving the power and space depends on the ownership model.

- Requirements should LA County decide to **buy or build** a data center
  - Data center's electrical and mechanical infrastructure shall be designed for a minimum day one load of 700kW with the capability to upgrade to 2.1 MW with no interruption to business operations during the upgrade. The total computer room space requirement is less than 14,000 ft^2. This modularity allows for adjustments to changes in needs (like lack of full participation in consolidation).
- Requirements should LA County decide to **lease** from a data center co-location provider:
  - The prevailing contractual model for today's DC leased space is based on the cost of reserved UPS capacity plus actual cost of power consumed. Cost of space is typically included in the cost of reserved power capacity.



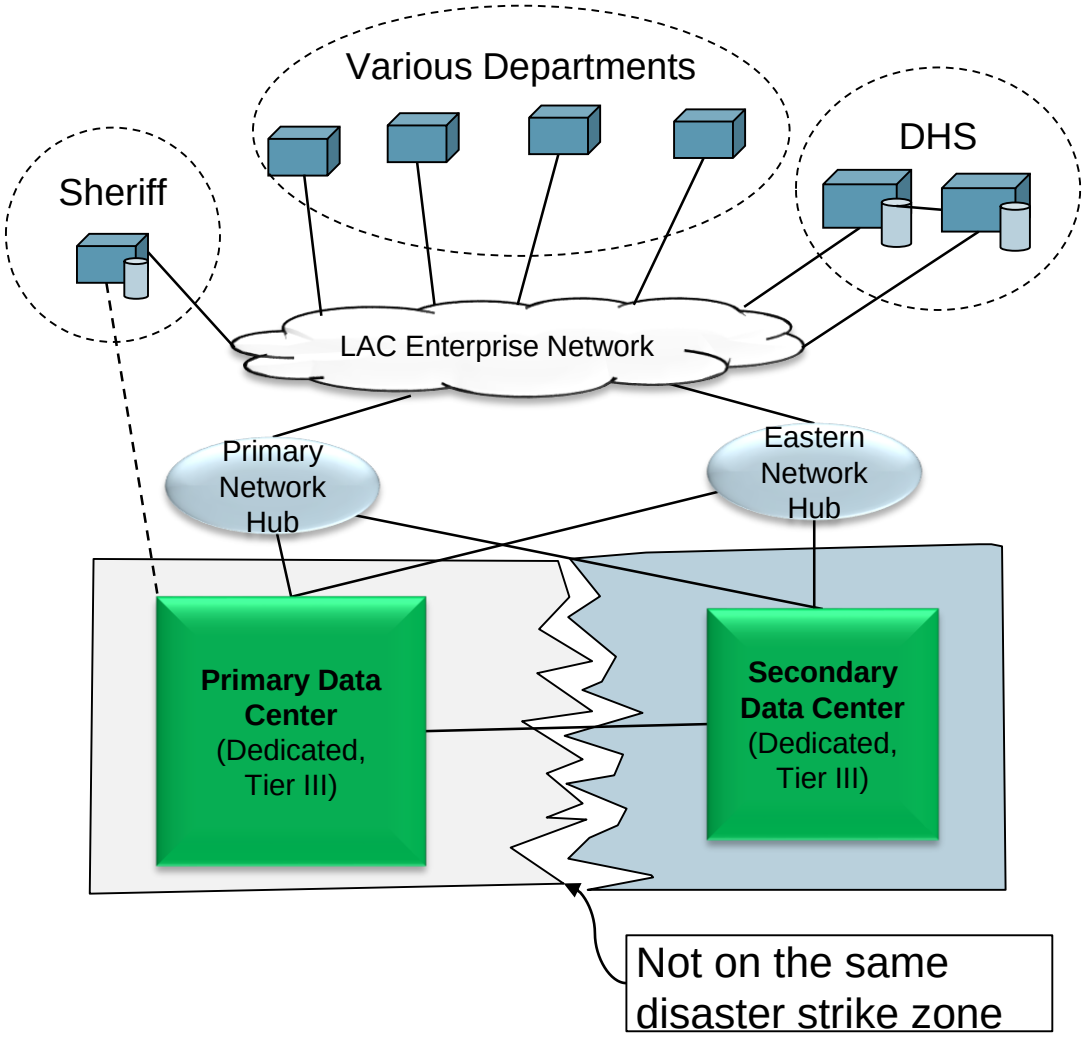
  - Most providers compute cost of the consumed power by multiplying the total IT power consumption in one month by the data center Power Usage Effectiveness (PUE) to obtain the total KWh consumption, and then multiplying by the utility rate.
  - For this reason it is financially advantageous for the LA County to incrementally add reserved power overtime as departments continue to consolidate.
  - The service provider must however be able to contractually guarantee that will be able to provide 2.1MW of power and 14,000 ft^2 of space as requirements increase.
  - Although having contiguous space is advantageous, it need not be a hard requirement. For, example LA County could have two separate 7,000 ft^2 areas at the same facility.

In addition to the capacity needs, the County's future data center vision must incorporate the following requirements to provide the required support for its business needs



- **Active-Active Environment:** LA County should plan for two consolidated County data centers capable of operating in active-active configuration with a maximum latency of 10ms (see appendix for distance implications).
- **Disaster Recovery:** Data centers shall not be within the same earthquake fault zone unless mitigated by a third facility.
- **Essential Facility Specifications:** Building shell shall comply with the International Building Code (IBC) Essential Facility specifications.
- **Tier III Reliability:** To enhance availability and manage risk, consolidated data centers shall comply with TIA-942 Tier III specifications and be able to pass formal certification if so desired by the County.
- **Operational Excellence:** Facilities and IT operational maturity and excellence shall be assessed, monitored, and improved
- **Dedicated Facility:** Building shall only house data center and associated support services such as a Network Operations Center (NOC).
- **Energy Efficient:** Energy efficiency is of great importance. Every effort should be made to design or select a facility for optimum energy efficiency. Total facility Power Usage Effectiveness (PUE) shall not exceed 1.4.
- **Modular Build:** In order to satisfy future demand while managing initial cost, data center power and cooling infrastructure shall be modular with ability to increase capacity without outage to any operating IT infrastructure.

The future state vision will have important effects on the County's current network environment and require additional bandwidth for departmental connectivity

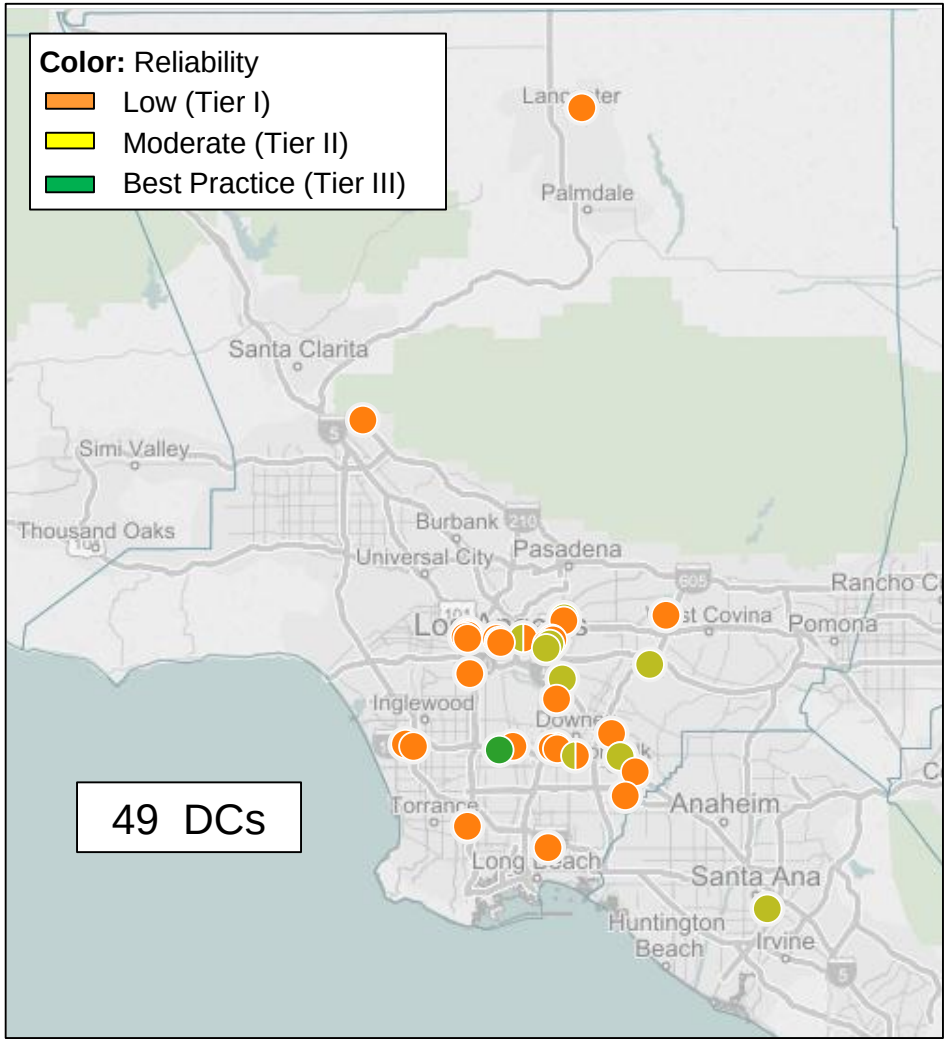


- The consolidation to a new, primary facility will change the County's network configuration in a few key ways:
  - Most departments will only be able to access all their systems through the County's Enterprise Network
  - The County's primary facility may be separate from its network hub
- To enable active-active services, latency between the primary and secondary data centers should be 10ms or less
- In order to ensure departments have adequate performance, there will need to be adequate bandwidth to the new facility.

Gartner

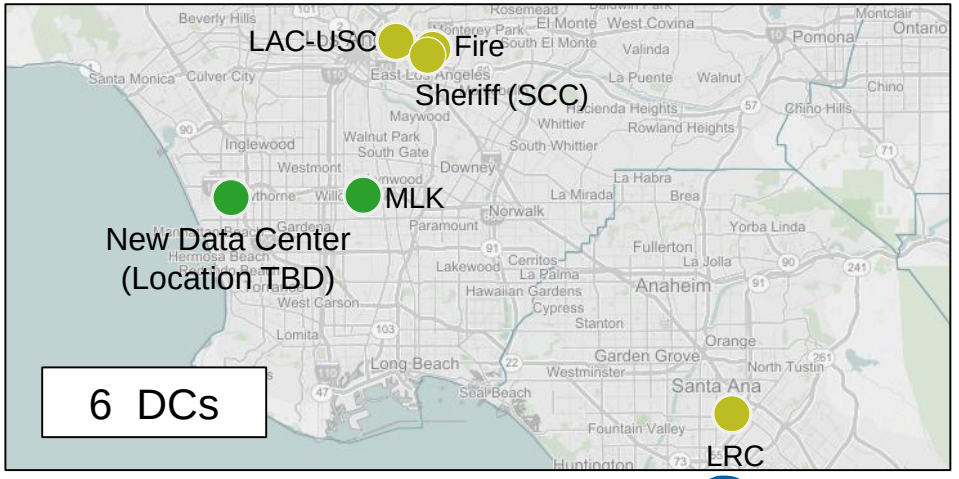
Full consolidation could reduce the number of data centers from 49 to 2. However, it is likely that some specific departments will maintain their own data centers, at least in the near term

Current State

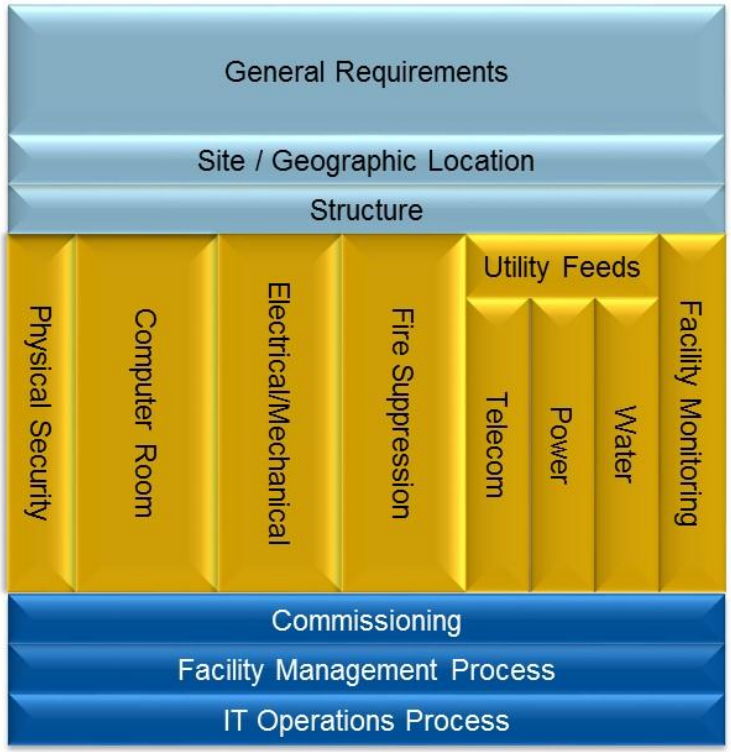


Future: Full Consolidation

Future: Likely Participation



Gartner developed a framework to further define the future state requirements



- **General Requirements:** Overall key requirements which drive the overall data center vision.
- **Site / Geographic Location:** Guidelines and requirements of the geographic location and site (e.g. land) where the data center will be located.
- **Structure:** Guidelines and requirements regarding the construction and layout of the building which will contain the data center.
- **Physical Security:** Requirements for physically securing the data center facility.
- **Computer Room:** Guidelines and requirements for the computer room including both features and capacity.
- **Electrical/Mechanical:** Guidelines and requirements for the heating, cooling and power distribution/transformation infrastructure required to support the computer room.
- **Fire Suppression:** Requirements regarding fire detection and suppression systems.
- **Utility:** Requirements regarding utilities (telecom, water, and power) including water storage and telecom/power diversity.
- **Monitoring and Control**: Requirements for systems to monitor the health and usage of the various power, cooling, hazard detection, security and other facility related systems.
- **Commissioning:** Requirements for a) testing and validating that the facility and its MEP components perform and function as designed, b) documenting and testing all the operating procedures, and c) ensuring that facilities staff are trained in those operating procedures.
- **Facilities and IT Operations Processes**: Requirements for processes, skills and staffing levels required to manage a critical facility and IT Operations.

See Attachment E for additional detail

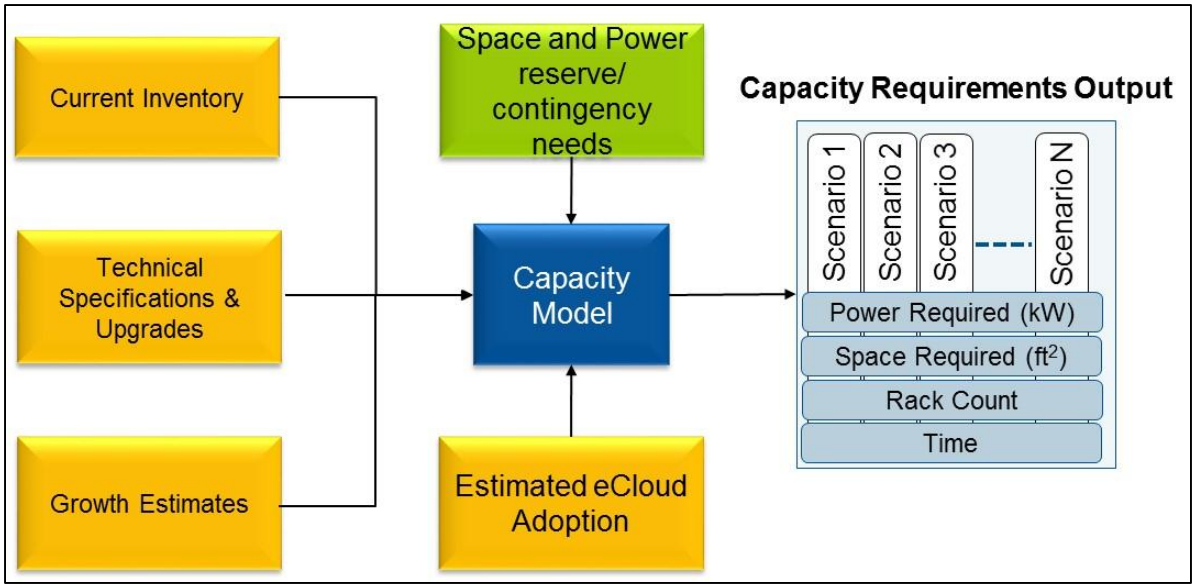
Capacity Model Details and Assumptions

Gartner

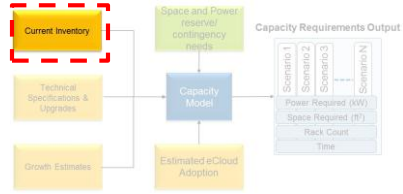
The capacity model incorporates a number of inputs to forecast potential scenarios – the following slides detail each input and the assumptions

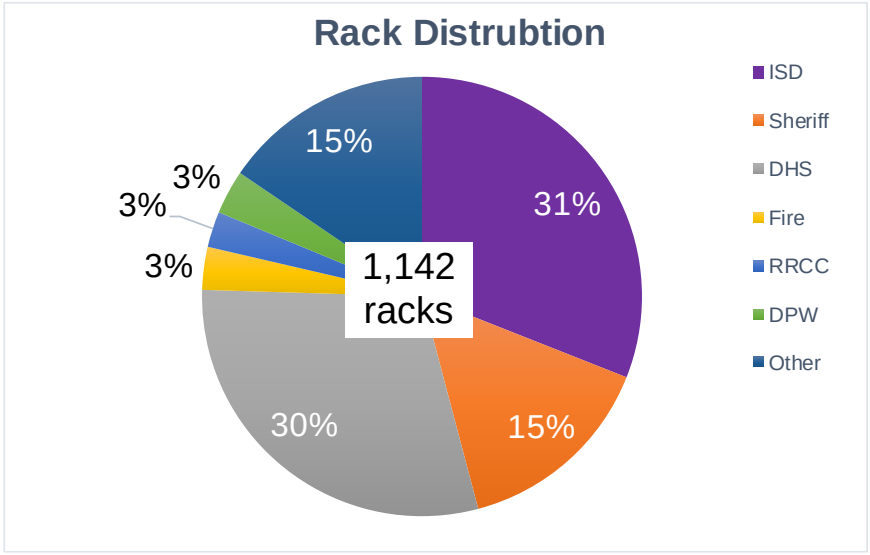
The inputs on the left are based on consideration of a few factors:

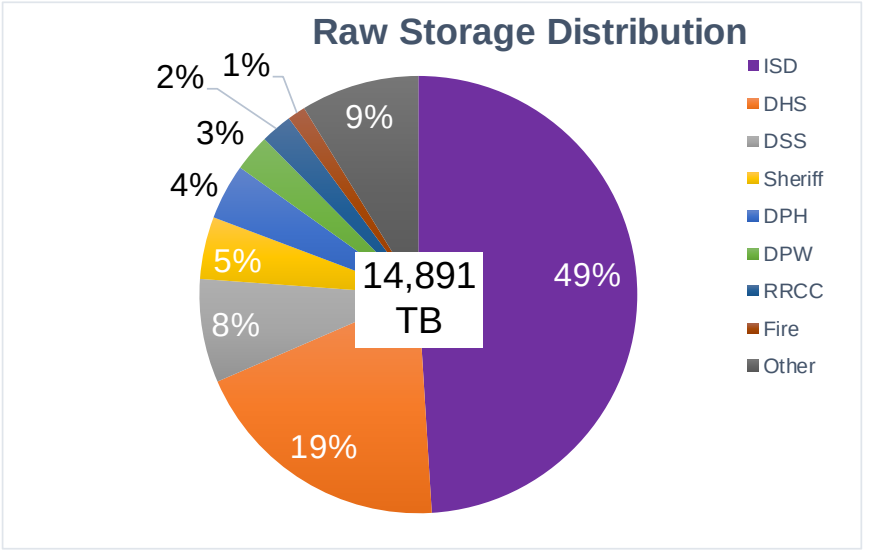
- Current Inventory:
  - Number of IT assets determined during data collection
  - Data center participation in or exclusion from consolidation
- Technical Specifications & Upgrades:
  - Current ISD Equipment
  - ISD Technology Purchase Trends
- Growth Estimates:
  - Past growth
  - Current Initiatives affecting growth

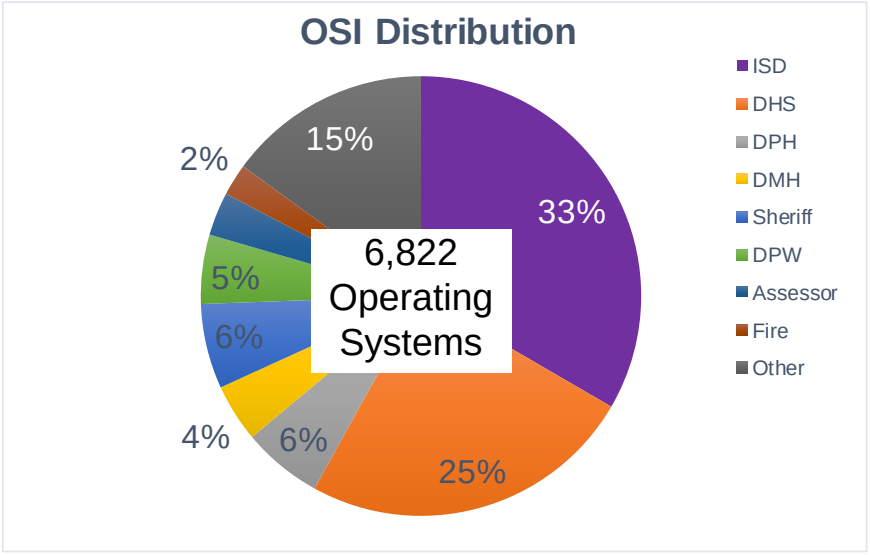


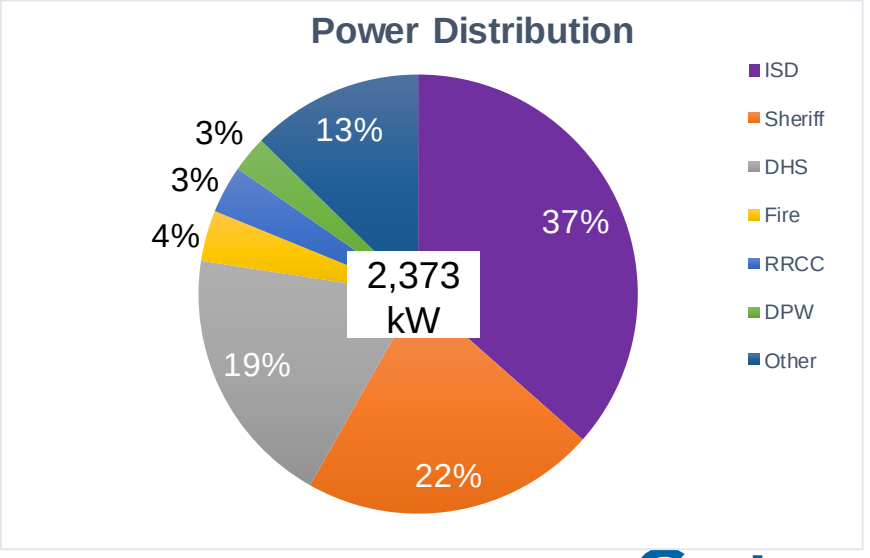
The County's data centers currently have 1,100 racks housing 6,800 Operating Systems and 14,900 TB of storage using 2.4MW of power











Numbers include LRC

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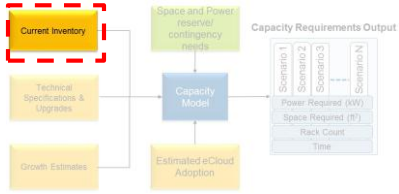
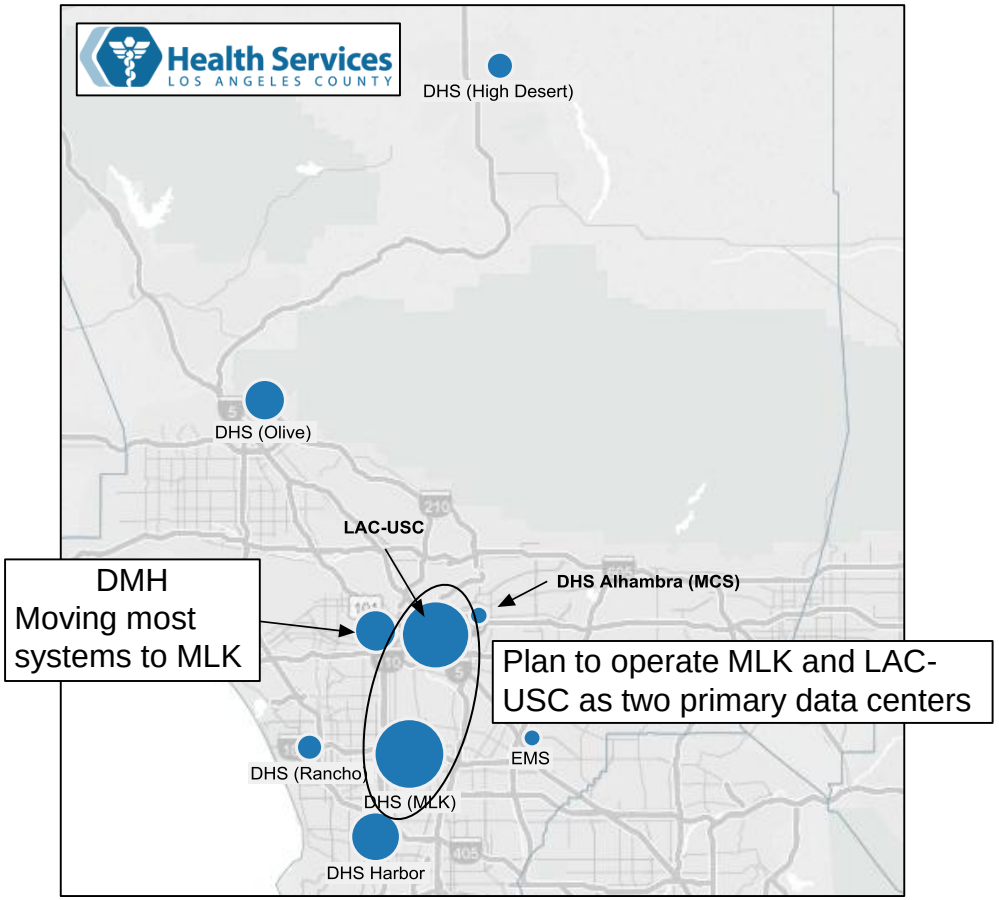
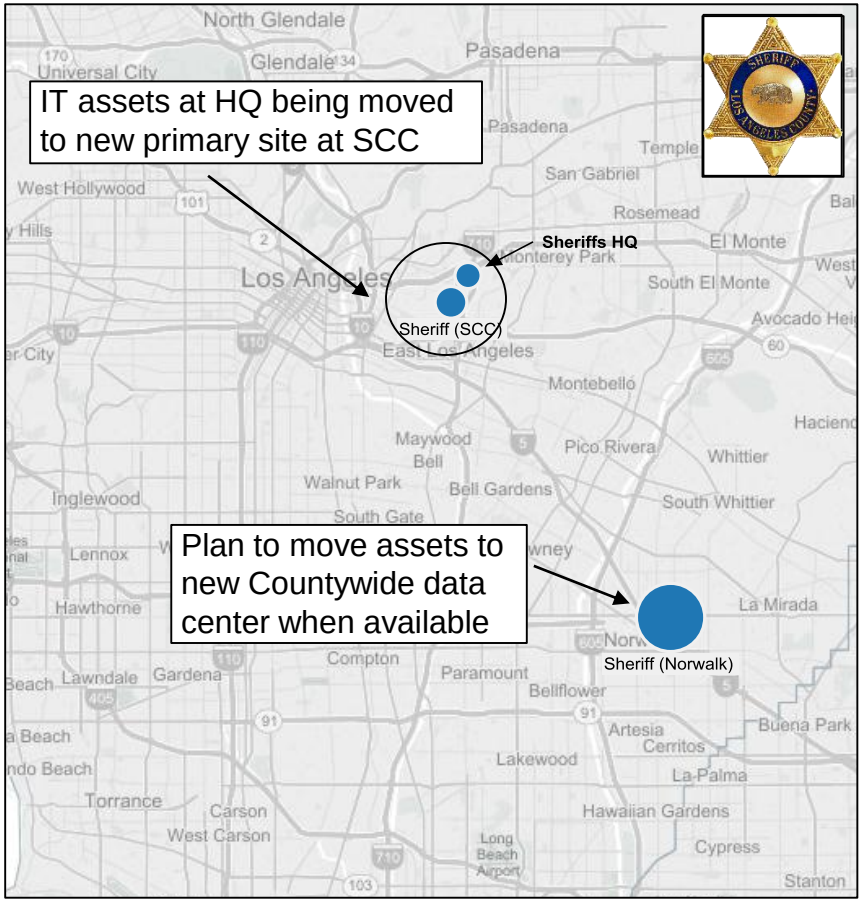
Recent investments and requirements of some departments could reduce departmental participation







Gartner does not anticipate that all departments will participate in the initial consolidation efforts. A few departments will likely maintain their current facilities due to security, proximity requirements (i.e. DHS, Sheriff SCC, Fire DMH, DPH lab), and base isolation.

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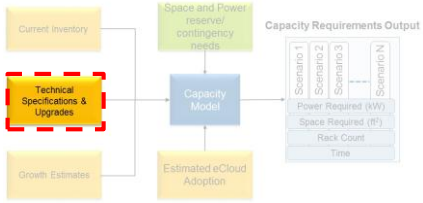
The rack specifications used in the model are based ISD's current environment



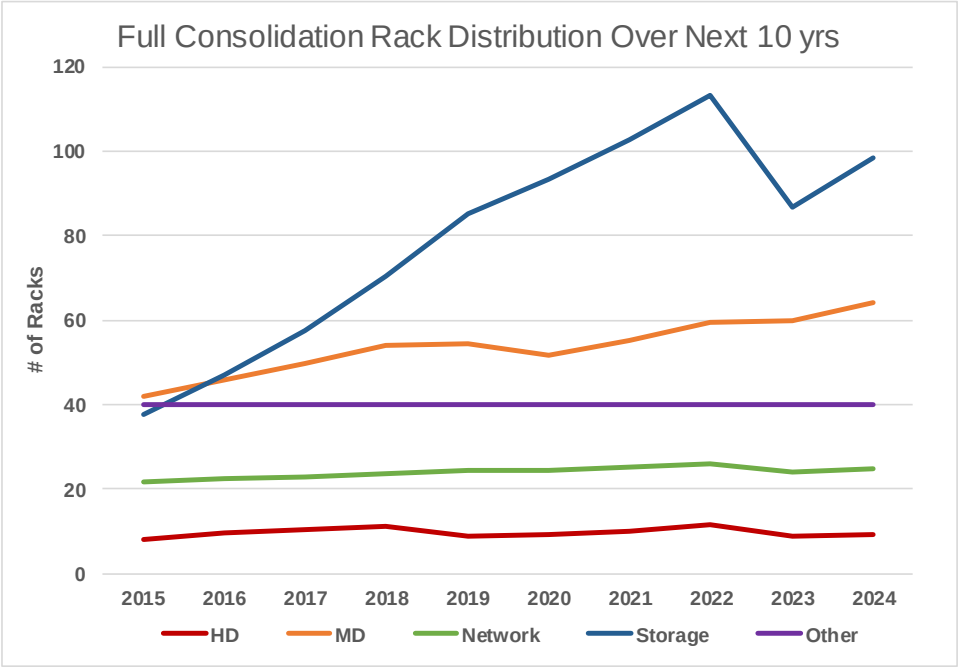
The model assumes:

- High Density (HD) racks are used for eCloud and VDI
- Medium Density (MD) racks are used for other servers (x86, UNIX and midrange)
- Network racks are used for the network core and network and SAN distribution
- Storage racks are used for storage and the SAN core
- Other racks are used for tape, mainframe, legacy, telecommunications, etc.

Rack densities are based on ISD's current rack configuration.

The rack ratios are based on ISD's current configuration. The model maintains ISD's current rack ratios except for MD racks, due to consolidation into eCloud.

- ISD currently has 5 network core racks (model assumes slightly more) and 1 network distribution rack per 20 server/storage rack (ratio is maintained)
- ISD currently has 4 SAN core racks and the model assume slightly more
- ISD currently has about 20 racks for "other" equipment, the model increase that to 27



Rack Density Assumptions

	MD	HD	Network	Storage	Other
Average Physical Servers Per Rack	24	48	N/A	N/A	N/A
kW / Cabinet	8.5	24	3	5	2

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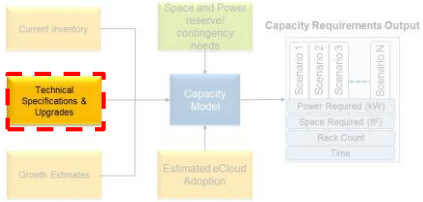
The model assumed that the new data center will incorporate technical specifications similar to ISD recent purchases



eCloud	
VM Physical Hosts	161
VM Guests	2170
V / P Ratio	13.5
Total Cores	3068
Av. Cores/Server	19
Highest Cores/Server	**24***
Cores per VM	1.41
Total Memory (GB)	31,040
Ave. Mem / Server	193
Max Mem / Server	**384***

HVD	
HVD Physical Hosts	127
HVD Desktops	5059
HVD / P Ratio	40
Total Cores	3068
Av. Cores/Server	17
Highest Cores/Server	**24***
Cores per HVD	0.44
Total Memory (GB)	34,464
Ave. Mem / Server	271
Max Mem / Server	**384***

Unix Systems	
Total P-770 Cores	712
Total P-770 Cabinets	20
Total P-770 LPARS	40
P-770 Cores/Cabinet	**36***
Total P-570 Cores	236
Total P-570 Cabinets	22
Total P-570 LPARS	39
P-570- Cores/Cabinet	11
Total HPUX Cores	76
Total HPUX Cabinets	6
Total HPUX LPARS	20
HPUX Cores/Cabinet	13

Storage Density (ISD)	
Total Raw Storage (TB)	7,286
Total Storage Cabinets	59
Avg. Raw Density / Cabinet (TB)	124
Highest Density /Cabinet (TB)	**317***
Assumption	280

Indicates assumptions

* Indicates trend in ISD technology purchases over past 2 years

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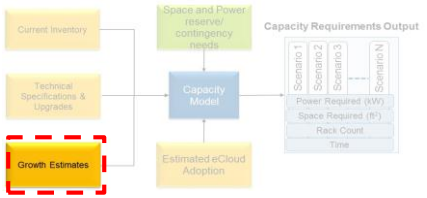
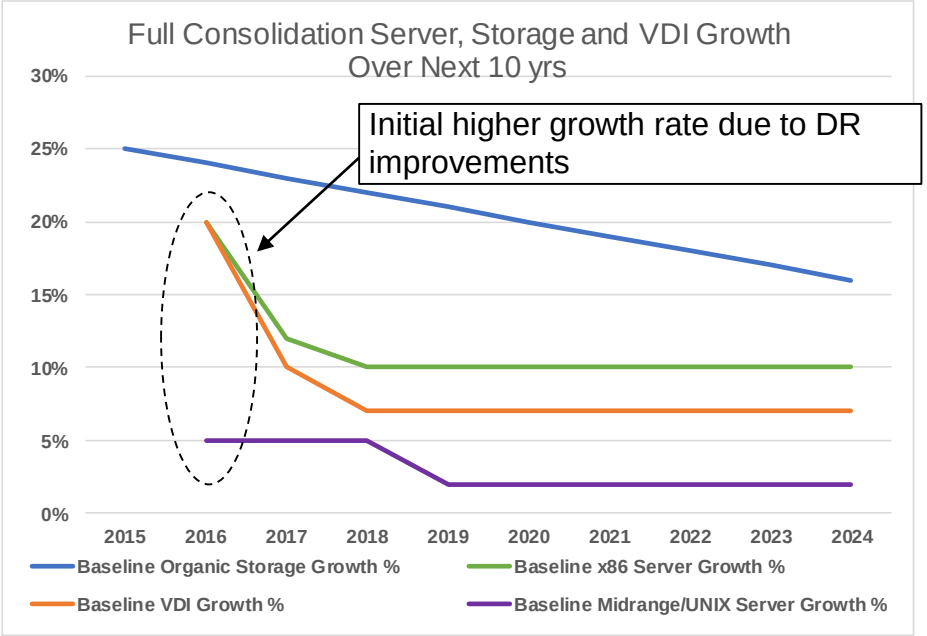
Growth estimates for storage considered historic ISD growth, server estimates were made based on Gartner's industry expertise





Server and VDI Growth Estimates:
Historic Server and VDI growth was not provided. Estimates were made based on conversations and general market trends.

Initial spike in growth accounts for the additional disaster recovery needs of departments that are consolidating. Some departments do not currently have warm or hot disaster recovery – when they consolidate they will require two servers – one for their current server and one for disaster recovery, resulting in higher initial server growth.

Storage Growth

Fiscal Year	capacity (raw) PB	Capacity usable PB	Growth %
2006-07	0.6	0.4	
2007-08	1.0	0.6	67%
2008-09	1.5	0.9	50%
2009-10	2.0	1.3	33%
2010-11	2.3	1.5	15%
2011-12	3.2	2.1	39%
2012-13	4.3	2.8	34%
2013-14	5.2	3.3	21%

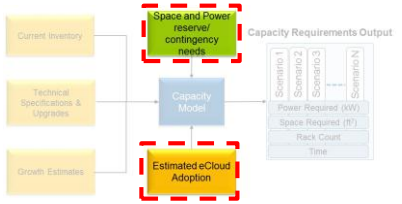
Storage Growth Estimates:
Historical ISD storage growth comes from:

- Inorganic - County-wide consolidation efforts such as e-mail and other departmental servers.
- Organic – Normal increase in data volume.

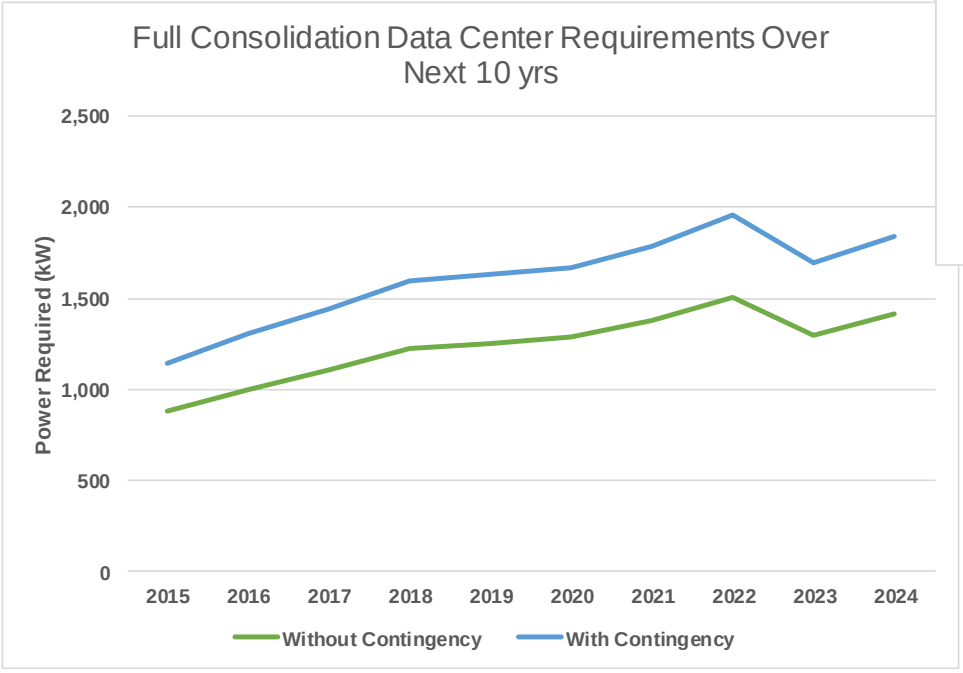
Storage Growth Assumptions Moving Forward:

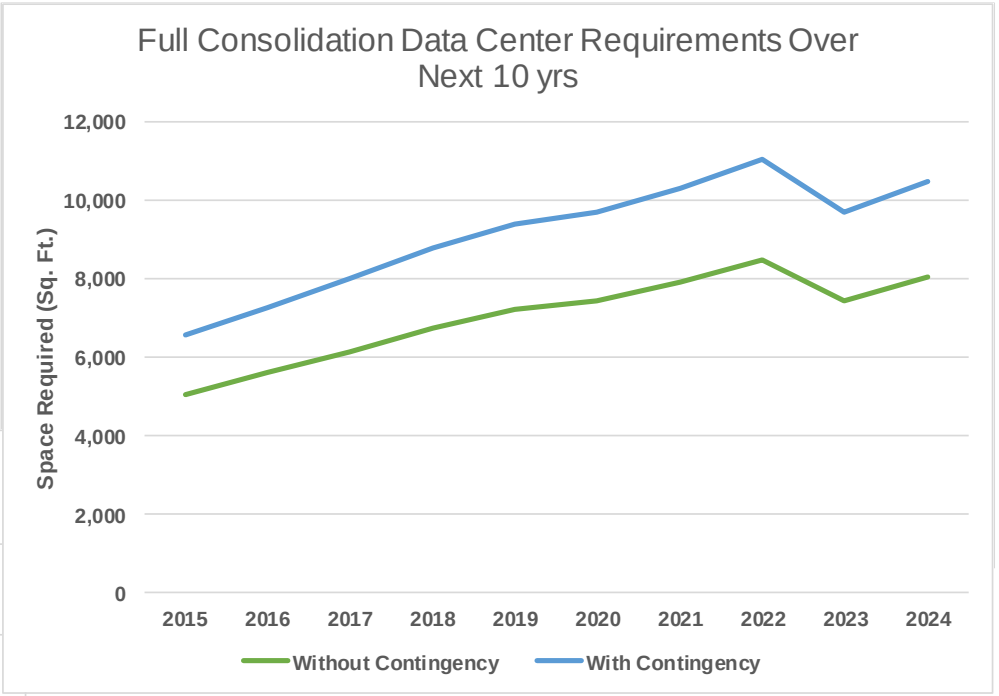
- Inorganic – Add in existing departmental storage capacity to the total raw capacity
- Organic – Normal increase in data volume as a % of total volume is added.
- E-mail and its associated storage will be moved to Microsoft cloud.

The model provides consideration for systems that do not consolidate into eCloud and contingency to allow for a margin of error



Model Contingency: Provisioned power and space are both 30% above the forecasted consumption to provide a margin of error.





eCloud Adoption (not pictured) assumption: 70%

- The sensitivity of capacity needs to eCloud adoption is considered in sensitivity analysis

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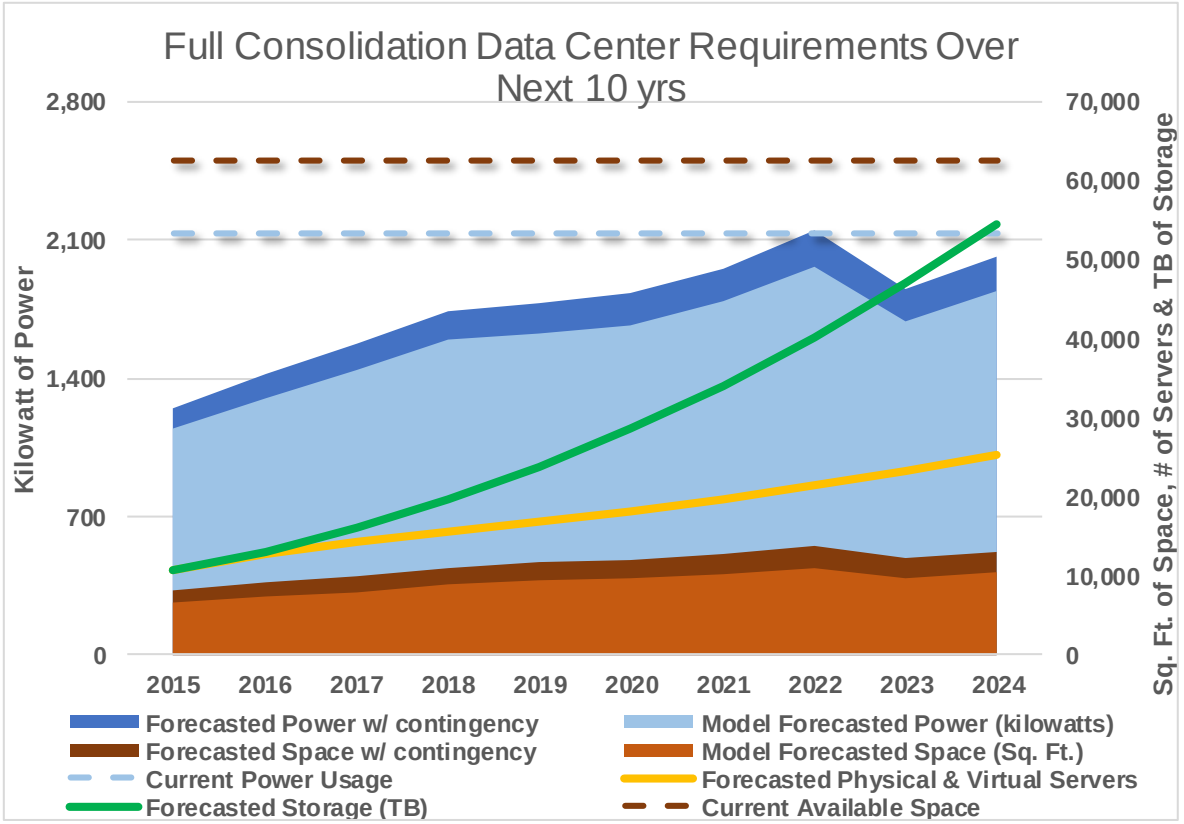
In summary, a full consolidation scenario created based on these assumptions generated the following results

Factors	Full Consolidation
Server &Storage Growth	**Server:** Y1 20%, Y2 12%, 10% after **Storage:** 25% Y1 to 16% Y10
Departmental Participation	All Departments Participate (no LRC)
Percent eCloud Adoption	70% adoption
Technology Refresh	**Storage Density:** 280 TB per cabinet **eCloud:** 24 cores per rack



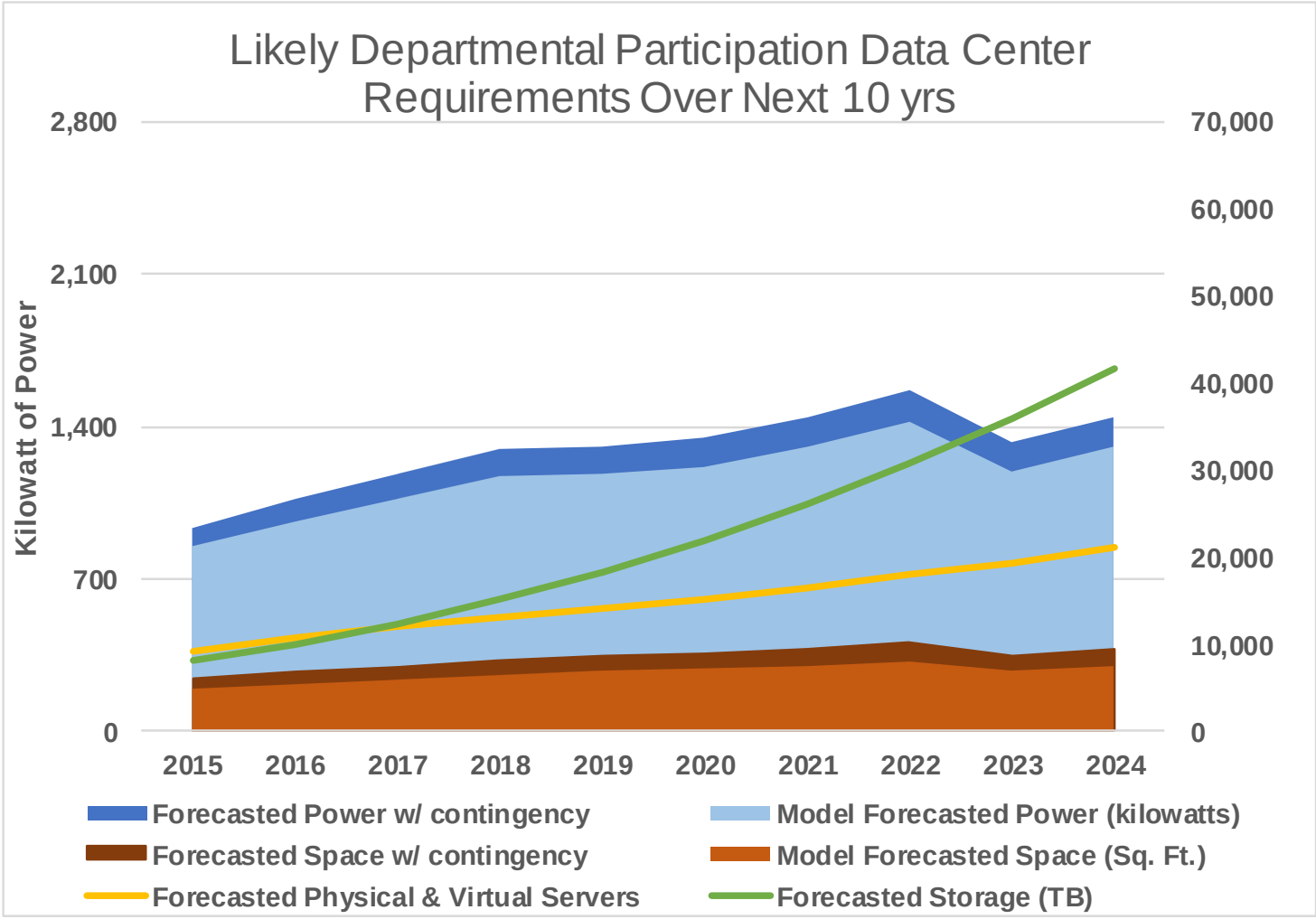
To ensure the validity of the capacity model, Gartner performed a set of sensitivity analyses to see how changing key assumptions would affect the capacity over time

Factors	7 Reduce	Full Consolidation	8 Increase
Server &Storage Growth	2 **Server:** 5% **Storage:** 15%	**Server:** Y1 20%, Y2 12%, 10% after **Storage:** 25% Y1 to 16% Y10	3 **Server:** 20% **Storage:** 30%
Departmental Participation	1 LRC, DHS, Sheriff (SCC), Fire, DMH and DPH (lab) do not participate	All Departments Participate (no LRC)	All Departments Participate (no LRC)
Percent eCloud Adoption	70% adoption	70% adoption	4 20% adoption
Technology Refresh	6 **Storage Density:** 350 TB per cabinet **eCloud:** 32 cores per server	**Storage Density:** 280 TB per cabinet **eCloud:** 24 cores per server	5 **Storage Density:** 124 TB per cabinet **eCloud:** 19 cores per server

Sensitivity Scenarios:

1. Scenario 1: Likely Departmental Participation
2. Scenario 2: Low Server and Storage Growth
3. Scenario 3: High Server and Storage Growth
4. Scenario 4: Low eCloud Adoption
5. Scenario 5: No Technology Refresh
6. Scenario 6: Better Technology Refresh
7. Scenario 7: Lowest Possible demand (combination of 5 & 6)
8. Scenario 8: Highest Possible demand (combination of 1-4)

The full model output for the likely departmental participation scenario is provided as an example sensitivity scenario



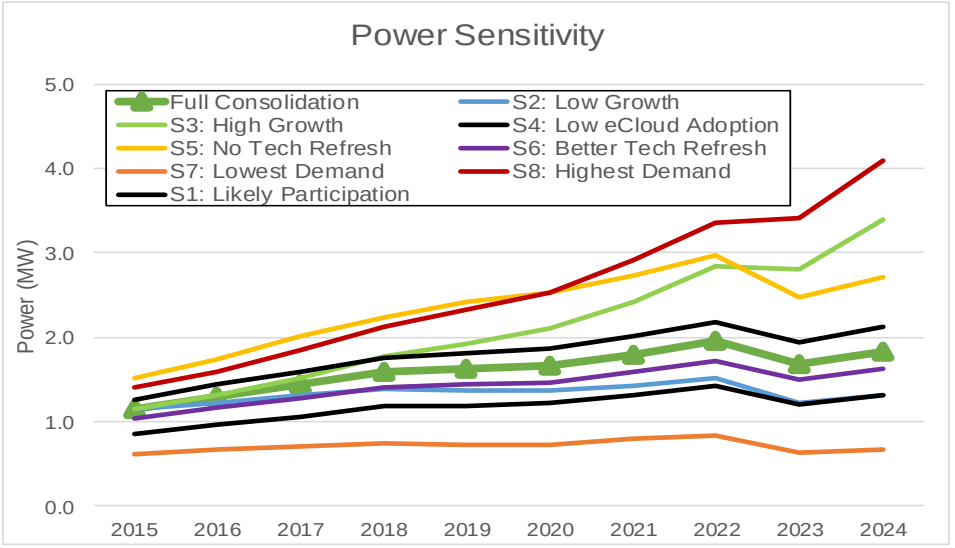
The sensitivity analysis indicates that County's forecasted power capacity is most sensitive to growth forecasts, departmental participation and technology refresh

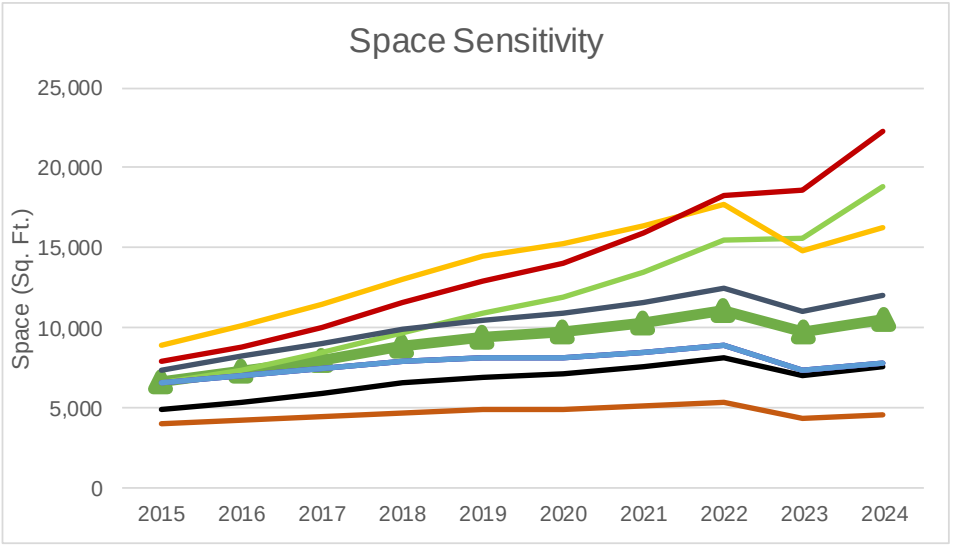
The model is especially sensitive to server and storage growth, departmental participation and technology refresh.

Although there are some sensitivities that can result in significantly higher capacity requirements these situations are unlikely:

- Technology refreshes will likely occur as part of moving to a new data center.
- Storage and server growth rates are conservative estimates.

Gartner does not anticipate that all departments will participate in the initial consolidation efforts. A few departments will likely maintain their current facilities due to security, proximity requirements (i.e. DHS, Sheriff SCC, Fire DMH, DPH lab), and base isolation. This is represented by the lower participation line and is the expected capacity need.





See Appendix C for additional detail

Appendix

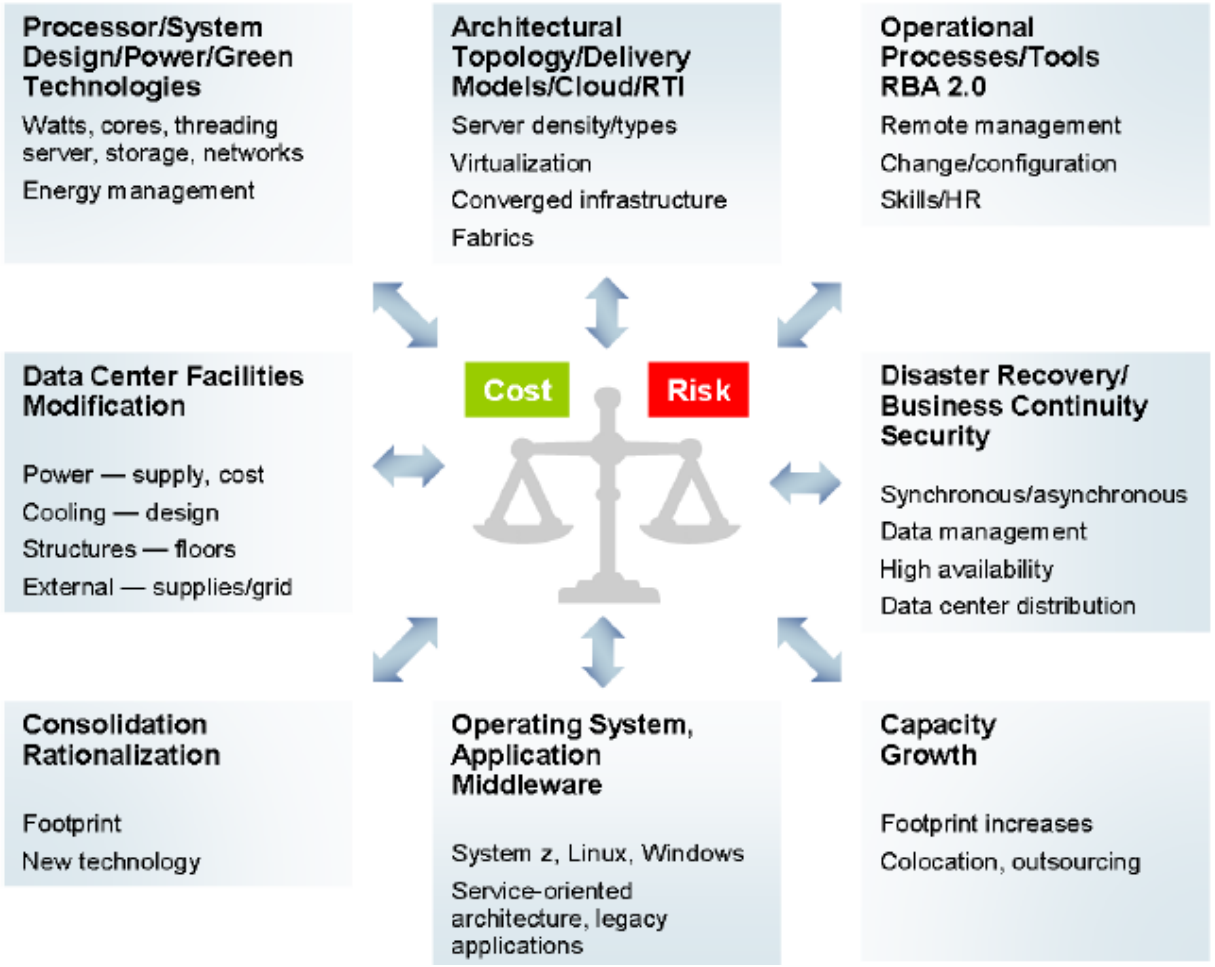
Appendix A: Key Trends
Appendix B: Current ISD Inventory
Appendix C: Sensitivity Analysis

Appendix A: Key Trends

Key trends taken into considering in developing the future state vision

1. Cost and Risk pressure are forcing most organizations to fewer, higher quality data centers.
2. The same cost and risk pressure are forcing organizations to rethink long held data center strategies around ownership, geographic distribution, co-location with people/corporate campuses, redundancy levels and use of cloud technologies as an alternative to data centers.
3. While the Public Sector lagged behind the Private Sector in adopting data center consolidation strategies, many government agencies have now implemented consolidating policies.
4. Virtualization technologies and the continued forward march of “Moore’s Law” will make future data centers “hotter and smaller”. You might never outgrow your next data center.
5. As business processes become completely dependent on the IT systems, more robust disaster recovery solutions will be required for most applications.
6. Most public sector data center organizations have implemented private clouds, but will need to turn these into hybrid cloud solutions to remain competitive

1. Cost and Risk pressure are forcing most organizations to fewer, higher quality data centers



These forces shape the approach to planning future data centers. Key elements include:

Treatment of major cost drivers

- Facilities: floor space, power, cooling
- Assets: servers, storage, data center network
- Labor: Full time staff, contractors

Type of Facility (e.g., Availability Tier)

Number of data centers and their geographic location

Cost (OpEx, CapEx)

Service Delivery Requirements: Latency, Growth, Flexibility, Control, Security, Legal, Business Continuity, Environmental

Risk in implementing new models

2. The same cost and risk pressure are forcing organizations to rethink long held data center strategies around ownership, location, use of cloud and other issues

Leading Practice	Description
1. Consolidate and Establish Multi-site Strategy to Manage Risk and Provide Differentiated Class of Service	•Regional organizations require a minimum of two locations to manage risk. National and global organizations may leverage paired regional or continental data center hubs. •Distinction between Primary and Backup data centers are diminishing as active/active and continuous availability requirements increase.
2. Prioritize Mission Critical Applications	•Define discrete criticality levels for applications and align them to DC service classes. For example, mission-critical applications that do not operate in active/active mode from multiple DCs will need to be hosted in Tier III or higher data centers
3. Support Realistic RTOs and RPOs	•Select data center architectures that support RTOs and RPOs that are in minutes vs. hours to support digitalization of IT and avoid disruptions to critical services
4. Avoid the same disaster strike zone	•Location of data centers must avoid the same disaster strike zone. Additional considerations must include power cost, personnel availability, network cost, real estate cost, and climate (which impacts energy efficiency)
5. Leverage Cloud Services Where Appropriate	•When appropriate, use cloud services to leverage assets and improve agility, scalability, elasticity, and self-provisioning. SaaS can enhance maturity of service capability. Hybrid Clouds can extend capacity when needed.
6. Avoid DC Ownership to Improve Flexibility and Reduce Investment Risk	•Leased DC space using experienced service providers enables rapid deployment and replication of the DC environment at a much lower investment risk and initial capital than ownership. Furthermore, existing and proven operational best practices can be leveraged.
7. Utilize DC-only Edifices	•Data centers should be located in dedicated data center facilities in order to improve security, reduce environmental risks, and minimize impact of corporate real-estate strategies on IT operations

3. While the Public Sector lagged behind the Private Sector in adopting data center consolidation strategies, many government agencies have now implemented consolidating policies

Due to its size (~10M people) and governmental structure (federated) LA County is not comparable to most other municipalities.

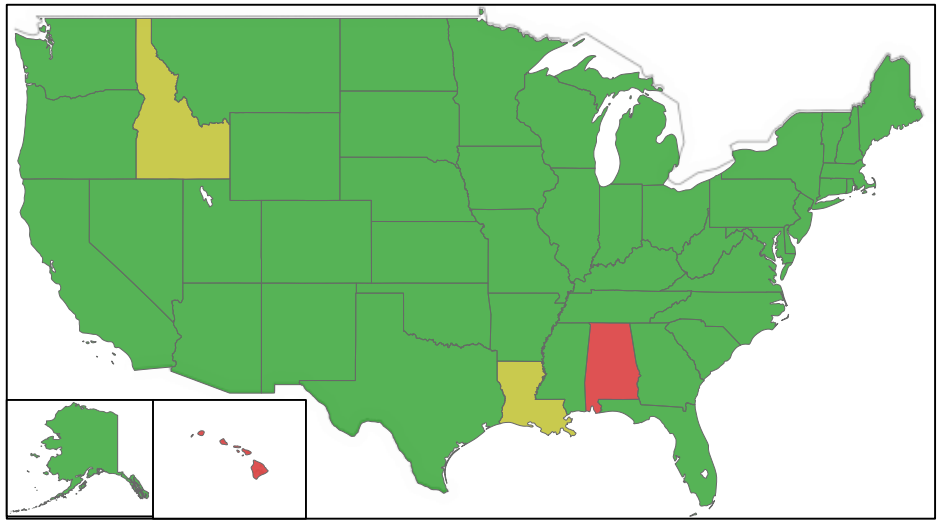
- The closest are New York City and San Francisco City/County, which are both undergoing similar consolidation efforts

To find peer government entities, Gartner looked at State government strategies across the Country

- Even in considering states, LA County is more populated than 40, including the non-consolidated ones.
- Most states have a 2-3 data center strategy with at least one Tier III facility and some departments that have not participated.
- Due to the diversity of critical applications with varying degrees of resiliency and recoverability at the application level most primary data centers are Tier III facilities.

A number of drivers are leading to consolidation:

- Budget reductions
- Aging distributed data centers needing costly upgrades (or sometime cannot be possibly upgraded) to meet new security, availability and capacity requirements.
- Difficulty of securing data in distributed data centers against natural disasters and cyber or physical (e.g. FAA, Chicago) attacks.

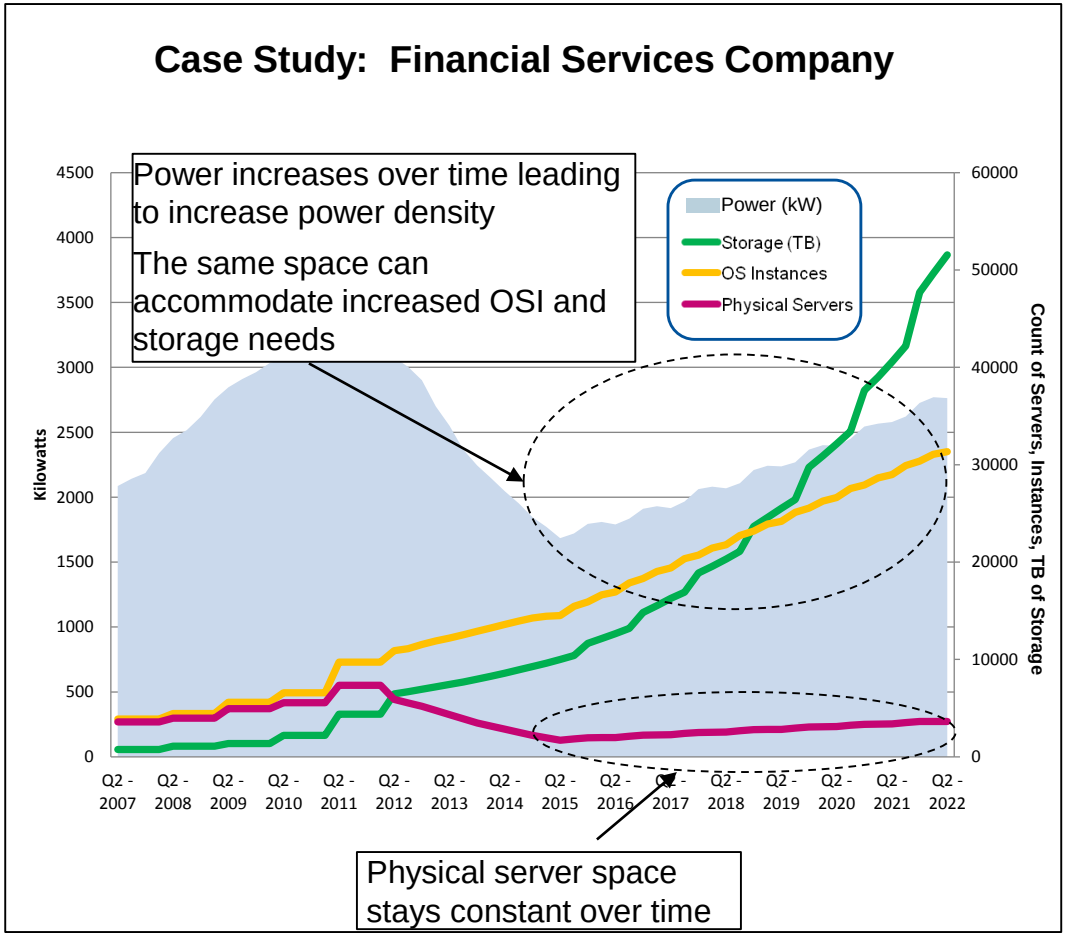


**Based on information found on State websites

Gartner

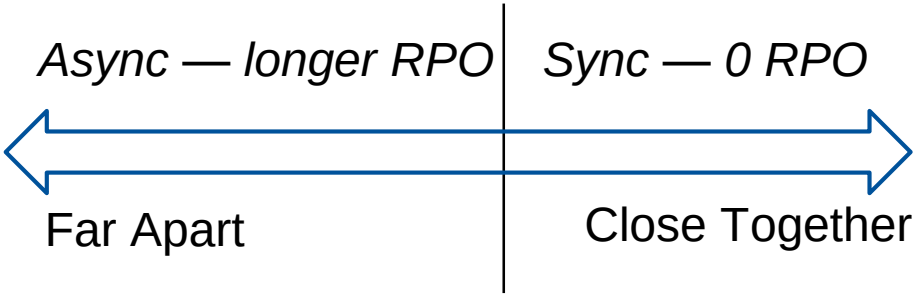
4. Virtualization technologies and the continued forward march of “Moore’s Law” will make future data centers “hotter and smaller”. You might never outgrow your next data center

- Smaller and Hotter*:
  - Over the next 10 years, data centers will get smaller (in terms of square feet) and hotter (in terms of power per square feet).
- The Infinite Data Center*:
  - Most organizations will see internal data center capacity needs stay constant or (more likely) decline over the next decade.
- Virtualized Windows And Linux:
  - While legacy workloads (Unix, Mainframe, etc.) will persist they will become an increasingly smaller footprint in the data center.



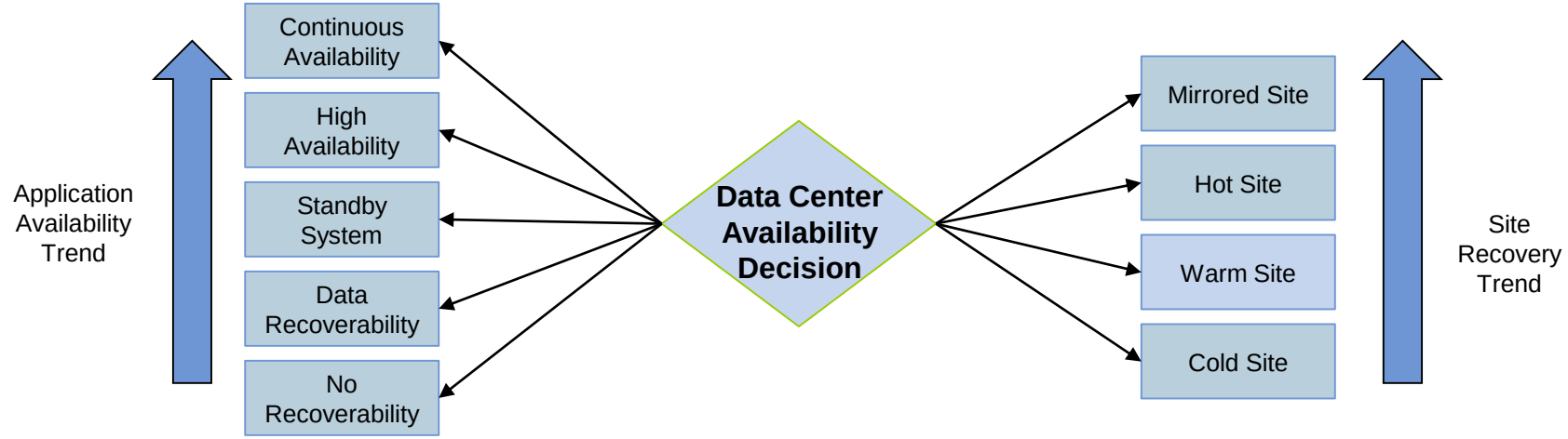
*The full Gartner articles detailing these trends are included in the Appendix C & D

5. As business processes become completely dependent on the IT systems, more robust disaster recovery solutions will be required for most applications



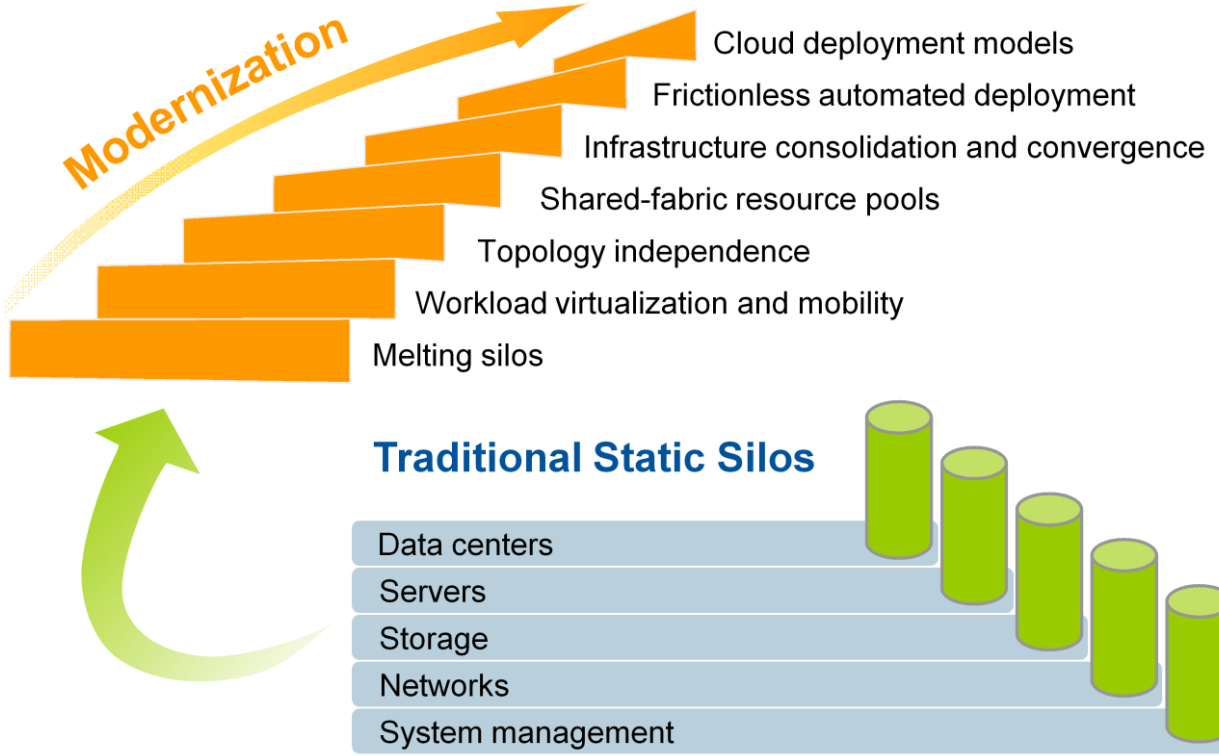
Number of Data Centers?
Balance Cost and Risk

Distance Between Data Centers?
Balance Cost, Risk, Regulations and RPO



6. Most public sector data center organizations have implemented private clouds, but will need to turn these into hybrid cloud solutions to remain competitive

Data Center Modernization and Consolidation involves customizing data center strategies according to business plans, regulatory requirements, skills availability and rapidly changing technologies.



Drivers

- Leveraging cloud and other current market offerings
- Cost containment and efficiency
- Agility and scale
- Integration of new and legacy technologies
- Keeping pace with business needs, regulatory requirements, energy costs and rapidly evolving technologies

While legacy workloads (Unix, Mainframe, etc.) will persist they will become an increasingly smaller foot print in the data center.

Appendix B: Current ISD Technical Specifications

Technical Specifications:
Current ISD Statistics (X86 Environment)

eCloud	
VM Physical Hosts	161
VM Guests	2170
V / P Ratio	13.5
Total Cores	3068
Av. Cores/Server	19
Highest Cores/Server	**24***
Cores per VM	1.41
Total Memory (GB)	31,040
Ave. Mem / Server	193
Max Mem / Server	**384***

HVD	
HVD Physical Hosts	127
HVD Desktops	5059
HVD / P Ratio	40
Total Cores	3068
Av. Cores/Server	17
Highest Cores/Server	**24***
Cores per HVD	0.44
Total Memory (GB)	34,464
Ave. Mem / Server	271
Max Mem / Server	**384***

ISD has standardized on Cisco UCS blades for these environments as follows:

- 6 blade chassis per cabinet for a total of 48 servers per cabinet
- **Power density approaching 24 KW/cabinet**
- **Latest configuration includes 24 core blades with 384 GB of memory. We have assumed 16 V / P ratio with this configuration vs. current average of 13.5.**

*** Indicates trend in ISD technology purchases over past 2 years**

Gartner

Technical Specifications:
Current ISD Statistics (Unix Environment)

Unix Systems	
Total P-770 Cores	712
Total P-770 Cabinets	20
Total P-770 LPARS	40
P-770 Cores/Cabinet	**36***
Total P-570 Cores	236
Total P-570 Cabinets	22
Total P-570 LPARS	39
P-570- Cores/Cabinet	11
Total HPUX Cores	76
Total HPUX Cabinets	6
Total HPUX LPARS	20
HPUX Cores/Cabinet	13

In 2015, ISD will implement an AIX cloud service called Power Cloud.

Plans call for:

- Implementation of Power Cloud on eight (8) P770 frames in each data center
- Consolidation and elimination of most existing P570 and HPUX platforms when possible.
- Termination of lease of older P-770 frames
- Likely transition of P-770 to P8 processor family from the current P7 before of during consolidation
- **Model assumed 8 LPARS per P770 cabinet in the consolidated environment for first 5 years**

*** Indicates trend in ISD technology purchases over past 2 years**

Gartner

Technical Specifications:
Current ISD Statistics (Storage Density)

Storage Density	
Total Raw Storage (TB)	7,286
Total Usable Storage (TB)	5,829
Total Storage Cabinets	59
Ave Raw Density / Cabinet (TB)	124
Highest Density /Cabinet (TB)	**317***

In 2015 ISD will be consolidating all the existing storage platforms into a virtualized storage environment as follows:

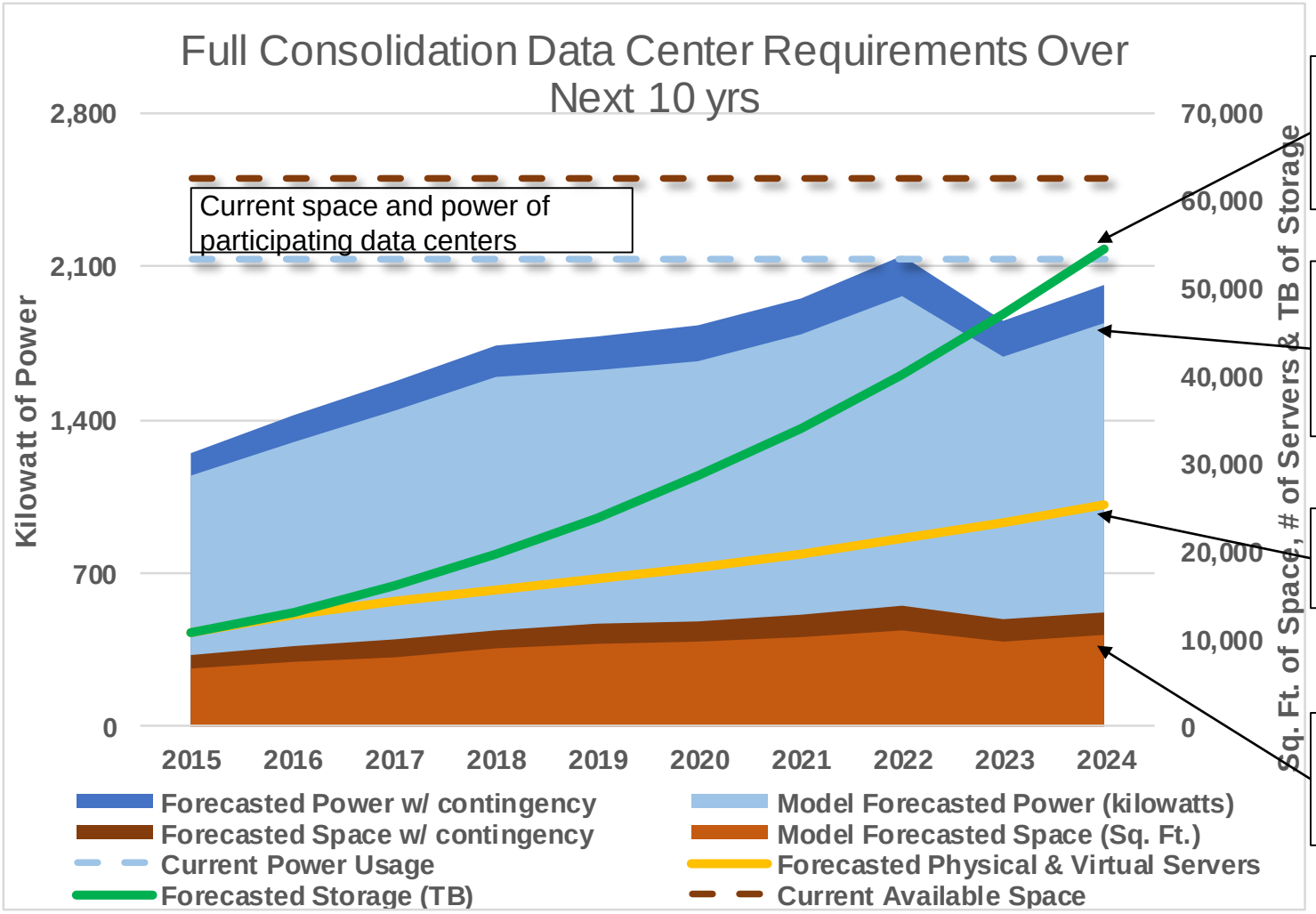
- Leveraging three (3) VMAX 40K frames at each data center.
- Each VMAX 40K frame could support up to 4 petabyte (PB) of storage or up to eleven (11) cabinets depending on the disk configuration.
- **Based on current trends Gartner has assumed a starting raw storage density of 280 TB per cabinet, increasing to 420 TB per cabinet in 2021.**

*** Indicates trend in ISD technology purchases over past 2 years**

Gartner

Appendix C: Sensitivity Analysis Details

The model's full consolidation scenario indicates that the County should plan to accommodate 2.1MW of power and 14,000 ft^2 of space



Storage volume will increase at a close to exponential rate, increasing from 10.6PB to 54.3PB

Power usage will grow faster over time than space leading to a hotter configuration (more power usage per ft^2 over the next 10 years

OS Instances & VDI will steadily grow over time from 10,700 to 25,300

Space usage will not grow nearly as substantially as other metrics, only increasing 4,000 ft^2 over 10 years

Note: Current Space and Power numbers exclude LRC

See Capacity Model Details and Assumptions for additional detail

Gartner

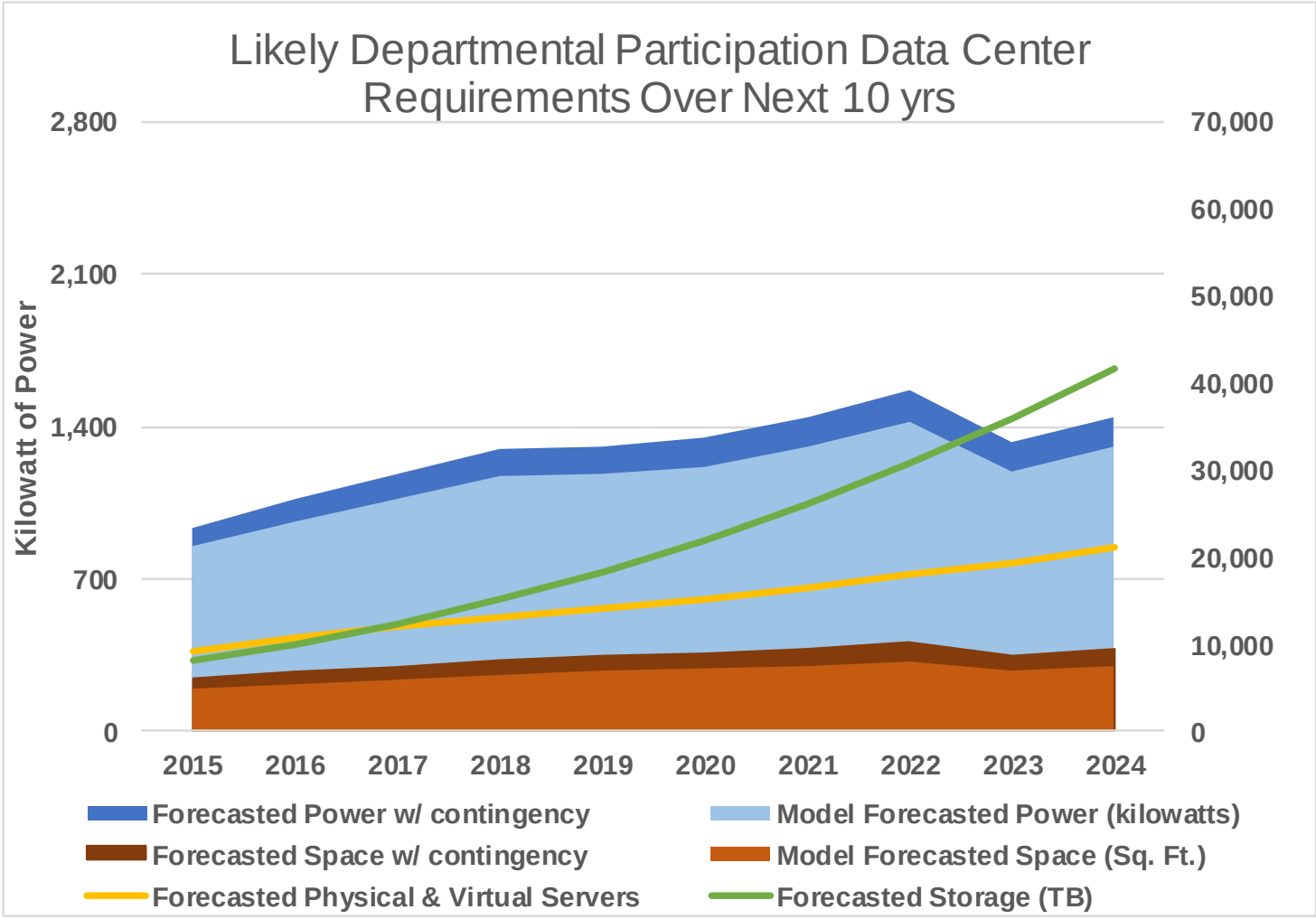
To ensure the validity of the capacity model, Gartner performed a set of sensitivity analyses to see how changing key assumptions would affect the capacity over time

Factors	7 Reduce	Full Consolidation	8 Increase
Server &Storage Growth	2 **Server:** 5% **Storage:** 15%	**Server:** Y1 20%, Y2 12%, 10% after **Storage:** 25% Y1 to 16% Y10	3 **Server:** 20% **Storage:** 30%
Departmental Participation	1 LRC, DHS, Sheriff (SCC), Fire, DMH and DPH (lab) do not participate	All Departments Participate (no LRC)	All Departments Participate (no LRC)
Percent eCloud Adoption	70% adoption	70% adoption	4 20% adoption
Technology Refresh	6 **Storage Density:** 350 TB per cabinet **eCloud:** 32 cores per server	**Storage Density:** 280 TB per cabinet **eCloud:** 24 cores per server	5 **Storage Density:** 124 TB per cabinet **eCloud:** 19 cores per server

Sensitivity Scenarios:

1. Scenario 1: Likely Departmental Participation
2. Scenario 2: Low Server and Storage Growth
3. Scenario 3: High Server and Storage Growth
4. Scenario 4: Low eCloud Adoption
5. Scenario 5: No Technology Refresh
6. Scenario 6: Better Technology Refresh
7. Scenario 7: Lowest Possible demand (combination of 5 & 6)
8. Scenario 8: Highest Possible demand (combination of 1-4)

The full model output for the likely departmental participation scenario is provided as an example sensitivity scenario



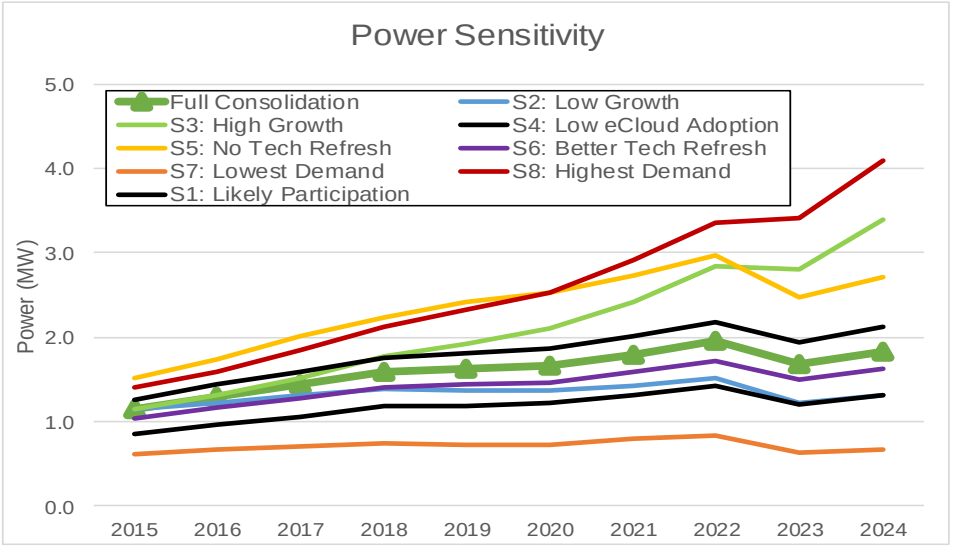
The sensitivity analysis indicates that County's forecasted power capacity is most sensitive to growth forecasts, departmental participation and technology refresh

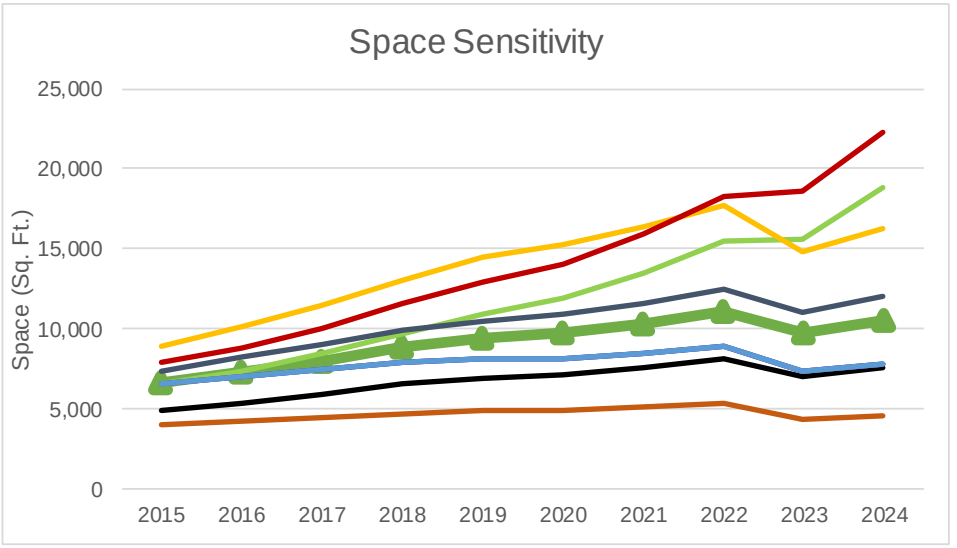
The model is especially sensitive to server and storage growth, departmental participation and technology refresh.

Although there are some sensitivities that can result in significantly higher capacity requirements these situations are unlikely:

- Technology refreshes will likely occur as part of moving to a new data center.
- Storage and server growth rates are conservative estimates.

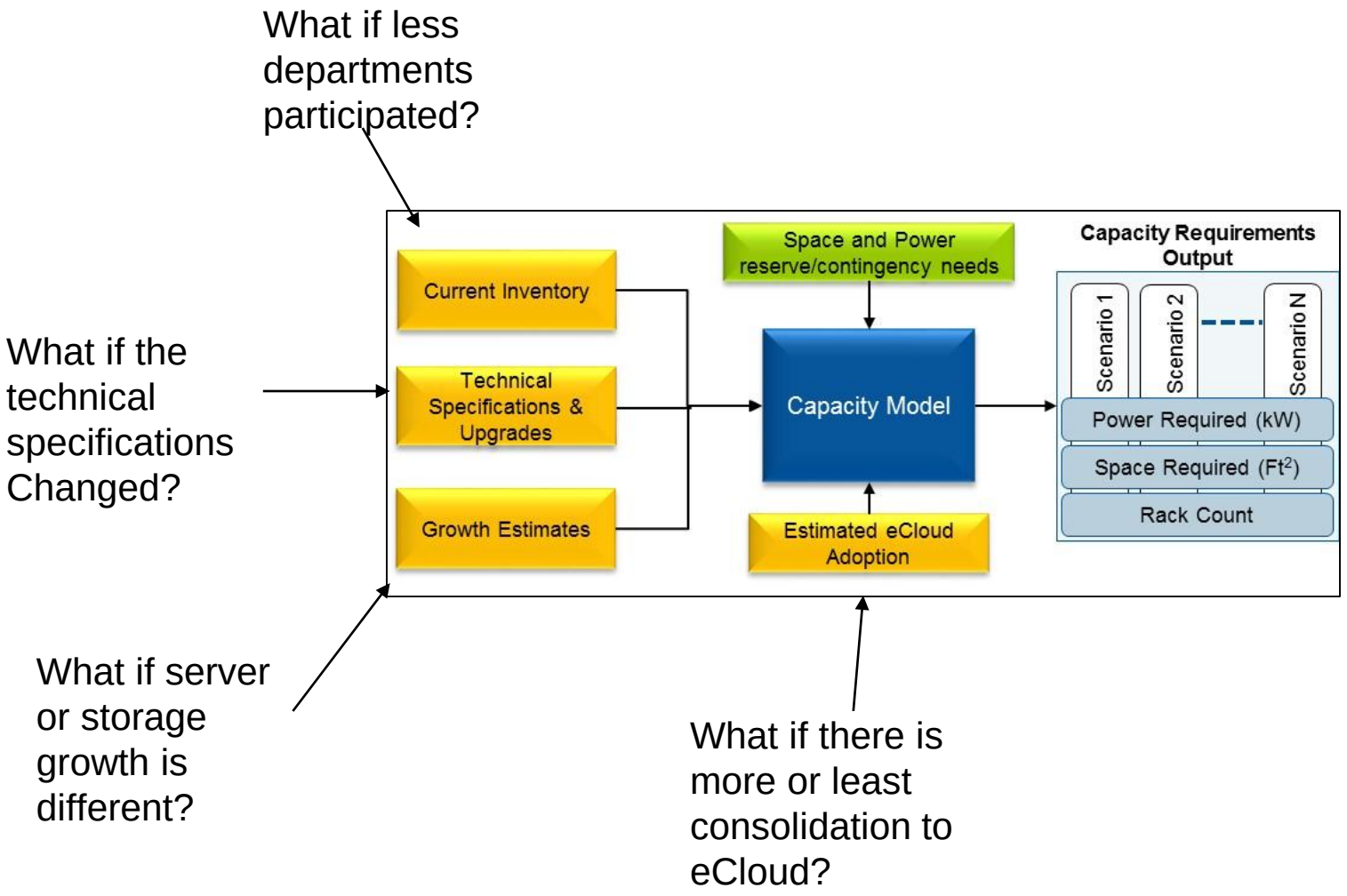
Gartner does not anticipate that all departments will participate in the consolidation efforts. A few departments will likely maintain their current facilities due to security or proximity requirements (i.e. DHS, Sheriff [SCC], Fire, DMH, DPH lab). This is represented by the lower participation line and is the expected capacity need.



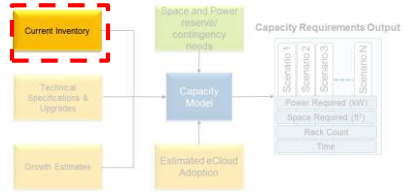


See Appendix C for additional detail

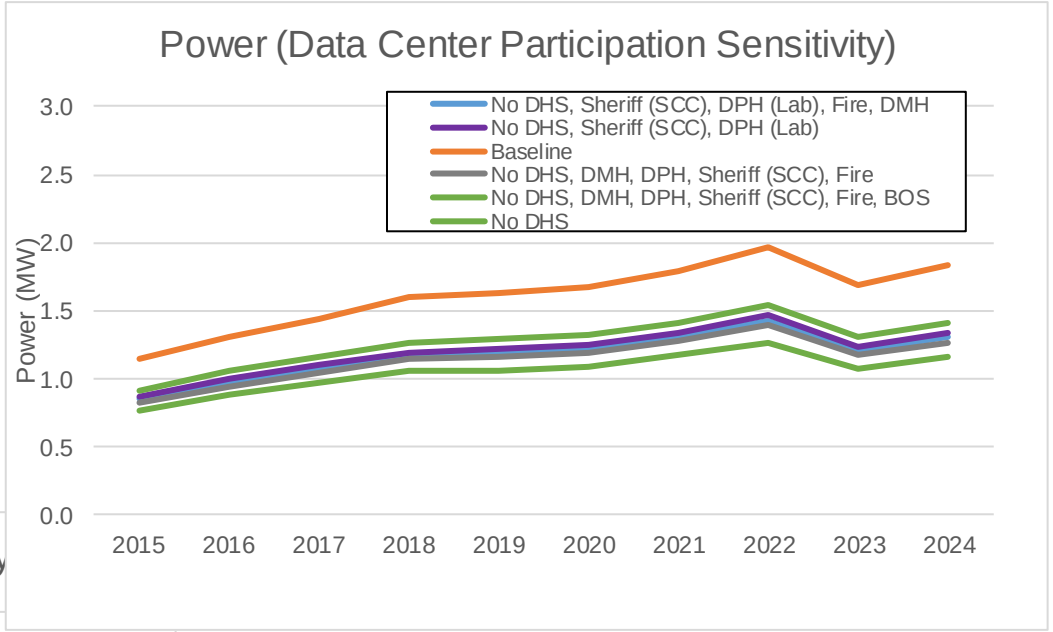
Further Sensitivity Analysis was conducted on each Model Assumption

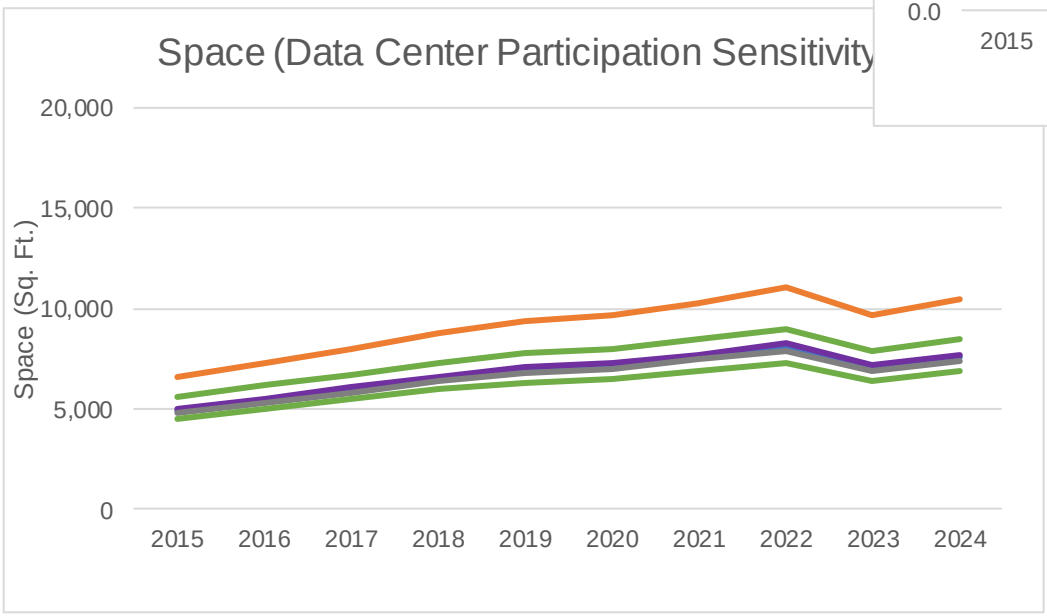


DHS's participation in the consolidation efforts has the most significant effect on the capacity needs



- DHS's participation in the consolidation efforts adds 0.7MW and 3,000 ft^2 of space to the capacity requirement
- DHS has a departmental strategy and has made significant investments in its data centers recently and is not likely to full participate in the consolidation





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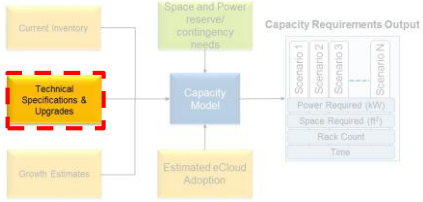
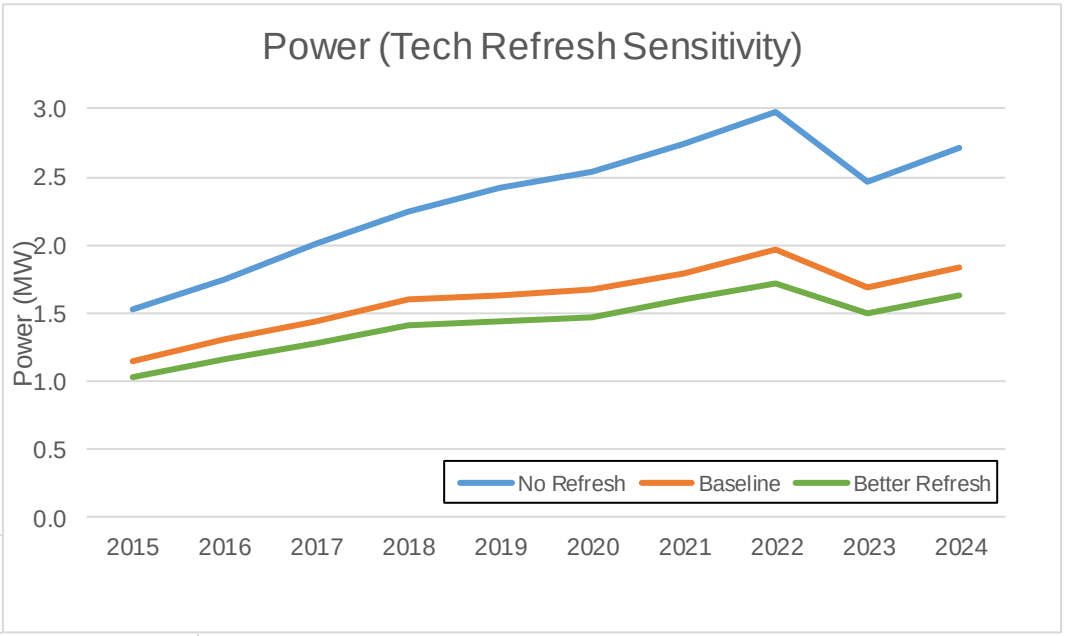
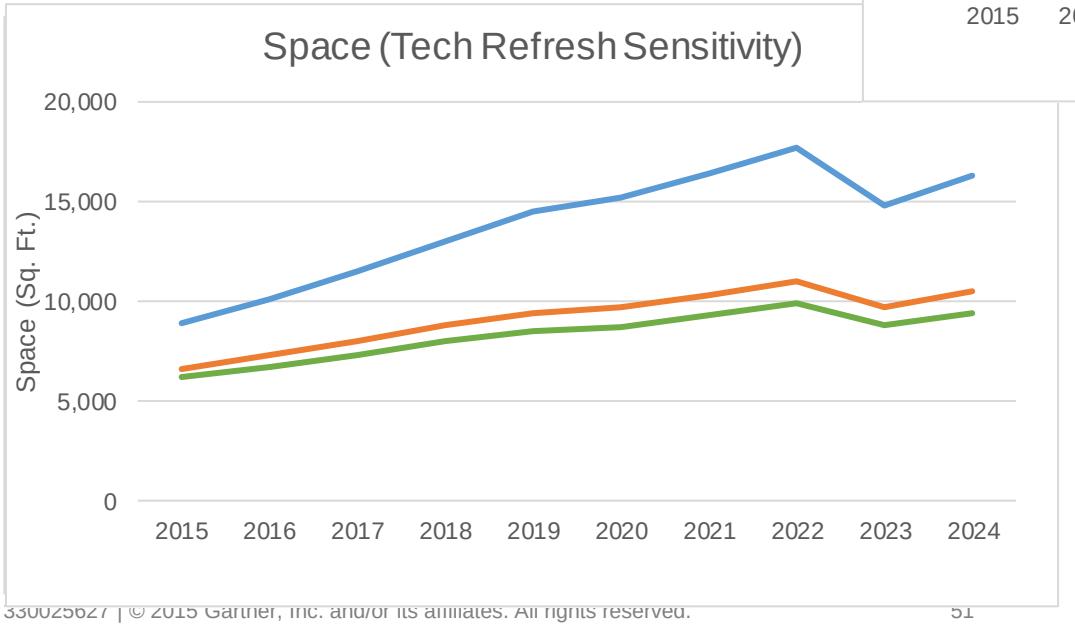
If the new data center maintains the technology that ISD current uses, the capacity needs will increase



If there is no refresh of technology as the County moves into a new facility and it maintains the same equipment as ISD currently has, the new facility will eventually need to support 2.7MW of power and 16,000 ft^2 of space.

- Although some equipment may be moved as is, the new data center will likely have mostly newer equipment





Note: The assumption are based on current ISD purchasing trends

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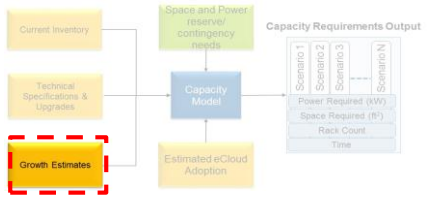
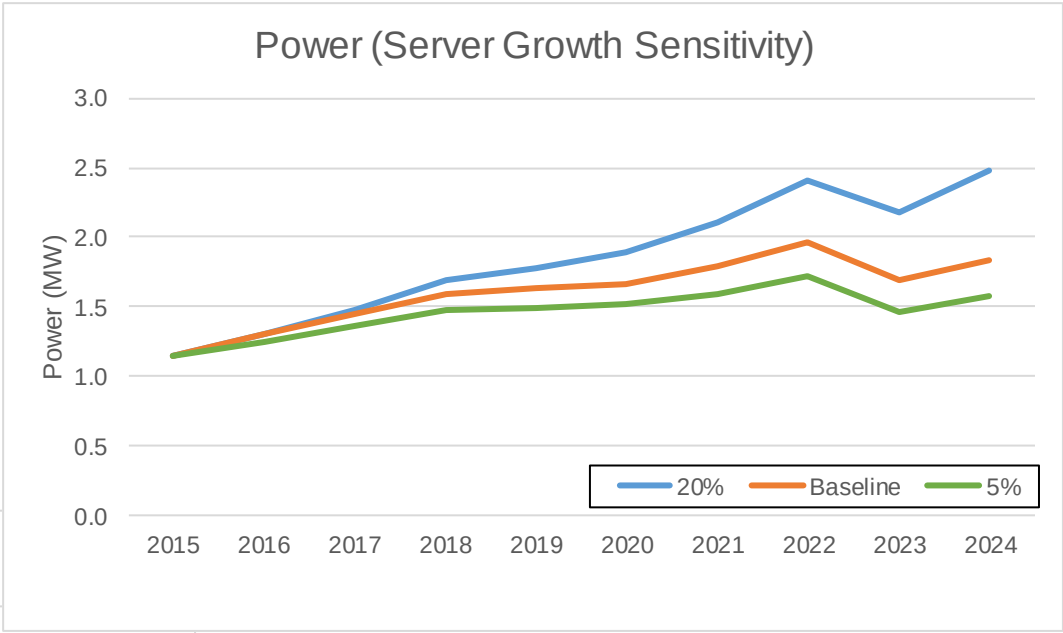
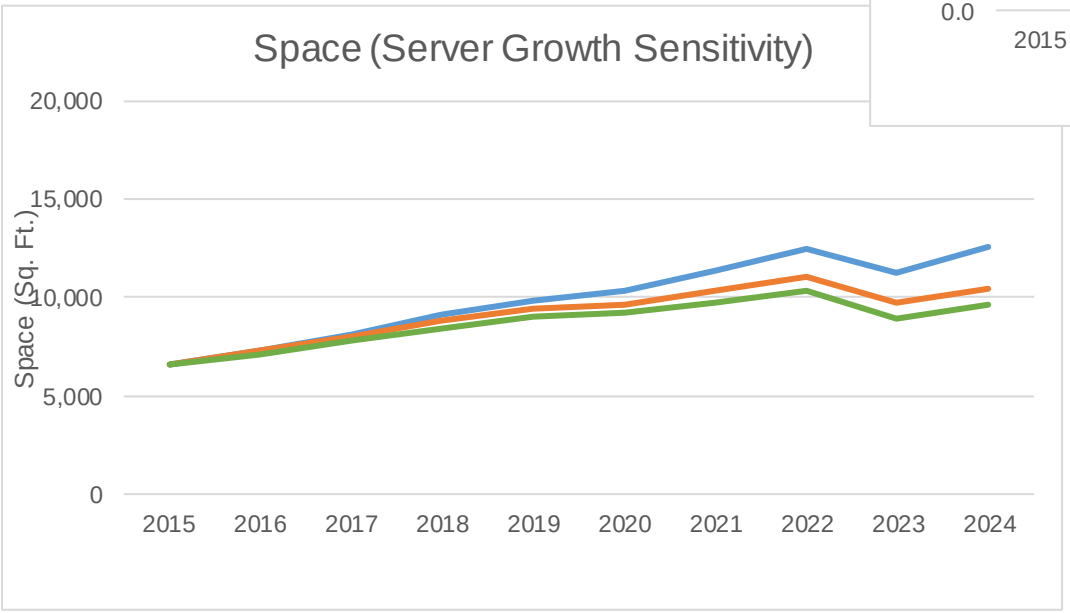
The model is sensitive to the server growth rate, especially in terms of power requirements



If the server growth rate is double the assumption (from 10% to 20%) power needs will increase 0.7MW, but space needs will only increase 2,100 ft^2.

- A 10% server growth rate is fairly conservative and it is unlikely to be 20% over the entire 10 years

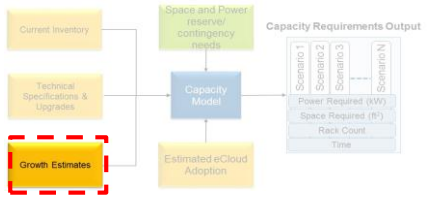




Even if server growth was 20%, the 15,000 ft^2 of recommended space would cover the increased space requirements and additional UPS could be added to provide the needed power

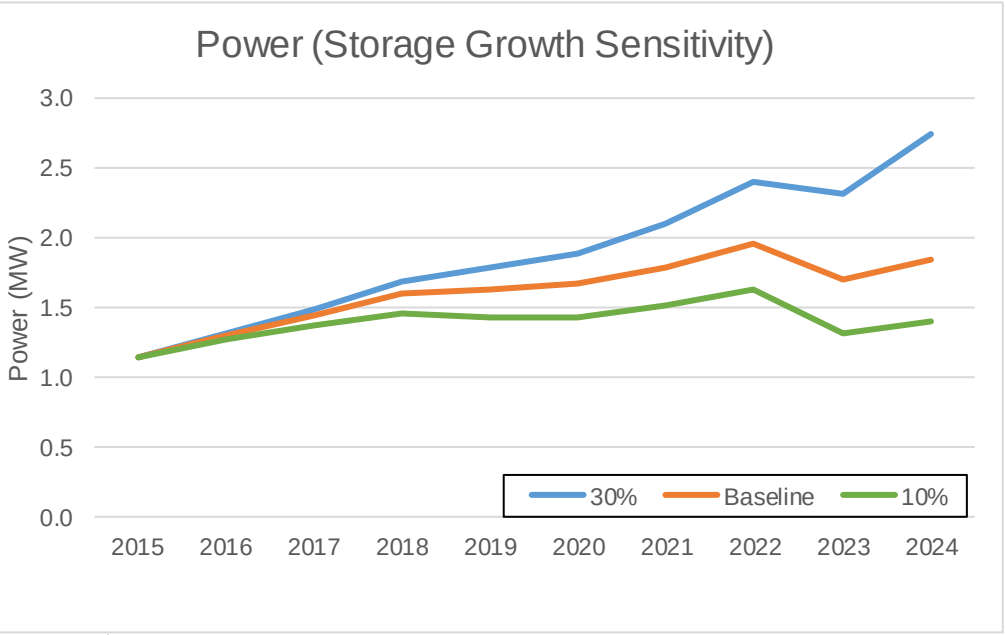
Gartner

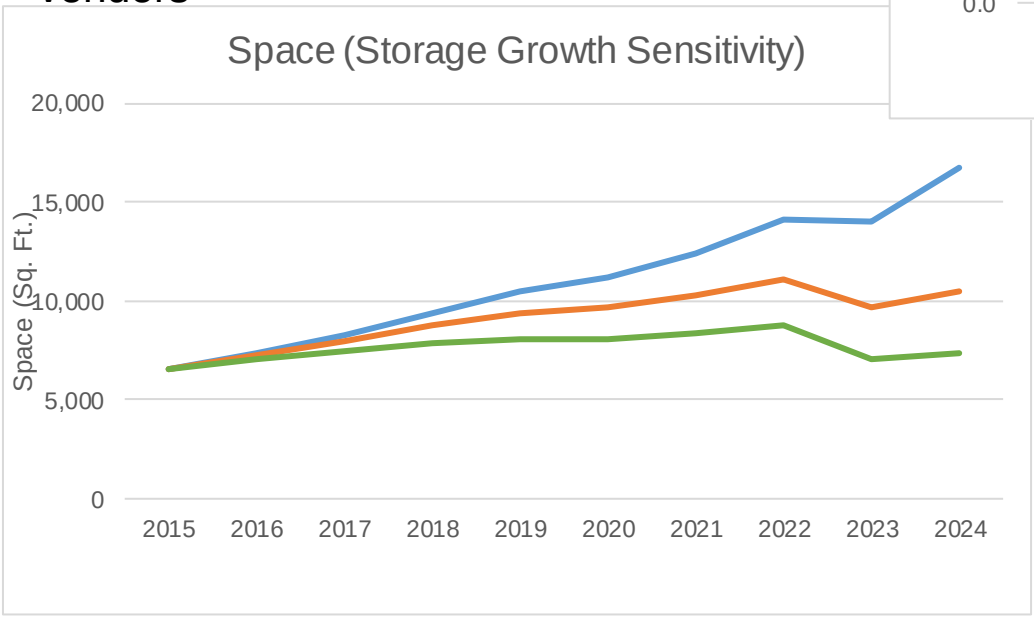
The model is more sensitive to the storage growth rate in both power and space capacity needs



If the storage growth rate is 30% (as opposed to an initial rate of 25% that decline over time in the assumptions) power needs will increase 0.9MW and space needs will increase 6,300 ft^2.

- The storage growth is unlikely to be constant at 30% - storage growth has been declining at ISD and some storage heavy applications (i.e. email, LEADS) will soon be managed by vendors





Storage cabinets account for a larger percentage of the space over time, resulting in a strong space sensitivity to a change in storage growth

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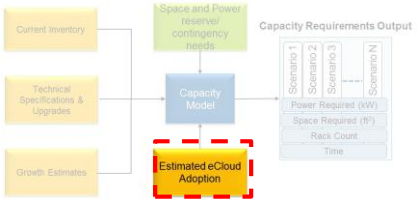
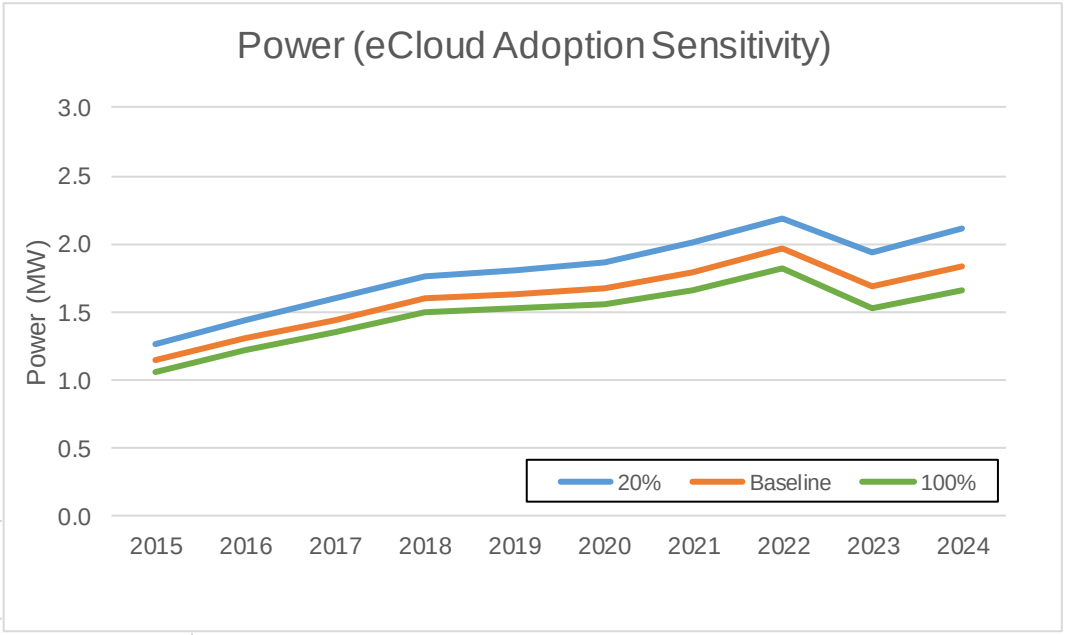
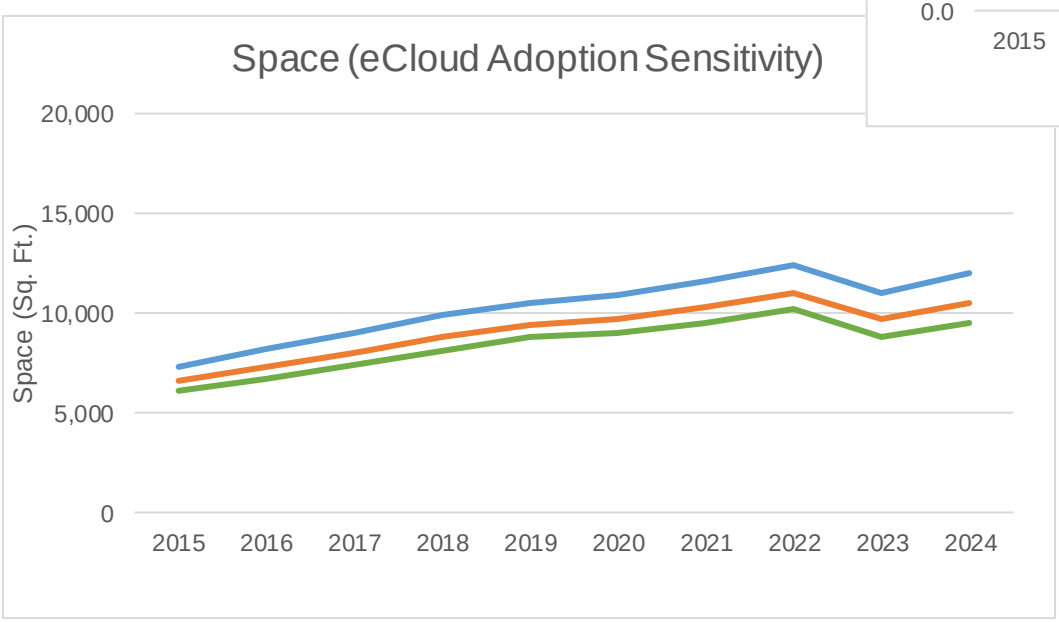
The model is least sensitivity to eCloud adoption due to the County's virtualization efforts



There is not much of a variance between the assumption (70% adoption of eCloud) and only 20% adoption eCloud – about a 15% variance.





Most of the County's servers are already virtualized at a 9-10 virtual to physical ratio. eCloud improves the ratio to 16, but not enough to significantly affect space and power requirements considering server racks do not take the majority of the space

Gartner

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Report on LA County's Data Center Strategy

Current State Assessment and Future State Requirements

Attachment E Future State Requirements

March 30, 2015

Prepared for: Los Angeles County

GARTNER CONSULTING

Project Number: 330025627

Gartner

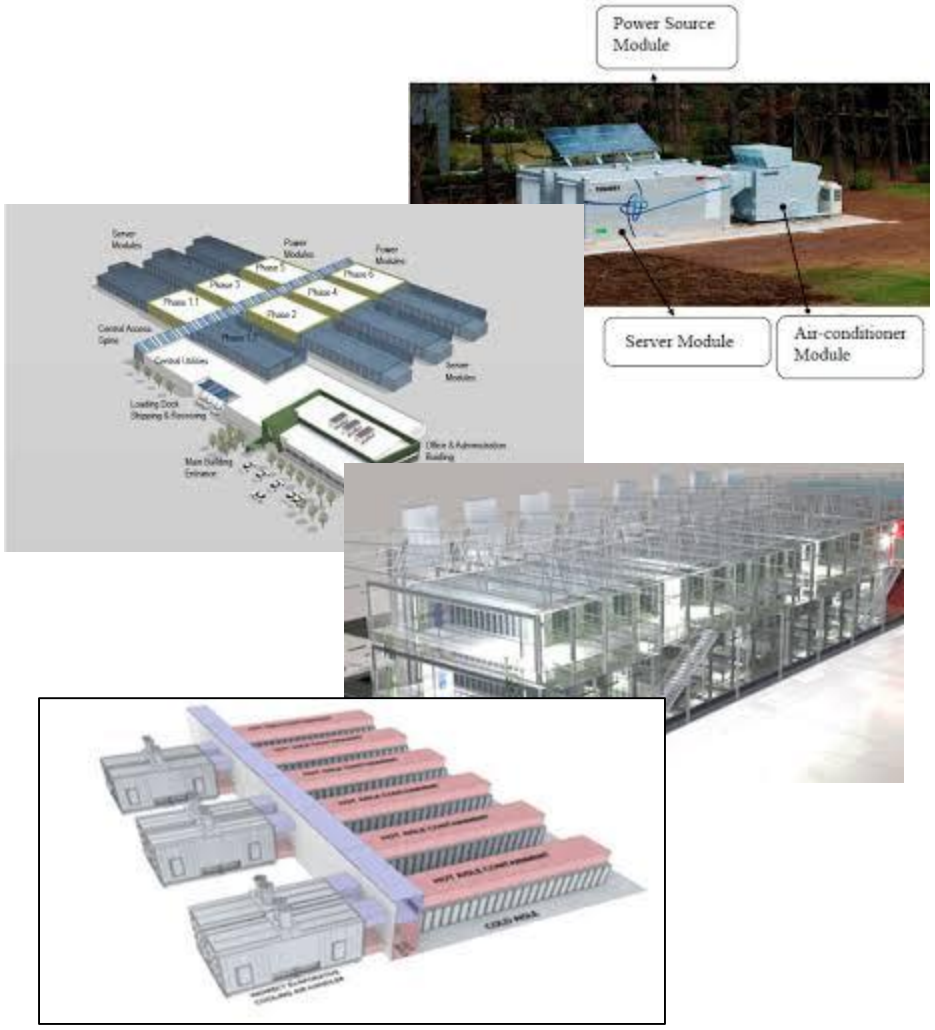
Table of Content

Gartner

Definitions for Future State Data Center Requirements

Business and Technical Requirements
Definitions: Modular Design

- To accommodate maximum flexibility, upgradeability, and to accommodate growth over time while controlling capital expenditures, modern data centers follow a modular design concept.
- Each facility may be comprised of one or more modules.
- Each module is comprised of the computer room and its associated mechanical/electrical capabilities and spaces.
- It is possible for modules to share some common infrastructure (power feeds, generators, chillers, etc.).
- Sharing of infrastructure should not diminish the compatibility to add or upgrade modules while the remaining modules remain operational.



Business and Technical Requirements
Definitions: Data Center Tiers

	Description (TIA 942-A)	Common Usage Models
Tier I: Basic	• Single points of failure exist which can result in unscheduled outages. • Single path for power and cooling distribution will require scheduled outages for maintenance • No redundant components, therefore replacement of parts can prolong outage	• Non critical systems • Test and development • Disaster recovery • High Performance and Scientific Computing where downtime can be tolerated • Applications that are distributed among multiple data centers such as internet search engines
Tier II: Some Redundant Components	• Redundant components can reduce time to recovery • Not all single points of failure are eliminated, therefore unexpected outages are still possible • Single path for power and cooling distribution will require scheduled outages for maintenance	• Critical systems that are active/active at more than one DC • Disaster recovery • Engineering and product development • Local manufacturing sites • Satellite data centers
Tier III: Concurrently Maintainable	• Multiple power grids or continuous on-site generation capability • Multiple power and cooling distribution paths, but only one path may be active • Redundant components and distribution paths are configured as concurrently maintainable, thereby eliminating any scheduled outage for maintenance.	• Mission critical applications • E-Commerce sites • Co-location and managed services with contractual SLAs • Primary corporate or government data centers • Global centers where downtime cannot be scheduled
Tier IV: Fault Tolerant	• Multiple power grids or continuous on-site generation capability • Multiple active power and cooling paths • Redundant components are concurrently maintainable and fully fault tolerant.	• Extensive financial transactions • Large financial institutions • Insurance industry • Some co-location and managed services providers

Recommended Tier level

Business and Technical Requirements
Definitions: TIA-942-A (2012)

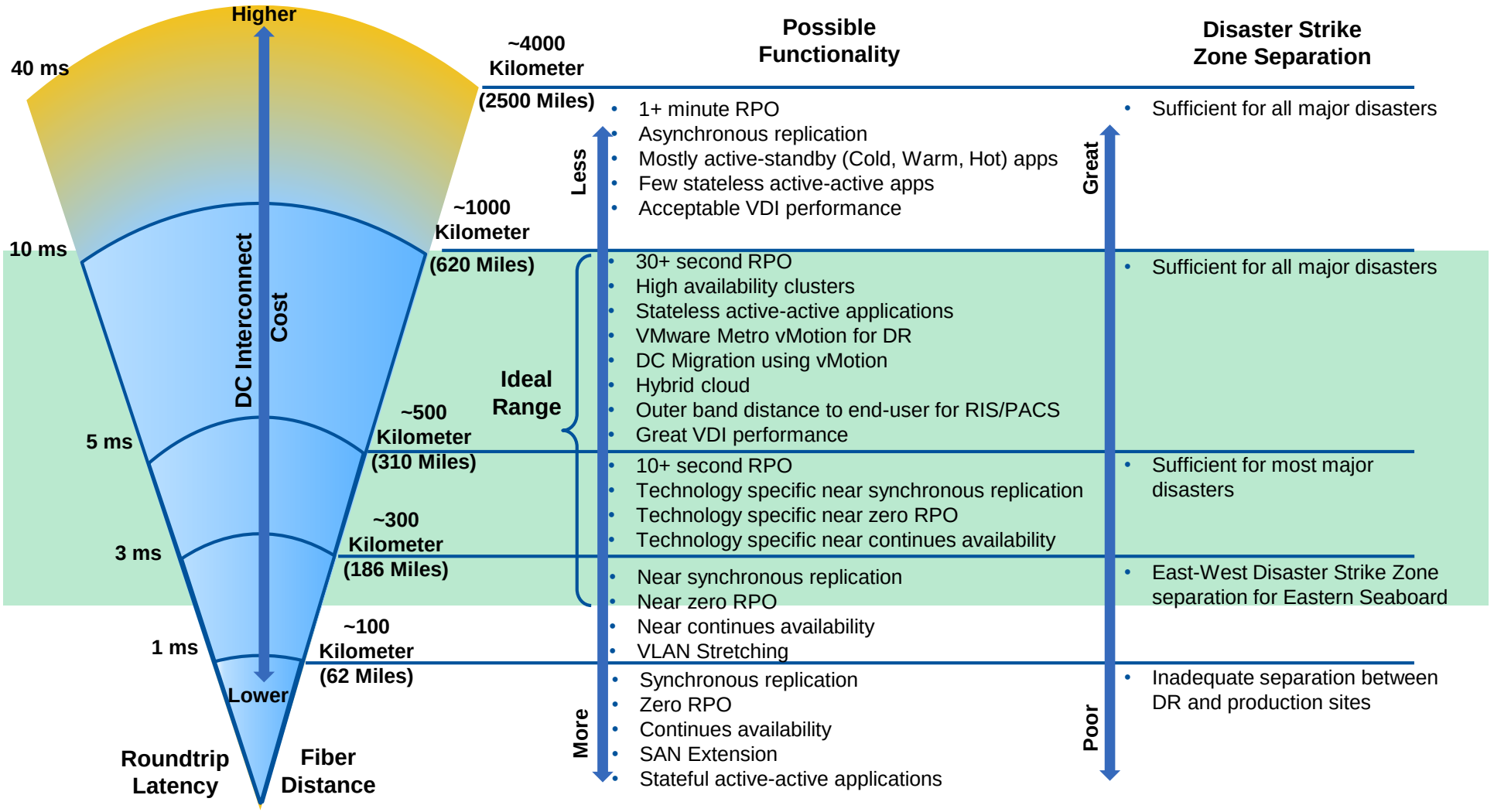
- First published in 2005 (TIA-942) and later amended in 2012 (TIA-942-A)
- Provides global standards for planning of data centers, computer rooms, server rooms, and similar spaces.
  - The standard encompasses much more than just telecommunications infrastructure.
  - Close to half of the technical content deals with facility specifications (Power, Cooling, Space)
  - Specifications for data center telecommunications pathways and spaces
  - Recommendations on media and distance for applications over structured cabling
- Establishes a standard for data center Tiers to replace several proprietary standards. The TIA data center Tier standard is:
  - A tool to evaluate existing data centers
  - A tool to communicate design requirements
- Define a standard telecommunications infrastructure for data centers
  - Structured cabling system for data centers using standardized architecture and media
  - Accommodates a wide range of applications (LAN, WAN, SAN, channels, consoles)
  - Accommodates current and future protocols (e.g., 10+ GbE)
  - Replaces unstructured point-to-point cabling that uses different cabling for different applications

Business and Technical Requirements
Definitions: Redundancy

The following terminology may be used throughout this document to refer to the desired level of redundancy in electrical, mechanical, and telecommunication infrastructure.

N	Normal number of facility support system components to meet the design load (i.e. Quantity of Air Handlers, Chillers, Pumps, UPS etc.).
N+1	One additional component above what is required for design load is provisioned. In some cases all units run at a reduced capacity in other cases the additional unit is off and ready to start.
N+1 Distributed Redundant	One additional component above what is required for design load is provisioned. This is a redundant UPS configuration where a number of UPS modules are configured independently on separate critical buses. The lowest distribution level (RPP, branch circuits) shall be 2N, but there are N+1 active UPS systems.
N+1 Parallel Redundant	This is a common configuration for UPS systems, where a number of UPS modules are configured in parallel on a single critical bus to form a single UPS system. One additional module above what is required to carry the load is provisioned for redundancy. Use of a single N+1 Parallel Redundant UPS system is a common configuration in a Tier II data center.
2N	Two systems each sized at 100% of N load. Intended on highly critical systems where operating for short periods at reduced capacity will cause downtime to server area. This system redundancy can also be used in geographies that experience high number of service interruptions. This configuration is often used for in a Tier III and IV data center.
2(N+1)	Primarily used for a fault tolerant design of UPS systems in a Tier IV configuration. Two parallel redundant systems each sized at 100% of N load plus one additional UPS module.

Implication of Distance Between Data Centers and/or End-Users



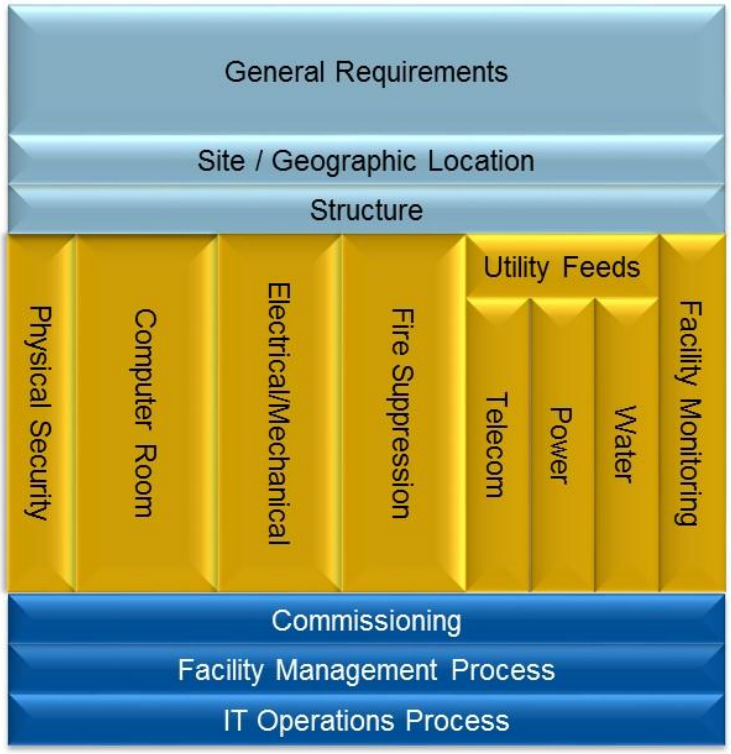
Future State Data Center Requirements

Business and Technical Requirements
How to use this document

Purpose:

- This document is intended to provide guidelines for successful implementation of the data center strategy by LA County. Outlined in this documents are technical and business requirements to guide the following:
  - Design and construction of a new data center, or
  - Purchase of a new data center, or
  - Lease of data center space from a service provider. When leasing a facility these requirements can be used to audit providers capabilities. Some portions may also be contractually included in the lease agreement.
- In accordance with TIA-942 standard, two categories of criteria are specified in this document; mandatory and advisory.
  - The mandatory requirements are designated by the words “shall” or “must”. Mandatory criteria generally specify the absolute minimum acceptable requirements.
  - Advisory requirements are designated by the words “should”, “may” or “desirable” which are used interchangeably in this document as well as TIA-942 standard. Advisory or desirable criteria are presented when their attainment will enhance reliability, availability, scalability, or manageability of the data center.

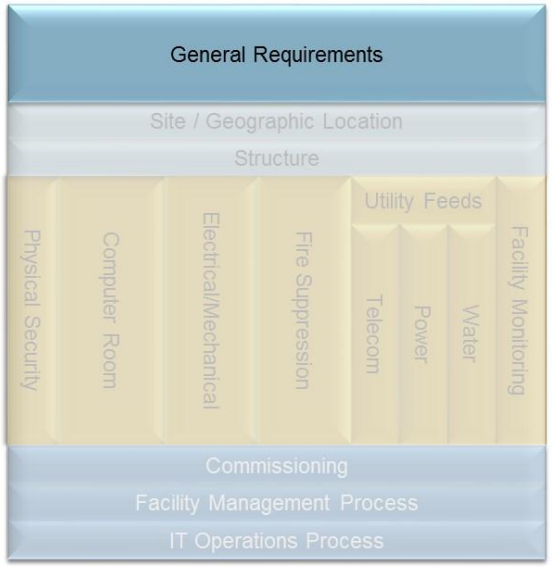
Gartner developed a framework to further define the future state requirements



- **General Requirements:** Overall key requirements which drive the overall data center vision.
- **Site / Geographic Location:** Guidelines and requirements of the geographic location and site (e.g. land) where the data center will be located.
- **Structure:** Guidelines and requirements regarding the construction and layout of the building which will contain the data center.
- **Physical Security:** Requirements for physically securing the data center facility.
- **Computer Room:** Guidelines and requirements for the computer room including both features and capacity.
- **Electrical/Mechanical:** Guidelines and requirements for the heating, cooling and power distribution/transformation infrastructure required to support the computer room.
- **Fire Suppression:** Requirements regarding fire detection and suppression systems.
- **Utility:** Requirements regarding utilities (telecom, water, and power) including water storage and telecom/power diversity.
- **Monitoring and Control**: Requirements for systems to monitor the health and usage of the various power, cooling, hazard detection, security and other facility related systems.
- **Commissioning:** Requirements for a) testing and validating that the facility and its MEP components perform and function as designed, b) documenting and testing all the operating procedures, and c) ensuring that facilities staff are trained in those operating procedures.
- **Facilities and IT Operations Processes**: Requirements for processes, skills and staffing levels required to manage a critical facility and IT Operations.

General Requirements:

1. LA County should plan for two consolidated County data centers capable of operating in active-active configuration.
2. Data centers shall not be within the same disaster strike zone, unless mitigated by a third facility.
3. Data center space should be purchased, built, or leased from commercial data center operators taking into consideration a right balance of:
   a) Future growth and capacity
   b) Agility and flexibility in provisioning for servers and applications (measured in hours rather than days or weeks)
   c) Time required to fund, plan, construct, and occupy
   d) Availability, efficiency, and performance
   e) Risk mitigation and disaster recovery
   f) Upfront investment required
   g) On going and long term operating expenses
4. To enhance availability and manage risk, consolidated data centers shall comply with TIA-942-A (2012) Tier III specifications and be able to pass formal certification if so desired by the County.

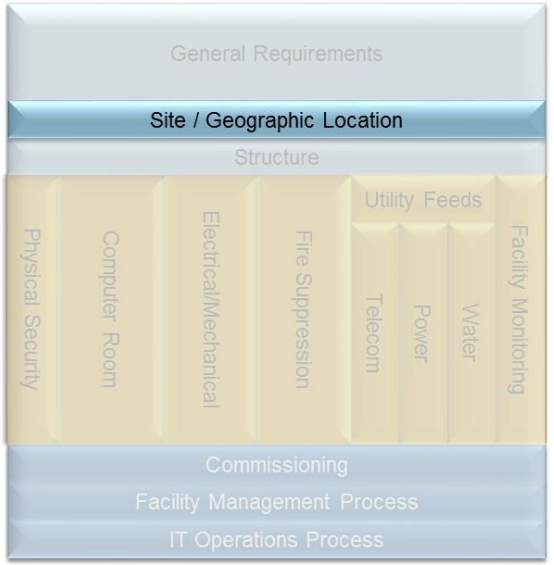


5. In order to satisfy future demand while managing initial cost, data center power and cooling infrastructure shall be modular with ability to increase capacity without outage to any operating IT infrastructure.
6. Building shell shall comply with the International Building Code (IBC) Essential Facility specifications
7. Building shall only house data center and associated support services such as a Network Operations Center (NOC)
8. Facilities and IT operational maturity and excellence shall be assessed, monitored, and improved
9. Energy efficiency is of great importance. Every effort should be made to design or select a facility for optimum energy efficiency. Total facility Power Usage Effectiveness (PUE) shall not exceed 1.4.

Site Selection / Geographic Location

In compliance with TIA 942, Data center site should comply with the following:

1. The site should not be located in a 100-year flood plain, near an earthquake fault, on a hill subject to slide risk, or down stream from a dam or water tower.
2. The building should not be nearby other buildings that could create falling debris during an earthquake.
3. The building should not be in the flight path of any nearby airports.
4. The building should be no closer than 0.8 km (½ mile) from a railroad or major interstate highway to minimize risk of chemical spills.
5. The building should not be within 0.4 km (¼ mile) of an airport, research lab, chemical plant, landfill, river, coastline, or dam.
6. The building should not be within 0.8 km (½ mile) of a military base.
7. The building should not be within 1.6 km (1 mile) of a nuclear, munitions, or defense plant.
8. The building should not be located adjacent to a foreign embassy.
9. The building should not be located in high crime areas



Other site considerations include:

1. The site should have easy diverse routes to multiple carrier telecommunication access points (AT&T, Time Warner, Verizon)
2. The site should have access to multiple utility substations providing reliable power.

Structural Requirements

In compliance with TIA 942, Data center structure should comply with the following:

1. The building structural system should be either steel or concrete.
2. At a minimum, the building frame should be designed to withstand wind loads in accordance with the applicable building codes for the location under consideration and in accordance with provisions for structures designated as essential facilities (for example, Building Classification III from the International Building Code).
3. Facilities located within seismic zones 3 & 4 should be designed in accordance with seismic zone 4 requirements. All facilities should be designed with an Importance Factor I = 1.5. Equipment and data racks in seismic zones 3 & 4 should be base attached and top braced to resist seismic loads.
4. Minimum floor loading for IT equipment areas should be 250 lbs/ft^2
5. Minimum floor loading for UPS, Chiller and other mechanical areas should be 500 lbs/ft^2
6. Roofs should be designed for actual mechanical equipment weights plus an additional 25 lbf/ ft^2 for suspended loads.
7. Roof areas over UPS rooms should be designed to accommodate a suspended load of 30 lbf/ ft^2.
8. Computer room doors and walls should provide a minimum of (2) hours fire rating. All other walls and doors should provided a minimum of one (1) hours fire rating.

Structural Requirements (Continued)

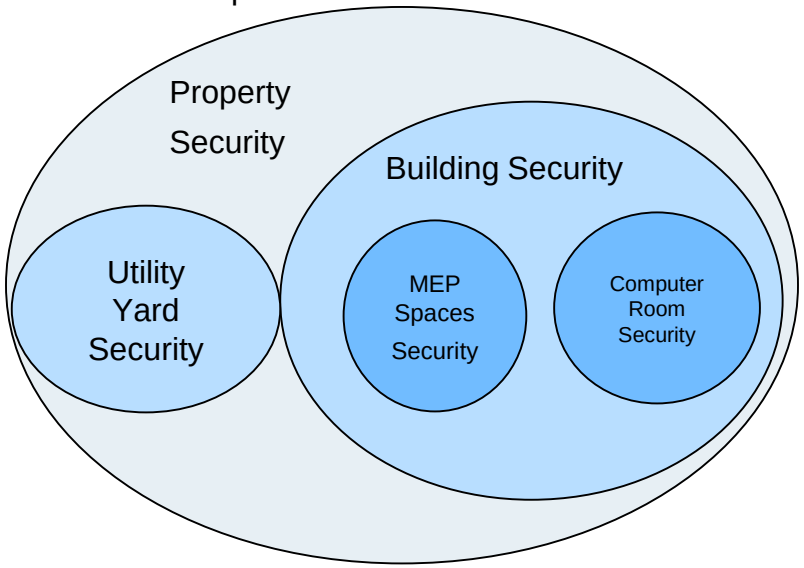
1. Preliminary list of required spaces and their size estimates for data center (new construction) is shown in the table. This is not a comprehensive list. These values shall be verified during the program design phase.
2. Leased data center space may use shared areas for all the support areas. Computer room space in a leased facility need not be contiguous, but each area shall be fenced and with access control and security cameras. Day 1 allocated space in a leased facility may be as needed, but the ability to expand to the maximum requirement shall be demonstrated.

No	Space	Size (Sq. Ft.)
1	Computer Room (SF)	14,000
2	Operations Center	1,000
3	Staging Room	800
4	Tape Storage	700
5	Electrical Rooms	4,000*
6	Battery Rooms	1,700
7	Mechanical Rooms	4,000
8	Mechanical Galleries for Air Handlers	1,500
9	Loading and Receiving	450
10	Parts and Storage	1,000
11	Ramps, Corridors, Lobby	3,000
12	Hotel Office Space	1,000
13	Conference Rooms	650
14	**Total Support Areas (SF)**	**21,800**
15	Office Area (SF)	5,000
16	**Total Gross Square Footage (SF)**	**38,800**
17	Utility Yard (SF)	20,000

Assumes that generators are located in the Utility Yard.

Physical Security Requirements:

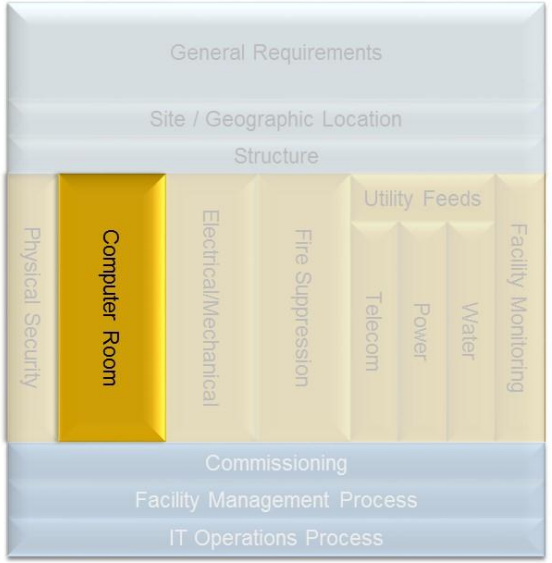
1. Facility shall provide a minimum of 3 concentric rings of security before access to the computer room or any critical power and cooling infrastructure is gained.
2. Minimum of two layers of security shall be provided for any equipment installed in a utility yard.
3. Property and building access must be fenced and guarded 24x7x365
4. Building must have at least a 50’ setback from any parking spaces and 100’ setback from roads.
5. Fences, landscape, planters, and other devices must be able to stop vehicles from approaching the building.
6. Security cameras with DVR must provided coverage for each security ring access points and perimeter, computer room space – cameras on each aisle or entrance to each modular pod



7. Minimum of 90 days of video retention should be considered
8. Anti-tailgating devices and mantraps shall be provided prior to reaching computer room or MEP security rings.
9. All cargo areas shall provide anti-tailgating areas.
10. Biometric access control for computer room is recommended. At a minimum a combination of card and pin must be used.
11. All entrances and gates shall be designed to prevent forced entry

Computer Room Requirements

The computer room is an environmentally controlled space that serves the sole purpose of housing equipment and cabling directly related to the computer systems and other telecommunications systems.



1. Computer room should comply with TIA-942-A standard and recommendations
2. Computer Room Space capacity needs are estimated to be under 10,000 ft^2 over the next 10 years
3. Use of a raised floor system should be optional
4. Multiple service entrances for deployment of a secure cage system for co-location partitions should be considered
5. Columns in the computer room should be avoided
6. Installation of MEP equipment such as CARC units, UPS, and batteries in this space should be avoided. Such equipment should be installed in dedicated electrical/mechanical galleries adjacent to the computer room with separate service entrances.
7. Ramps (if required) shall be placed in hallways outside of computer room.
8. Minimum circulation width in all aisles (hot or cold) shall be 4 ft.
9. Each equipment row shall be provisioned for a minimum cabinet depth of 4 ft.
10. Floor load carrying capacity shall be greater than 250 lb/ft^2.
11. Provisions for seismic bracing of all cabinets shall be provided.
12. Provisions for full containment of hot and cold aisles should be provided.
13. Computer room should be rectangular. “L” shaped space or round walls shall be avoided.
14. Computer room shall not have windows to any unsecured space or exterior of building.
15. Overhead water lines and drains, and roof openings are not permitted.

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Electrical and Mechanical Requirements

Electrical requirements are as follows:

1. Electrical systems shall be designed for day 1 usable UPS capacity of 700 KW, expendable in a modular design to 2.1MW.
2. Computer room shall be designed to support rack densities of up to 24KW
3. Electrical systems shall be designed with two active power pathways to each IT equipment downstream of the Utility Service Entrance.
4. The electrical distribution system to all IT and Mechanical equipment shall be concurrently maintainable.
5. The electrical distribution system supporting IT and Mechanical loads shall not include any single points of failure.
6. Permanent load banks should be installed for testing of generator and UPS systems.
7. Use of overhead busways for power distribution in the computer room is recommended.
8. Branch circuit monitoring for all IT equipment shall be provided
9. Unconditioned house power outlets shall be provided throughout the computer room and facility for tools.
10. Use of EPO in the computer room should be avoided when permitted by the Authority Having Jurisdiction (AHJ) to avoid human errors and accidental shutdowns.
11. Lightening protection shall be provided.
12. Transient voltage surge suppression (TVSS) should be used throughout the power distribution system.
13. Grounding and Signal Reference Grid (SRG) should be provided for all IT equipment

Electrical and Mechanical Requirements (continued)

Electrical requirements are as follows: (Continued)

14. The following power studies shall be conducted for new construction or prior to purchase of a new location. Service providers should provide evidence that these studies have been conducted.
    a. Utility source quality
    b. Comprehensive short circuit study
    c. Coordination study with local utility company
    d. Power factor correction
    e. Harmonic analysis study
    f. Arch flash study
15. Standby power generation shall be provided as follows:
    a. A minimum of N+1 concurrently maintainable configuration shall be provided for all generation components including fuel system and fuel system monitoring
    b. Generation system shall be rated for continuous operation if only one utility feed is present
    c. Generation system shall be sized to support all critical IT, mechanical, and building loads.
    d. TVSS should be provided for each generator output
    e. Generator fuel shall be diesel. A minimum of 72 hours of onsite fuel storage shall be provided
    f. All generators shall have heater blocks, redundant batteries, and redundant starters.
    g. Closed circuit transition should be supported by generator switchgear when permitted by the local utility.

Electrical and Mechanical Requirements (continued)

Mechanical requirements are as follows:

1. Computer room airflow shall be configured in Hot-aisle / Cold-aisle configuration
2. Full hot air containment shall be provided for cabinets exceeding 10KW of IT load
3. Environmental temperature and humidity thresholds shall comply with 2011 ASHRAE TC 9.9 Recommended Range for Classes A1-A4 data processing equipment
4. The power distribution system for all HVAC and mechanical equipment shall be concurrently maintainable.
5. Computer room air handler redundancy shall be N+2.
6. Electrical, UPS, and battery room HVAC system shall have at least N+1 redundancy
7. Efficiency of HVAC system should support a target Power Usage Effectiveness (PUE) of 1.4 or less.
8. All HVAC air handlers should use VFD or EC motors for maximum efficiency
9. Computer room air handlers should use supply air temperature set point for control
10. Humidity control in the computer room should only be provide by a make-up air air-handler. All other HVAC components should be free of humidifiers and reheat.
11. Temperature monitoring should be provided in all cold and hot aisles.
12. Computer room, mechanical rooms, and areas prone to leakage from pipes, drains, or HVAC condensation shall be equipped with a remotely monitored leak detection system
13. Use of a chilled water (CW) system is not a requirement, but if present the following additional requirements shall be met:
    a. Minimum redundancy of N+1 for all chillers, primary pumps, secondary pumps, cooling towers, and condenser pumps
    b. Chilled water and condenser water loops must be concurrently maintainable by use of either 2N configuration or double ended lines and isolation valves.
    c. Minimum of 72 hours of condenser water storage shall be provided

Fire Suppression and Protection

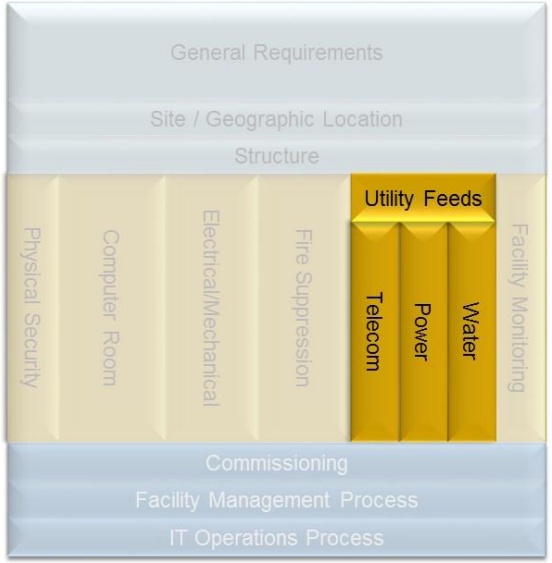
In addition to compliance with local code and National Fire Protection Association (NFPA) 75, the following requirements should be met.

1. VESDA smoke detection system or a similar early warning device should be deployed in the computer room.
2. Double interlock pre-action sprinkler system shall be used as a substitute for wet sprinkler system
3. Use of gracious fire suppression system such as FM200 or Inergen is recommended, but optional.
4. All handheld fire extinguishers shall be CO2, FM200, or Inergen

Utility Requirements

Electrical utility requirements:

1. At least two utility feeders should be provided to serve the data center at medium or high voltage, preferably from two substations. If only one utility feeder is present, the on-site generation system shall be rated for continuous operation
2. Utility transformers for each feed should be configured in N+1 or 2N configuration
3. Utility feeders should be underground
4. For additional information please refer to the Electrical / Mechanical Requirements



Water utility requirements:

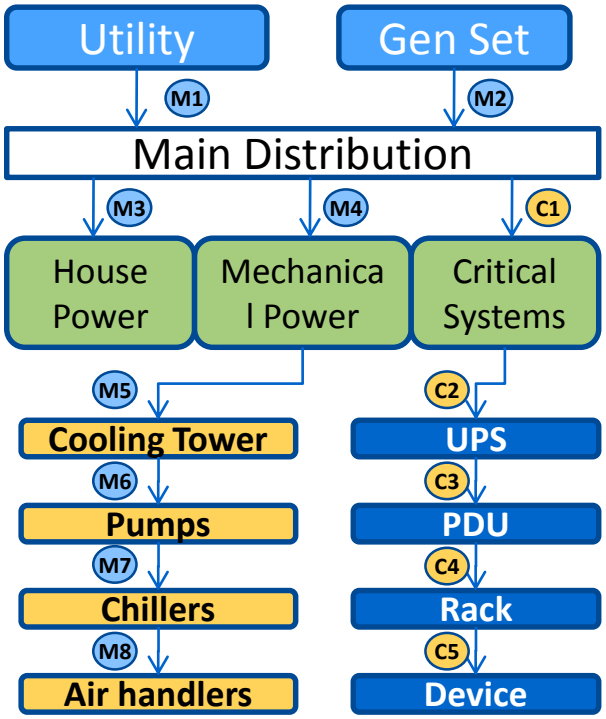
1. Site should have access to diverse water supplies or on-site water storage if evaporative cooling towers are used.
   a. A minimum of 72 hours condenser water storage should be provide, or
   b. On-site water well with redundant pumps that are supported by the power generation system.
2. Additional on-site water storage or well shall be provided to supply restrooms and sanitation requirements in the event of an emergency.

Telecommunication Entrances:

1. Site must have access to diverse fiber paths from all major telecom companies. Conduits to the site should not be shared by providers.
2. Diverse telecommunication entrance vaults shall be provide on opposing sides of the building for path diversity and protection against accidental cuts.

Monitoring and Control

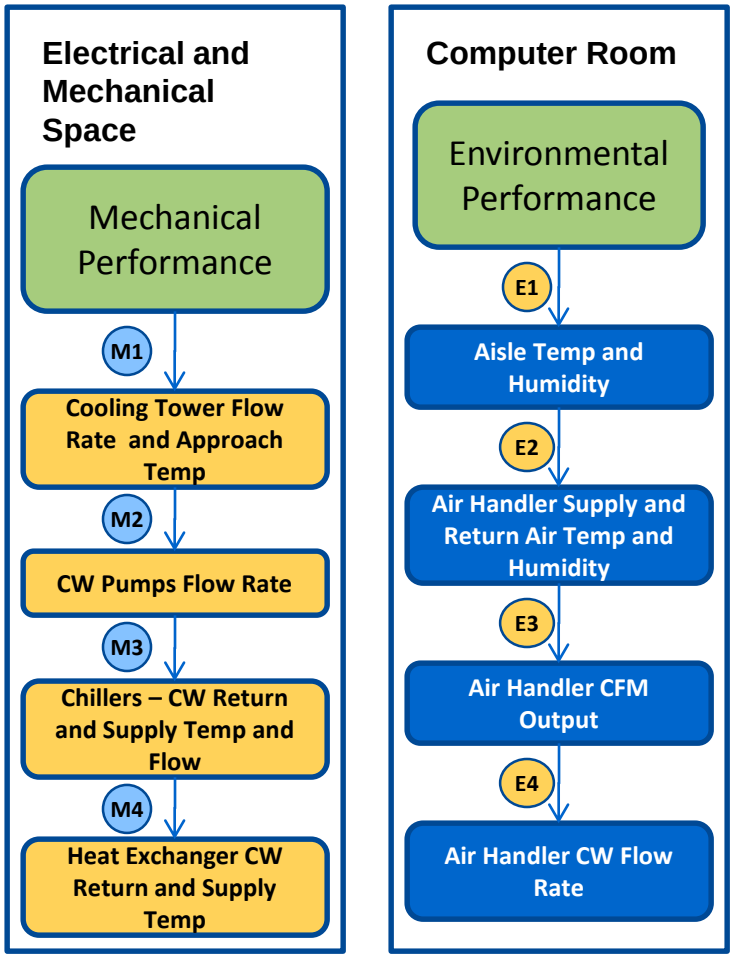
1. The monitoring and control requirements are key to proper management of the DC and ensuring that issues are discovered before they become a problems. Control systems will also allow operators to take corrective actions or automate corrective actions as required.
2. The required minimum electrical measurement layers are shown below.
3. Electrical Power Monitoring System (EPMS) system should also monitor and report power quality, voltage, and other pertinent data

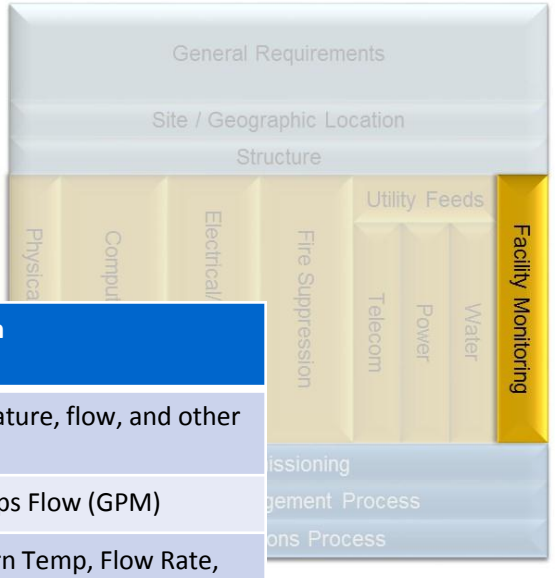


Measurement ID	Description
M1	Utility provided total load measurement
M2	Generator set total load measurement
M3	Office and non data center related load
M4	Total mechanical load
M5	Cooling tower load (each cooling tower)
M6	Main CW circulation pumps load (each pump)
M7	Chiller loads (each chiller)
M8	Air handlers and CRAC units (each unit)
C1	Total critical load
C2	Total Input/Output load on each UPS system
C3	Total Input/Output load on each PDU
C4	Branch circuit loads to each rack
C5	Device load

Monitoring and Control (continued)

3. The required minimum mechanical and environmental measurement layers are shown below.

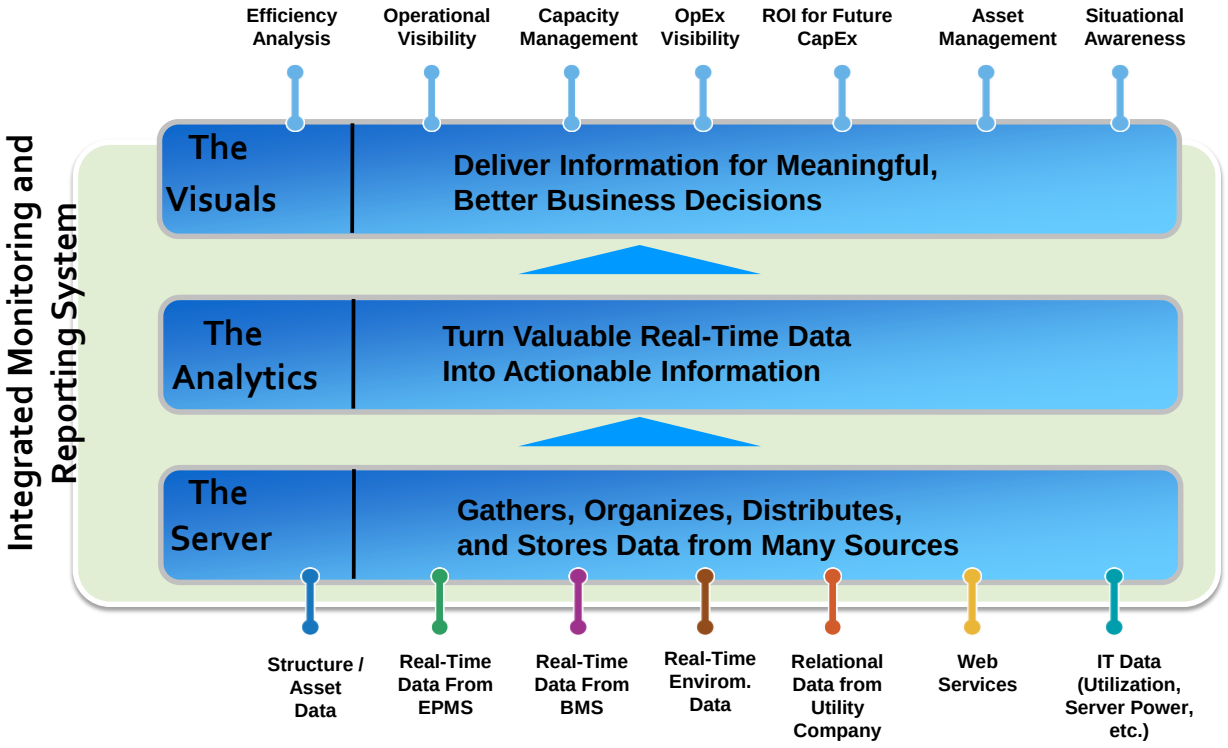




Measurement ID	Description
M1	Cooling tower approach temperature, flow, and other performance metrics.
M2	CW Primary and Secondary Pumps Flow (GPM)
M3	Chiller Metrics Such as CW Return Temp, Flow Rate, Supply Temp, Lift, etc.
M4	Heat Exchanger Performance Metrics Such as Lift, Supply Temp, Return Temp, Flow.
E1	Environmental Parameters Measured at Each Aisle and Other Key Locations
E2	Air Handler Supply and Return Temperature and Humidity (Note: Same is Required for Air Handlers in Electrical and Mechanical Spaces)
E3	Air Handler CFM Output (Note: Same is Required for Air Handlers in Electrical and Mechanical Spaces)
E4	Air handlers CW Flow Rate

Monitoring and Control (continued)

4. Monitoring and control system should integrate data from Building Management System (BMS), Electrical Power Monitoring System (EPMS), and other monitoring tools into a data center infrastructure management tool (DCIM) for analytics and presentation as shown below

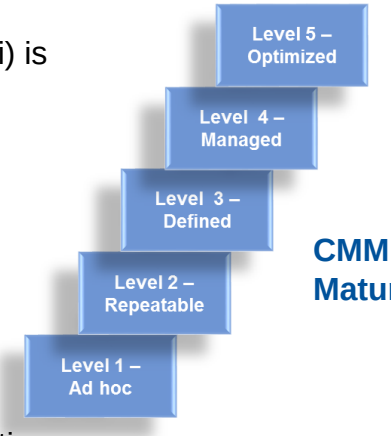


Commissioning Requirements

1. The building and all of its electrical and mechanical components shall be commissioned.
2. The commissioning process should be defined and completed by an independent third party commissioning agent.
3. For new construction commissioning process should include:
   a) Design peer review
   b) Factory witness tests (optional) – factory startup and performance tests for generators and other major MEP equipment witnessed by a commissioning agent
   c) Site system startup tests - performed by the general contractor and its trades and/or manufacturer field service personnel and reviewed by the commissioning agent
   d) Site system performance tests – scripted by the commissioning agent and performed by the general contractor and its trades and manufacturer field service personnel.
   e) Integrated system tests – detailed integrated failure simulations to test the automated and manual recovery procedures of integrated electrical and mechanical systems at maximum practical loads. These tests will be scripted and supervised by the commissioning agent and will be performed with the assistance of the general contractor and its trade sub contractors.
4. All operating methods and procedures should be tested during commissioning
5. Facilities staff should be trained prior to and during commissioning on the proper methods and procedures
6. For a leased data center facility, service provider must demonstrate that commissioning has been performed on existing equipment. Any new MEP equipment installed for the County in a leased facility shall undergo complete commissioning.

Facilities Management Process

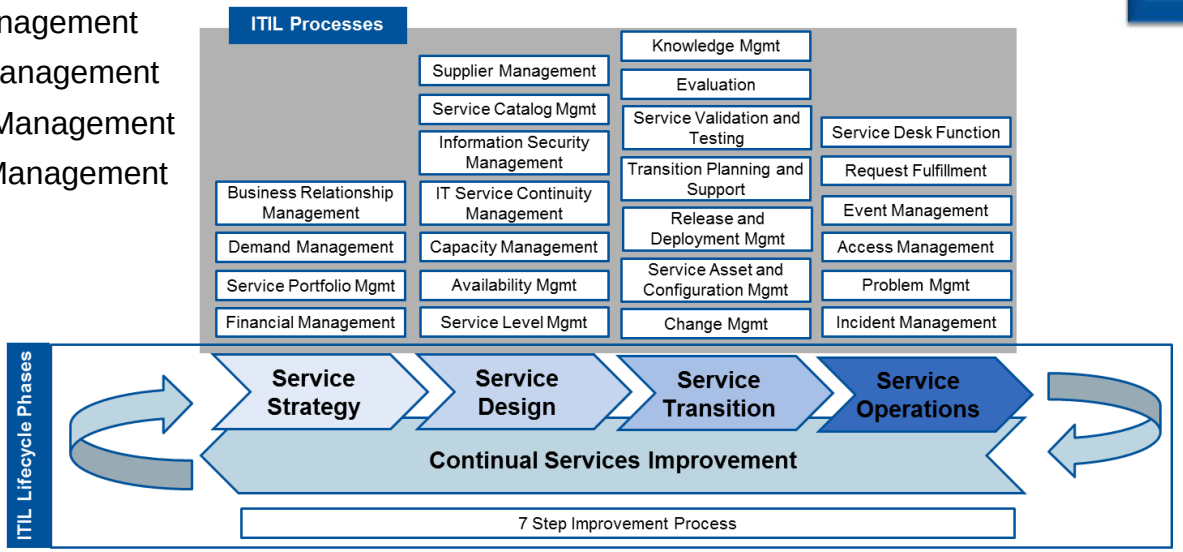
1. The data center staffing requirements shall be as follows:
   a. 24x7x365 on-site facilities engineering staff
   b. 24x7x365 on-site Security staff
2. Following facilities operating procedures shall be well documented and tested
   a. Standard Operating Procedures (SOP)
   b. Emergency Operating Procedure (EOP)
   c. Maintenance Operating Procedures (MOP)
3. Gartner recommends that ISD evaluate its processes and procedures as follows:
   a. Assess the current operating processes and procedures and establish a baseline against which improvements could be measured.
   b. Implement appropriate tools, techniques, methodologies, and best practices for its critical operating processes and procedures.
   c. Ensure that most critical processes reach level 3,“defined”, or level 4, “managed” maturity levels if a methodology similar to the SEI Capability Maturity Model (CMMi) is used.
4. Each critical process shall meet five core elements:
   a. Process Documentation and Implementation
   b. Process-to-Process Integration
   c. Skills and Staffing
   d. Tools and Automation
   e. Metrics and Governance
5. ITIL ITSM or a similar industry accepted framework may be used for consistent definition of processes and process groups.



CMMi Capability Maturity Model

Facilities Operations Process (Continued)

5. Service Design and Service Transition processes that should have a Level 3 or 4 maturity should include:
   a. Capacity Management
   b. Availability Management
   c. Service Level Management
   d. Asset and Configuration Management
   e. Change Management
6. Service Operations processes that should have a Level 3 or 4 maturity should include:
   a. Service Desk Function
   b. Request Fulfillment
   c. Event Management
   d. Access Management
   e. Problem Management
   f. Incident Management



Source: Adapted from ITIL V3

IT Operations Process

1. The data center should have 24x7x365 on-site IT operations staff or smart hands
2. Gartner recommends that ISD evaluate its processes and procedures as follows:
   a. Assess the current operating processes and procedures and establish a baseline against which improvements could be measured.
   b. Implement appropriate tools, techniques, methodologies, and best practices for its critical operating processes and procedures.
   c. Ensure that most critical processes reach level 3,“defined”, or level 4, “managed” maturity levels if a methodology similar to the SEI Capability Maturity Model (CMMi) is used.
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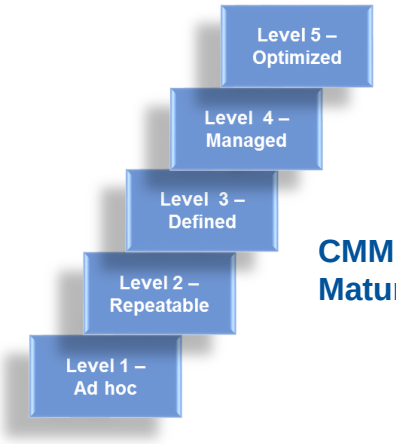

CMMi Capability Maturity Model

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IT Operations Process (Continued)

5. Service Design and Service Transition processes that should have a Level 3 or 4 maturity should include:
   a. Capacity Management
   b. Availability Management
   c. Service Level Management
   d. Asset and Configuration Management
   e. Change Management
6. Service Operations processes that should have a Level 3 or 4 maturity should include:
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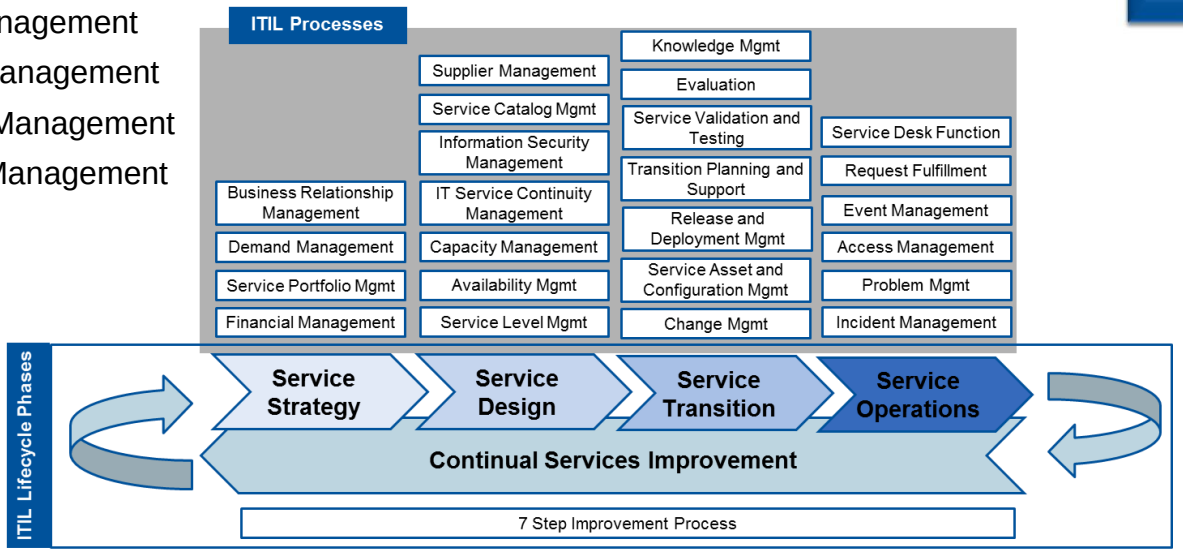

Source: Adapted from ITIL V3

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