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## Research and Academic Computing

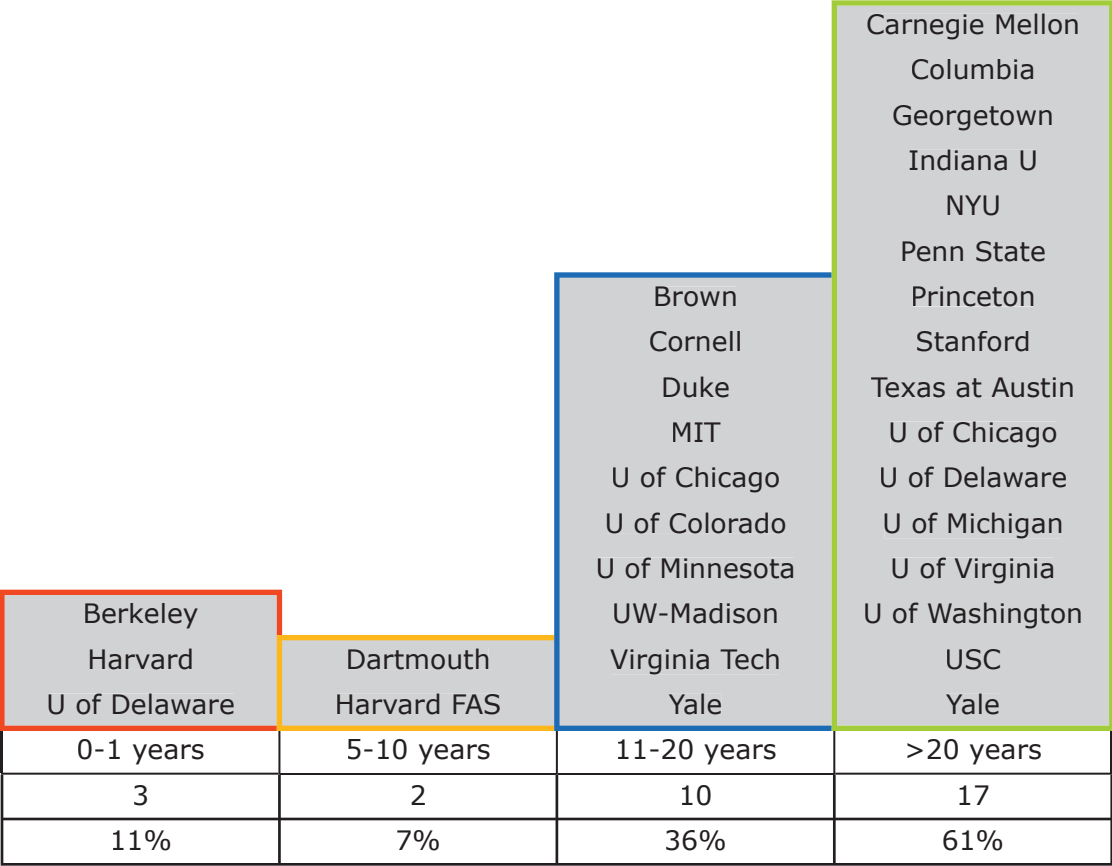
17. What percent of your current space is for Research Computing and Academic Computing (storage, grid, course management, etc.)?
18. If you are expanding, what percent of your total planned space will for Research Computing and Academic Computing?
19. What is the model for Research Computing with your faculty in your data center? (Check all that apply.)
20. Who provides system administration within the data center? (Check all that apply.)



# Current Baseline

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**1. How long have you occupied your current data center?**



Indiana U	one data center is 20 years old, the other is 3 years old
U of Michigan	Actually, years of occupancy range from 4 months for the newest to over 40 years for the oldest.
NYU	Varies. 1 less than 3 years, 1 > 20 years
Texas at Austin	We have one facility that is about 40 years old and another that is about 15 years old. Each has had upgrades over the years.
U of Washington	over 30 years

**2. Are you expecting to do data center expansion or improvement in the next 1-4 years?**

U of Delaware USC	Berkeley Brown Cornell Carnegie Mellon Duke Georgetown Indiana U Penn State Texas at Austin U of Chicago U of Michigan U of Minnesota U of Virginia U of Washington UW-Madison Virginia Tech	Brown Cornell Dartmouth Duke Georgetown Harvard FAS Indiana U MIT Princeton Penn State Stanford Texas at Austin U of Chicago U of Michigan U of Washington UW-Madison Yale	Columbia Cornell Duke Harvard MIT NYU Penn State U of Michigan U of Minnesota U of Washington	U of Colorado
No, we've completed an update within the past 3 years.	Yes, we are looking at a retrofit of existing space.	Yes, we are looking at building new space.	Yes, we are looking at off site colocation options.	No plans for data center changes at present
2	16	17	10	1
7%	57%	61%	36%	4%

**Note: This question was posed as a "Select One" question and a number of respondents used the comment section to indicate multiple selections. These additional selections are reflected above.**

USC	space will be done in fall
Berkeley	We will be expanding our new center
Carnegie Mellon	All 3 "Yes" choices are on our list, we are retrofitting our existing data center, building a new one on the Qatar campus and we are considering off-site colocation for disaster recovery/business continuity
U of Minnesota	also looking at new space, and off site space including lease options
Virginia Tech	We may find we need to build additional space, but that is not currently in the plans.
UW-Madison	We are in the process of both upgrading our main space and opening a "new" alternate site. We moved from an older (soon to be demolished) alternate site to another older data center this past year and are in the process of upgrading both.
U of Chicago	This will be additional space, not a replacement of existing.
Cornell	Plans for a new building are under consideration
Dartmouth	We are looking to "go-live" Feb 07 with new space in a multi-tenant facility
U of Michigan	We currently have a new, 8500 sq. ft. data center under construction, projected completion 1Q07.
Stanford	I'd probably have picked more than one of these
Yale	Multiple paths likely
Columbia	We are also looking at upgrading our current Computer Center. This is all pending budget.
U of Michigan	Site identified moves planned in the next 3 months. Also undergoing renovation of existing site

**3. What is your current data center's density specification?**

Brown Carnegie Mellon Columbia Georgetown MIT Penn State Stanford U of Chicago USC Yale	Duke Harvard Harvard FAS Indiana U Texas at Austin U of Chicago U of Colorado U of Delaware U of Michigan UW-Madison	Cornell Dartmouth NYU Princeton U of Delaware U of Minnesota U of Virginia U of Washington Virginia Tech	Berkeley
Reused mainframe data center	Medium density power and cooling throughout	Majority of space for medium density, some high density areas	Majority of space for high density, some ultra high density areas
10	10	9	1
36%	36%	32%	4%

U of Chicago	Augmented original mainframe infrastructure
MIT	but upgraded for high density machines in 25% of space.
Penn State	but we're housing med, high and ultra high in there now
U of Washington	current average is 42 watts/sqft

**4. What is the size of your current data center(s) machine usable space?**

Columbia Dartmouth Georgetown Harvard FAS U of Colorado	Brown Cornell Harvard MIT Texas at Austin U of Chicago U of Delaware U of Michigan U of Virginia Yale	Berkeley Duke NYU Penn State Princeton U of Minnesota U of Washington USC UW-Madison Virginia Tech Yale	Carnegie Mellon Indiana U Stanford
1000-5000 sq ft	5000-10,000 sq ft	10,000-20,000 sq ft	>20,000 sq ft
5	10	11	3
18%	36%	39%	11%

U of Michigan	Not including hospital data centers and college/departmental machine rooms.
Duke	we have multiple data centers for health system, campus and schools and we are trying to resolve and collaborate with all
Virginia Tech	about 12,200 sq ft, with about 2,000 sq ft of warehouse space
U of Washington	reflects centrally managed raised floor space
UW-Madison	Approx 8,000 in primary and 2500 in alternate
Carnegie Mellon	Campus planning database shows 38,000 sqft as data processing space
Indiana U	Two facilities

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**5. What network bandwidth do you have into your data center?**

Berkeley Carnegie Mellon Dartmouth Georgetown MIT Penn State Princeton Stanford U of Chicago U of Colorado U of Delaware Virginia Tech Yale	Brown Columbia Cornell Duke Harvard Harvard FAS Indiana U NYU Texas at Austin U of Chicago U of Michigan U of Minnesota U of Virginia U of Washington USC UW-Madison
10/100/1000 mbps	10 gbps
13	16
46%	57%

Carnegie Mellon	Expecting to go to 10gbps within 2 years (as early as Spring 2007 or as late as Summer 2008)
Penn State	very soon to 10gbps

**6. How do you charge data center clients for use of the facilities? (Check all that apply.)**

	Berkeley		
Brown			
	Carnegie Mellon		
U of Chicago			
U of Colorado			
	Columbia		
	Cornell		
Dartmouth			
U of Delaware			
Duke			
Georgetown			
	Harvard		
Harvard FAS	Harvard FAS		
Indiana U			
U of Michigan		U of Michigan	
U of Minnesota	U of Minnesota		
	MIT		
NYU			
	Penn State	Penn State	
Princeton	Princeton	Princeton	
	Stanford		
	Texas at Austin		
	USC	USC	USC
Virginia Tech			
	U of Virginia		
		U of Washington	U of Washington
	UW-Madison		
Yale	Yale	Yale	Yale
No rates, centrally funded	All data center users pay the same rate	Research computing has a discount or exempt	Academic computing has a discount or exempt
15	16	6	3
54%	57%	21%	11%

Carnegie Mellon		Yellow		Central academic & administrative computing groups operates the centrally funded data center, all others pay labor and network fees
U of Chicago	Red			changes forthcoming
Columbia		Yellow		We have different rates for UNIX and Windows. So all our users who pay, pay the same rate.
Dartmouth	Red			We are considering a charge back model
Duke	Red			we don't charge but researchers must buy their own nodes
Georgetown	Red			Development cost and charge-back system for non-enterprise servers
Indiana U	Red			we do provide colo space for departmental uses that are charged a standard rate. All central IT sponsored equipment is housed without charge
Texas at Austin		Yellow		We have a set of rates and charge collocated groups accordingly.
Virginia Tech	Red			Cleints pay for network installs and any special electrical fixtures. After that, central I.T. foots the bill
U of Washington			Blue, Green	currently most core systems funded centrally, colos have discounted rate. currently reviewing recharge strategy for new data center

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## 7. What standards are in place for data center equipment?

Brown NYU Penn State Stanford UW-Madison Virginia Tech Yale	Carnegie Mellon Columbia Dartmouth Harvard Harvard FAS MIT Princeton Texas at Austin U of Colorado U of Delaware U of Michigan U of Virginia U of Washington USC	Duke U of Chicago	Berkeley Cornell Georgetown Indiana U U of Delaware U of Michigan U of Minnesota
No standards	Specific vendors recommended but not required	Only specific vendor equipment allowed	No specific vendors but require a certain level on another criteria, such as power efficiency, BTU output, etc.
7	14	2	7
25%	50%	7%	25%

Virginia Tech	We want to establish standards and have a working group discussing what they should be.
UW-Madison	Our racks and, power and networking are strictly enforced standards but generally we support any type of computing hardware / OS combination
Carnegie Mellon	Expect standards to get stricter as density increases and security requirements increase
Texas at Austin	ITS has standardized on specific platforms and models but there are exceptions depending on the purpose. Our only requirement for collocated servers is that they be rack mounted.
U of Washington	guidelines being developed, require adherence to minimum computing security standards
U of Chicago	more like specific vendors excluded
U of Chicago	Operating system driven as much as hardware driven
Cornell	rack mounted equipment only

**8. What service level agreements (SLAs) are there for the data center? (Check all that apply.)**

	Berkeley		
		Brown	
Carnegie Mellon			
U of Chicago	U of Chicago		
U of Colorado			
Columbia			
	Cornell	Cornell	Cornell
	Dartmouth	Dartmouth	Dartmouth
U of Delaware			
	Duke	Duke	Duke
	Georgetown	Georgetown	Georgetown
	Harvard	Harvard	
Harvard FAS			
Indiana U			
	U of Michigan	U of Michigan	U of Michigan
U of Minnesota			
	MIT		
	NYU	NYU	NYU
	Penn State		
Princeton			
	Stanford	Stanford	
	Texas at Austin	Texas at Austin	
		USC	USC
Virginia Tech			
U of Virginia			
U of Washington			
	UW-Madison	UW-Madison	
	Yale	Yale	Yale
No SLA for any client	SLA with administrative computing clients	SLA with academic computing clients	SLA with research computing clients
12	15	13	8
43%	54%	46%	29%

Brown			Blue		SLA with a very few academic clients eg., library, provost
Carnegie Mellon	Red				need tools to verify compliance with SLA terms
U of Chicago	Red				Major issue
U of Colorado	Red				No formal SLA for datacenter itself, SLAs (formal and informal) exist on specific services that are hosted on systems in the datacenter
Dartmouth		Yellow	Blue	Green	We have a list of critical systems that has support 24x7
U of Michigan		Yellow	Blue	Green	Some of our data centers, including the new one, are shared between units. OLAs for those relationships.
U of Minnesota	Red				service levels documented and the same for all
MIT		Yellow			working on SLA for research clients
NYU		Yellow			Not formal SLAs in all cases.
Princeton	Red				Some SLAs for a handful of hosted servers
Texas at Austin		Yellow	Blue		Collocated servers have SLAs.
U of Virginia	Red				It depends on definitions: we publish what we do and departments are free to purchase or not to purchase our services
U of Washington	Red				will evolve to include different customer types such as above
UW-Madison		Yellow	Blue		Not uniform yet but we are actively working towards it.



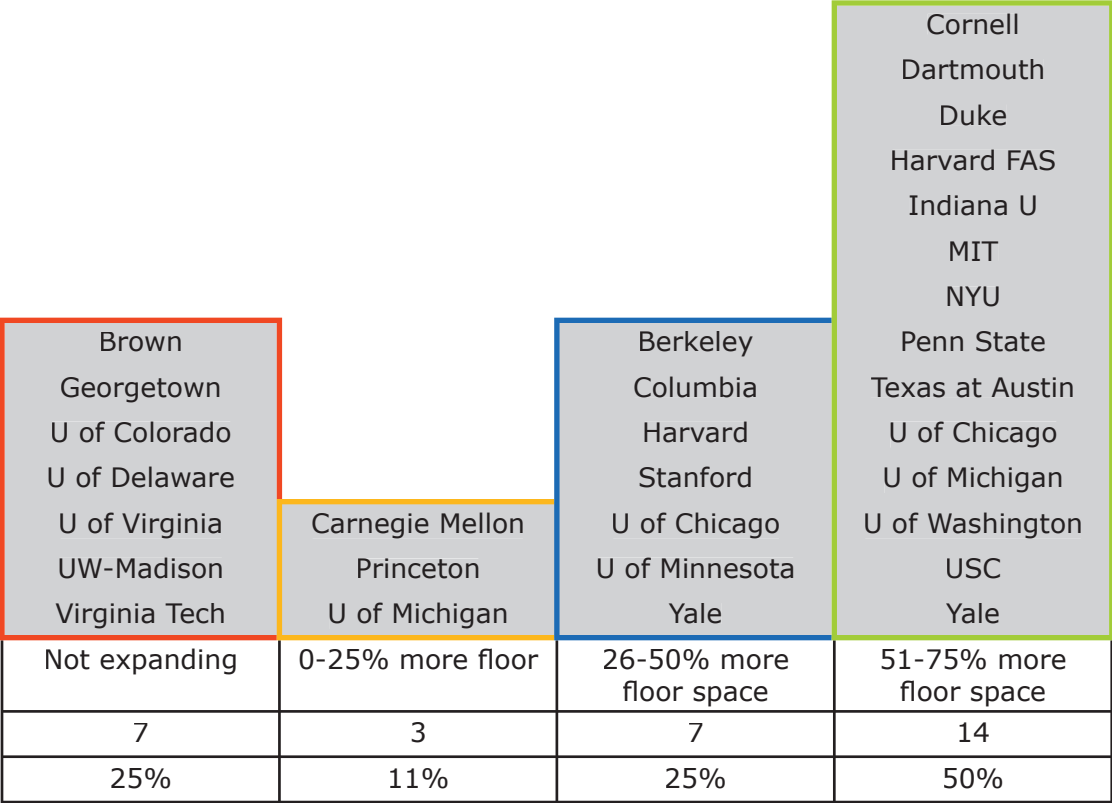
# Data Center Expansion

**9. If you have data center plans, what is the motivation? (Check all that apply.)**

	Berkeley	Berkeley	
Brown	Brown	Brown	Brown
Carnegie Mellon	Carnegie Mellon	Carnegie Mellon	Carnegie Mellon
U of Chicago	U of Chicago	U of Chicago	U of Chicago
Columbia		Columbia	Columbia
		Cornell	Cornell
		Dartmouth	Dartmouth
Duke	Duke	Duke	Duke
Georgetown	Georgetown	Georgetown	Georgetown
	Harvard	Harvard	Harvard
Harvard FAS	Harvard FAS	Harvard FAS	Harvard FAS
Indiana U	Indiana U	Indiana U	Indiana U
U of Michigan	U of Michigan	U of Michigan	U of Michigan
U of Minnesota	U of Minnesota	U of Minnesota	
		MIT	
	NYU	NYU	
Penn State	Penn State	Penn State	Penn State
Princeton	Princeton	Princeton	Princeton
Stanford	Stanford	Stanford	Stanford
Texas at Austin		Texas at Austin	Texas at Austin
USC	USC	USC	
	Virginia Tech	Virginia Tech	Virginia Tech
U of Virginia	U of Virginia	U of Virginia	
U of Washington	U of Washington	U of Washington	U of Washington
			UW-Madison
Yale	Yale	Yale	Yale
Data center worn out and outdated	Research computing effort starting to have an impact	Need more floor space, inadequate power, HVAC, etc.	Requirements for disaster planning
18	20	25	20
64%	71%	89%	71%

**Note: There were no comments offered.**

**10. If you are expanding, what size is your planned expansion?**



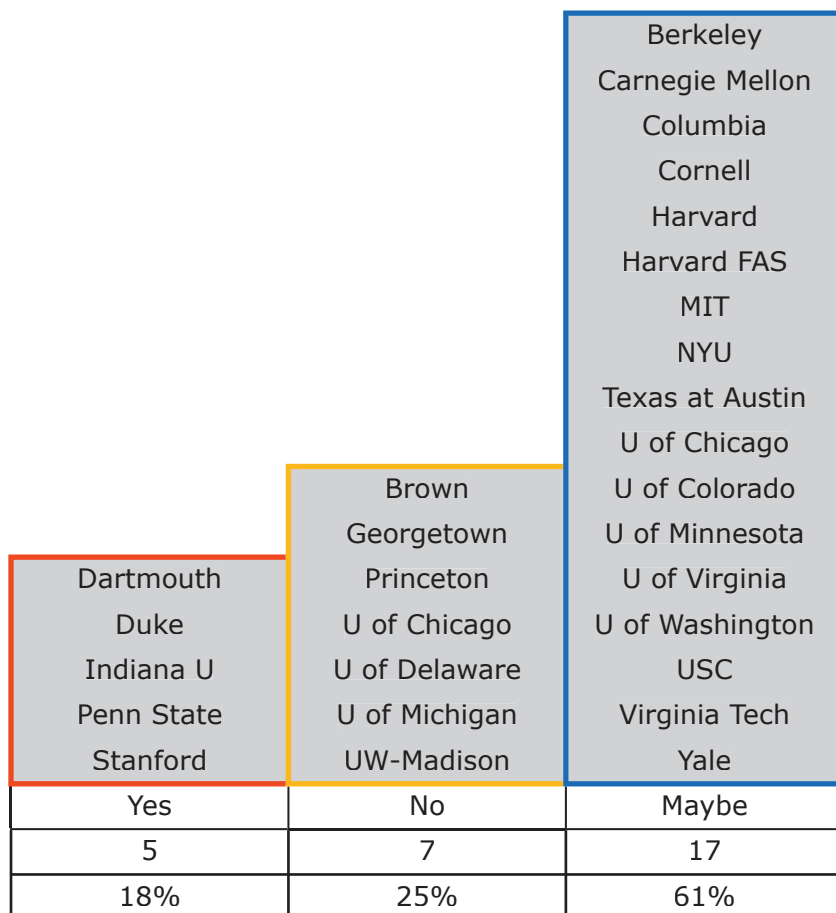
Carnegie Mellon	Expect addition 3.000 sq ft in new building expected to come on-line withn the next 2 -> 2.5 years
U of Michigan	1,200 at a second site
Duke	but, we are not going to get all this space at once - so, we might only double about 25% of the spaces.
Texas at Austin	We are hoping to double our current capacity and use a significant portion of that to provide collocation services to departments and colleges that may want to take advantage of the facilities.
U of Washington	Growth over the next 15 years is 38,000-45,000 sqft

**11. What is your planned data center density specification?**

	Carnegie Mellon Duke Georgetown NYU Princeton Stanford Texas at Austin U of Chicago U of Michigan UW-Madison Yale	Columbia Cornell Dartmouth Harvard Harvard FAS MIT U of Minnesota U of Virginia U of Washington USC	Berkeley Indiana U U of Michigan
Brown U of Chicago			
Medium density power and cooling throughout	Majority of space for medium density, some high density areas	Majority of space for high density, some ultra high density areas	Ultra high density in all areas
2	11	10	3
7%	39%	36%	11%

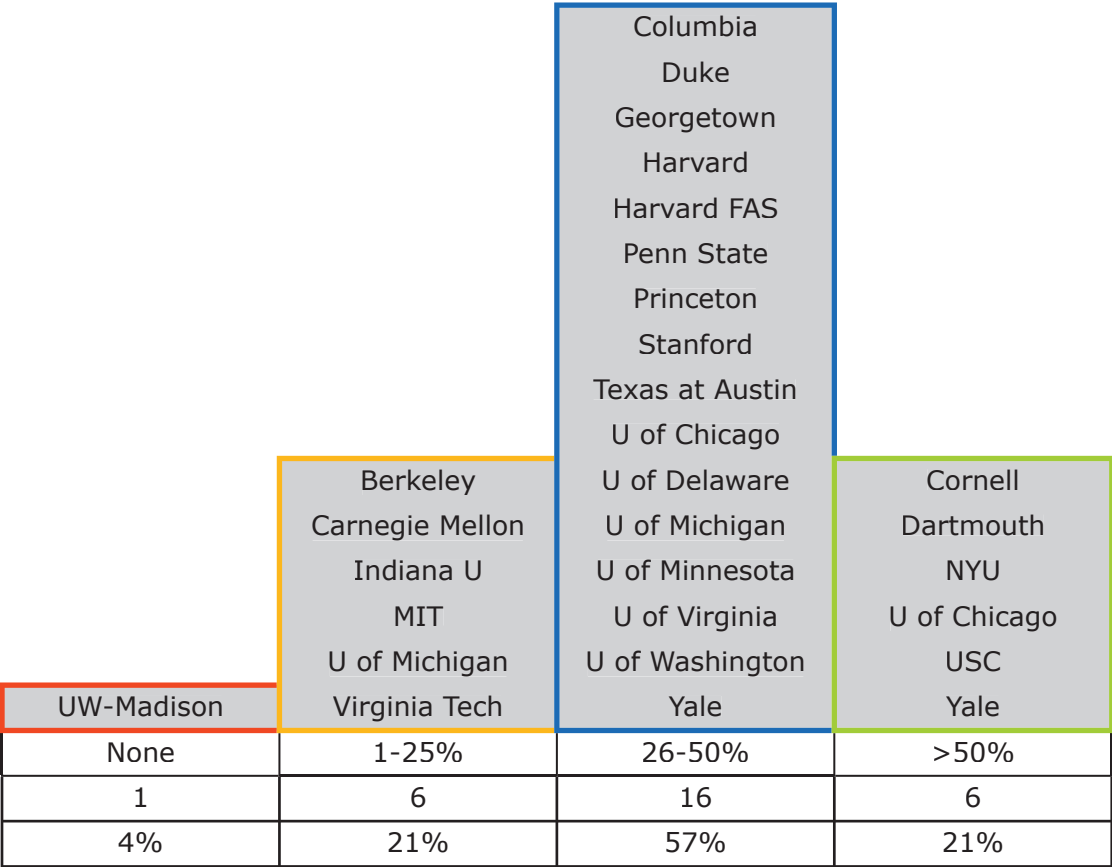
Duke	more like majority of space for medium density and some ultra high.
NYU	But would like ability to increase percentage of high density over time if required
Texas at Austin	We will plan to have sufficient power and cooling that can be distributed as needed. As mentioned earlier, we'll plan for expandability and upgrades without disruption to systems in the data center.
U of Washington	planned average is 200 watts/sqft
U of Michigan	A portion of the new facility will be high density.

**12. Do you expect to use water-cooled racks for your planned space?**



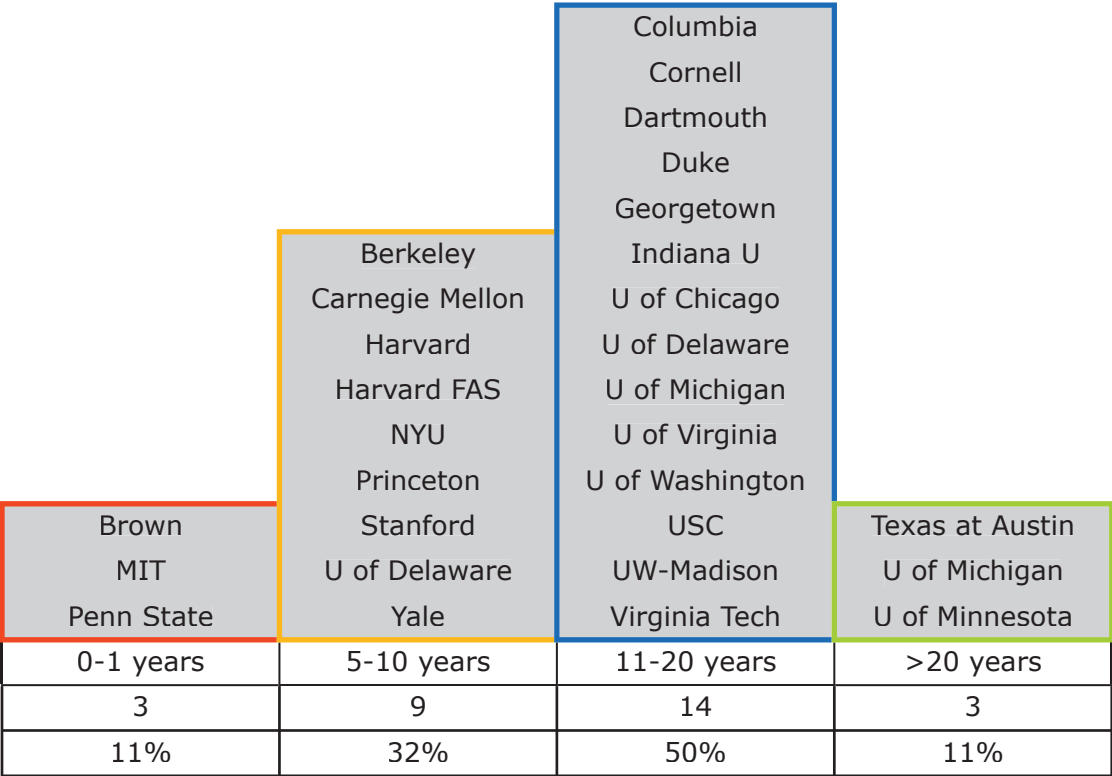
Duke	only for HPC, not for enterprise. 4kW for enterprise, 18kW for HPC.
UW-Madison	Not currently although we have discussed the possibility in the future
Carnegie Mellon	If density of special cases requires it
MIT	we will investigate

**13. What excess capacity are you planning for power and cooling beyond your new data center needs?**



Carnegie Mellon	Our plan is to triple capacity. We dont expect to get to that max leaving 1- 25% headroom
Indiana U	Unsure of the question
Duke	Depending on what space we get it may be less. we are looking for multiple locations so how we divide the space will determine utilization and excess capacity.
U of Washington	initial core and shell, systems buildout in 5-yr chunks, maintaining 25% margin until capacity reached

**14. What is your expectation for number of years you can use new or expanded data center space?**



U of Chicago	right, like I can predict...
UW-Madison	IF we were actively planning new space.
NYU	Highly subjective
Texas at Austin	Although 20 years sounds optimistic considering rapidly changing demands, our goal is to design the data centers facilities to be easily expanded or upgraded without service interruption.

**15. If you have data center plans, who is doing the planning and design work:  
(Check all that apply.)**

	Berkeley		Berkeley
			Brown
Carnegie Mellon			Carnegie Mellon
	U of Chicago		U of Chicago
Columbia			Columbia
			Cornell
Dartmouth			Dartmouth
Duke	Duke	Duke	Duke
Georgetown			Georgetown
Harvard	Harvard	Harvard	Harvard
Harvard FAS	Harvard FAS	Harvard FAS	Harvard FAS
Indiana U			Indiana U
U of Michigan	U of Michigan	U of Michigan	U of Michigan
U of Minnesota			U of Minnesota
MIT	MIT	MIT	MIT
NYU	NYU	NYU	
Penn State	Penn State		
Princeton	Princeton	Princeton	Princeton
Stanford	Stanford	Stanford	Stanford
Texas at Austin	Texas at Austin		
USC			
Virginia Tech	Virginia Tech		
U of Virginia			U of Virginia
U of Washington	U of Washington	U of Washington	U of Washington
UW-Madison			UW-Madison
Yale	Yale	Yale	Yale
University facilities group	University IT group	Senior university management	Consultants contracted for planning and/or design
22	15	10	21
79%	54%	36%	75%

Brown					Bruns-Pak Consulting
Columbia					We have not started this but when we do we would do all that I have checked above.
Duke					Consultants hired by fac group without IT involvement. No HPC experience.
MIT					Joint Faculty-IT committee assisted by outside consultants.
Texas at Austin					Up to this point it has mainly been the IT group that has done the planning but we will involve a design consultant when we get closer to implementation.
Virginia Tech					We may wind up hiring consultants, but have not so far.
UW-Madison					Reflects the model we have used and would use in the future.

**16. When thinking about your current and future plans, which of the following do they include? (Check all that apply.)**

Berkeley		Berkeley	
	Brown		
		Carnegie Mellon	
	U of Chicago	U of Chicago	
	U of Colorado		
Columbia		Columbia	
		Cornell	
		Dartmouth	
U of Delaware		U of Delaware	
Duke	Duke	Duke	Duke
	Georgetown	Georgetown	
	Harvard	Harvard	
	Harvard FAS	Harvard FAS	Harvard FAS
Indiana U	Indiana U		
	U of Michigan	U of Michigan	U of Michigan
		U of Minnesota	
	MIT	MIT	MIT
	NYU	NYU	NYU
	Penn State	Penn State	Penn State
	Princeton	Princeton	
		Stanford	
		Texas at Austin	
USC		USC	
		Virginia Tech	
U of Virginia		U of Virginia	
U of Washington		U of Washington	U of Washington
		UW-Madison	
	Yale	Yale	
Primarily a data center on campus	Multiple data centers on campus	Campus data center(s) and a remote disaster recovery site	One or more off campus data center(s) development
8	14	25	7
29%	50%	89%	25%

Brown					We are just starting to consider two datacenters with the possibility of one on campus and one off campus. It is likely that the primary would actually be the one that is off campus
U of Chicago					offsite only for certain key communication functions
U of Chicago					Remote and possible commercial service
Cornell					plans are for 2 campus datacenters and a remote cold site
Duke					I realize all 4 checked is a tad strange - but we are considering everything
Georgetown					Currently separate research from production, considering merging the two
Indiana U					We manage data centers on multiple c am psues and so we think of cross campus data centers
Texas at Austin					The goal is to have at least one data center on campus and another at another UT System site for disaster recovery.
Virginia Tech					We may go with some satellite centers for our use, but definitely looking at DR
U of Virginia					We'd like a second on-campus data center but don't know if/how we'll accomplish that
U of Washington					New primary data center within 15 mi of campus, retain current data center as refurbished secondary, and small DR site 300 miles away in a more stable seismic region.



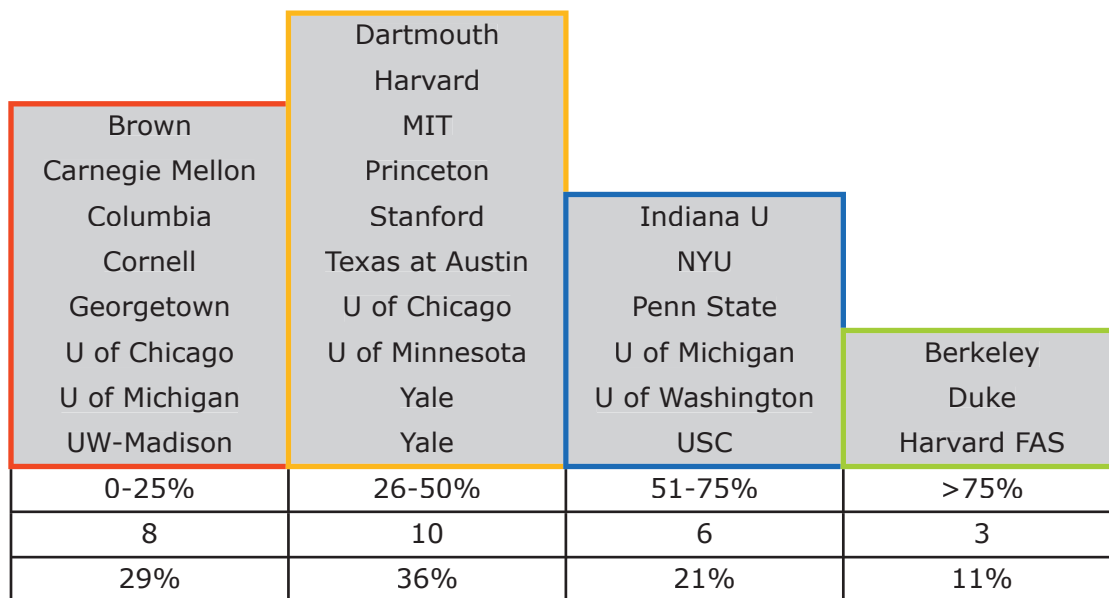
# **Research and Academic Computing**

**17. What percent of your current space is for Research Computing and Academic Computing (storage, grid, course management, etc.)?**

Brown Carnegie Mellon Cornell Dartmouth Duke Georgetown Harvard Harvard FAS MIT Princeton Stanford Texas at Austin U of Chicago U of Colorado U of Michigan U of Minnesota UW-Madison Yale	Berkeley Columbia Indiana U NYU Penn State U of Delaware U of Michigan U of Virginia U of Washington Virginia Tech	U of Delaware USC
0-25%	26-50%	51-75%
18	10	2
64%	36%	7%

Duke	it should be noted that current numbers show 25% space but power/cooling requirements are about 50-60% of our current computing requirements for campus central IT.
U of Michigan	administrative and student processing
UW-Madison	Very little central space dedicated to research. Most research computing and storage is distributed all over Campus
U of Washington	steadily increasing

**18. If you are expanding, what percent of your total planned space will for Research Computing and Academic Computing?**



Columbia	We have not really received information from the Research people.
Duke	want to double or triple our current space from 1000 sf to 3000 sf.

**19. What is the model for Research Computing with your faculty in your data center? (Check all that apply.)**

	Berkeley	Berkeley	
Brown			
	Carnegie Mellon		
U of Chicago	U of Chicago	U of Chicago	
U of Colorado			
Columbia			
Cornell			
		Dartmouth	
		U of Delaware	
		Duke	Duke
Georgetown		Georgetown	
Harvard	Harvard		
Harvard FAS	Harvard FAS	Harvard FAS	Harvard FAS
			Indiana U
U of Michigan	U of Michigan		
U of Minnesota			
MIT	MIT	MIT	
NYU	NYU	NYU	NYU
Penn State	Penn State	Penn State	Penn State
	Princeton		Princeton
Stanford			
	Texas at Austin		
	USC	USC	USC
		Virginia Tech	
		U of Virginia	U of Virginia
	U of Washington	U of Washington	
UW-Madison			
Yale	Yale	Yale	
No colocation - faculty house computers in their own lab space	Colocation - separate spaces for each research group, with or without cages, no system administrator help	Colocation - separate spaces, with system administrator help	Condominium approach where faculty buy into large cluster with 'fair-share' scheduling
16	14	15	8
57%	50%	54%	29%

U of Delaware					We are considering "condominium"
U of Michigan					We're putting together a condominium collaboration.
U of Minnesota					currently, plan to change
NYU					We have a bit of everything
Texas at Austin					Currently there is very little research computing in our data center facilities. Most of what we have is for academic computing. The Texas Advanced Computing Center (TACC) has a "condominium" type setup that offers shares in their cluster.
Virginia Tech					We actually do both, some folks want sys admin help, some don't
U of Virginia					Only systems under support contracts to central computing are eligible for collocation
U of Washington					Managed server with a range of sysadmin services is also available.

**20. Who provides system administration within the (Research Computing) data center? (Check all that apply.)**

Berkeley	Berkeley	Berkeley	
Brown	Brown	Brown	
Carnegie Mellon	Carnegie Mellon	Carnegie Mellon	
U of Chicago	U of Chicago	U of Chicago	U of Chicago
			U of Colorado
			Columbia
Cornell			
			Dartmouth
U of Delaware	U of Delaware	U of Delaware	U of Delaware
			Duke
Georgetown	Georgetown		
Harvard	Harvard		
Harvard FAS		Harvard FAS	
Indiana U	Indiana U	Indiana U	
U of Michigan	U of Michigan	U of Michigan	
	U of Minnesota		
MIT	MIT		
	NYU	NYU	
Penn State	Penn State	Penn State	
Princeton	Princeton	Princeton	
Stanford	Stanford	Stanford	
Texas at Austin	Texas at Austin	Texas at Austin	
USC		USC	
			Virginia Tech
	U of Virginia	U of Virginia	U of Virginia
U of Washington	U of Washington	U of Washington	
			UW-Madison
Yale	Yale	Yale	
Research group provides their own (could be faculty, staff or graduate students)	Full time system administrators for administrative computing	Full time system administrators for research and academic computing	One group of system administrators provides support for all systems
19	19	17	9
68%	68%	61%	32%

Columbia					We have no research at the present time.
Texas at Austin					ITS Systems group has full-time system administrators. Some collocated servers are administered by ITS User Systems groups under an SLA for services. Some collocated systems are administered by the department that owns them.
U of Virginia					There is a systems area composed of a few groups that deals with all system types
UW-Madison					As stated very little actual research computing in our central data center

Survey Administration  
and Reporting by

