The Pros and Cons of Modular Systems

Kevin Brown,
Vice President Global Data Center Offer
Schneider Electric

Desired characteristics of pre-fabricated modular systems

Flexibility

- Scalability
- Handles uncertain growth plans
- Quick to deploy

Cost Effective

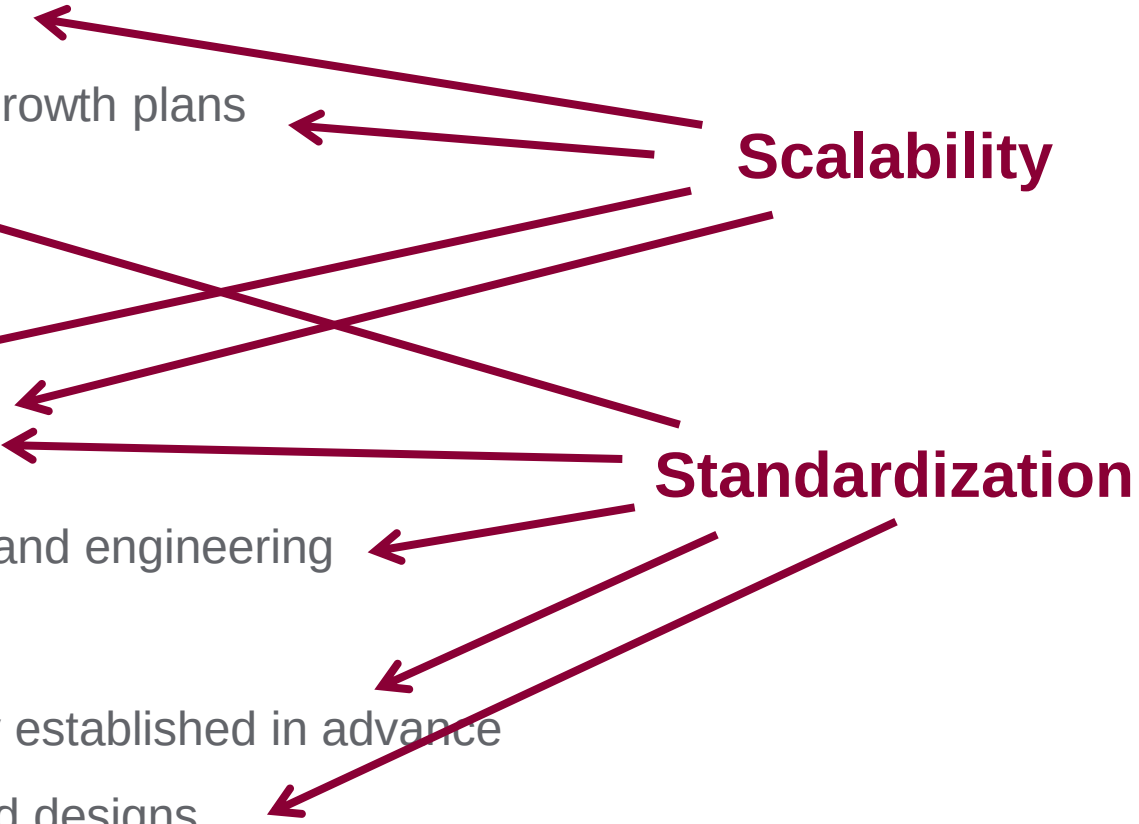
- Right-sized
- Low energy costs
- Simplified planning and engineering

Predictable

- Performance clearly established in advance
- Tested and validated designs

Desired characteristics

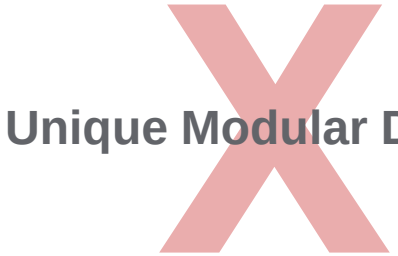
- Flexibility
  - Scalability
  - Handles uncertain growth plans
  - Quick to deploy
- Cost effectiveness
  - Right-sized
  - Low energy costs
  - Simplified planning and engineering
- Predictable
  - Performance clearly established in advance
  - Tested and validated designs



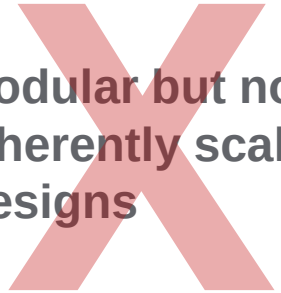
> ***Standardization and Scalability are the key. Modularity is just a technical tool that can help us achieve these.***

Modularity is valuable only to the extent that it helps achieve standardization and scalability

Modularity is valuable only to the extent that it helps achieve standardization and scalability



Unique Modular Designs



Modular but not inherently scalable Designs

What is a modular architecture?

It defines a set of modules from which data centers are deployed

The set of modules includes the necessary and sufficient subsystems to create the data center

Subsystems are packaged together to in order to minimize complexity of deployment.

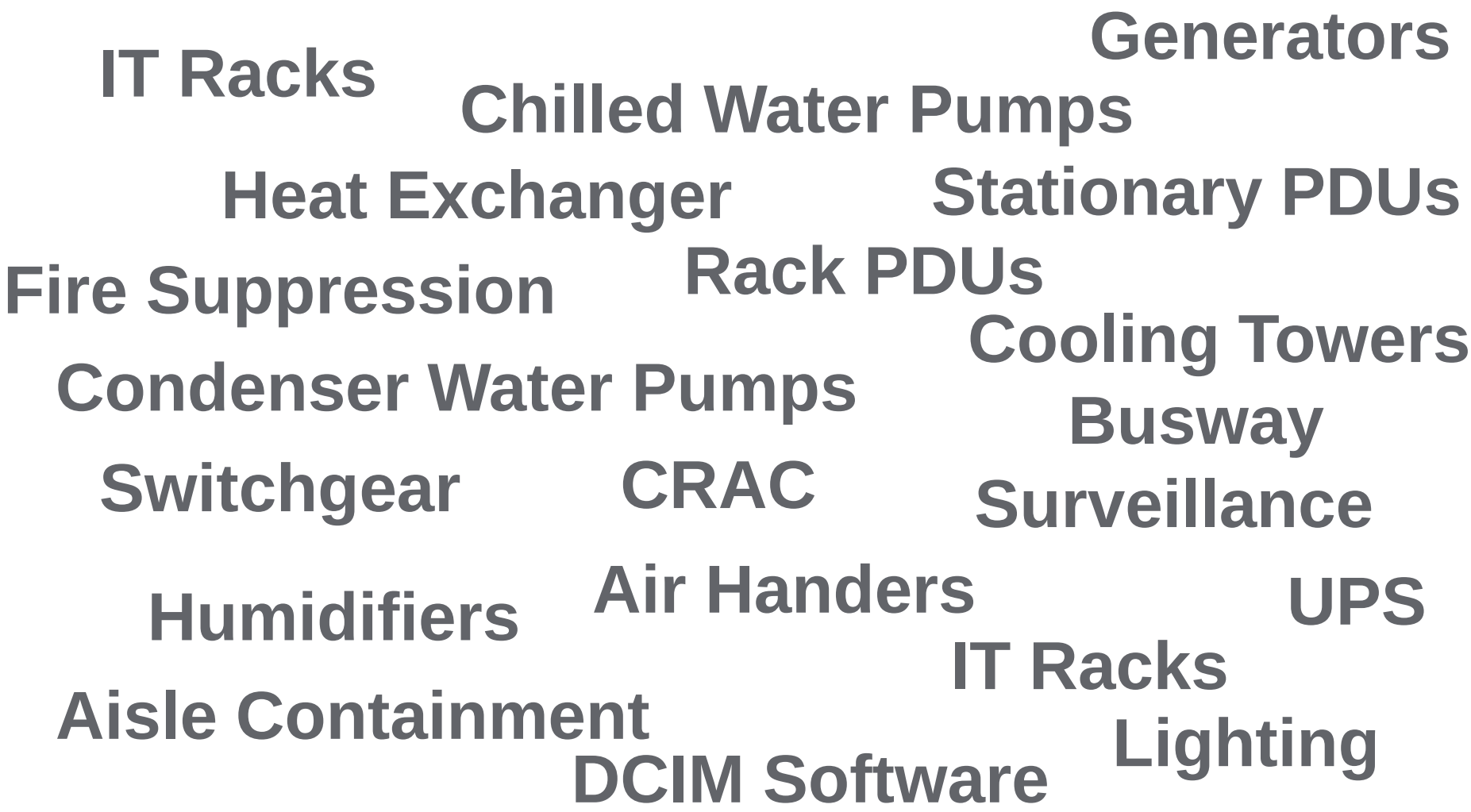
It is comprised of rules, tools, and methods that together prescribe how modules are deployed over time to support the growth plan for the data center

The compatibility and system performance of prescribed combinations of modules are assured in advance

What makes a modular architecture better?

- The system is engineered to minimize the planning, installation, configuration, and programming work required to deploy IT capacity.
- The “granularity” of module sizes has been established to be an effective tradeoff between cost, simplicity, and rightsizing for the application
- It achieves better performance for the application (smaller, lower PUE, lower water use, lower failure rate, etc)
- It allows for future options related to availability (redundancy) and power density

Data Center Sub-systems to be packaged in a modular architecture



Modularity Types

how implemented in devices

Device modularity: devices are made up of modular components

Examples:

a large UPS frame that holds UPS modules

a large air handler containing fan modules

Subsystem modularity: a functional block is made up of multiple devices of the same type

Examples:

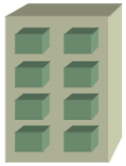
a parallel array of UPS

a parallel array of independent air handlers

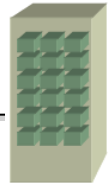
> ***The function can be obtained by either or a mix of types. Subsystems (power, cooling, etc) can use different types***

Device Modularity

Power Modules

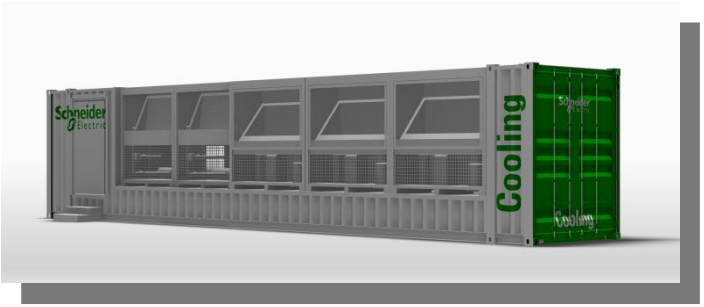


Battery Modules



Power Distribution Modules

Sub-System Modularity



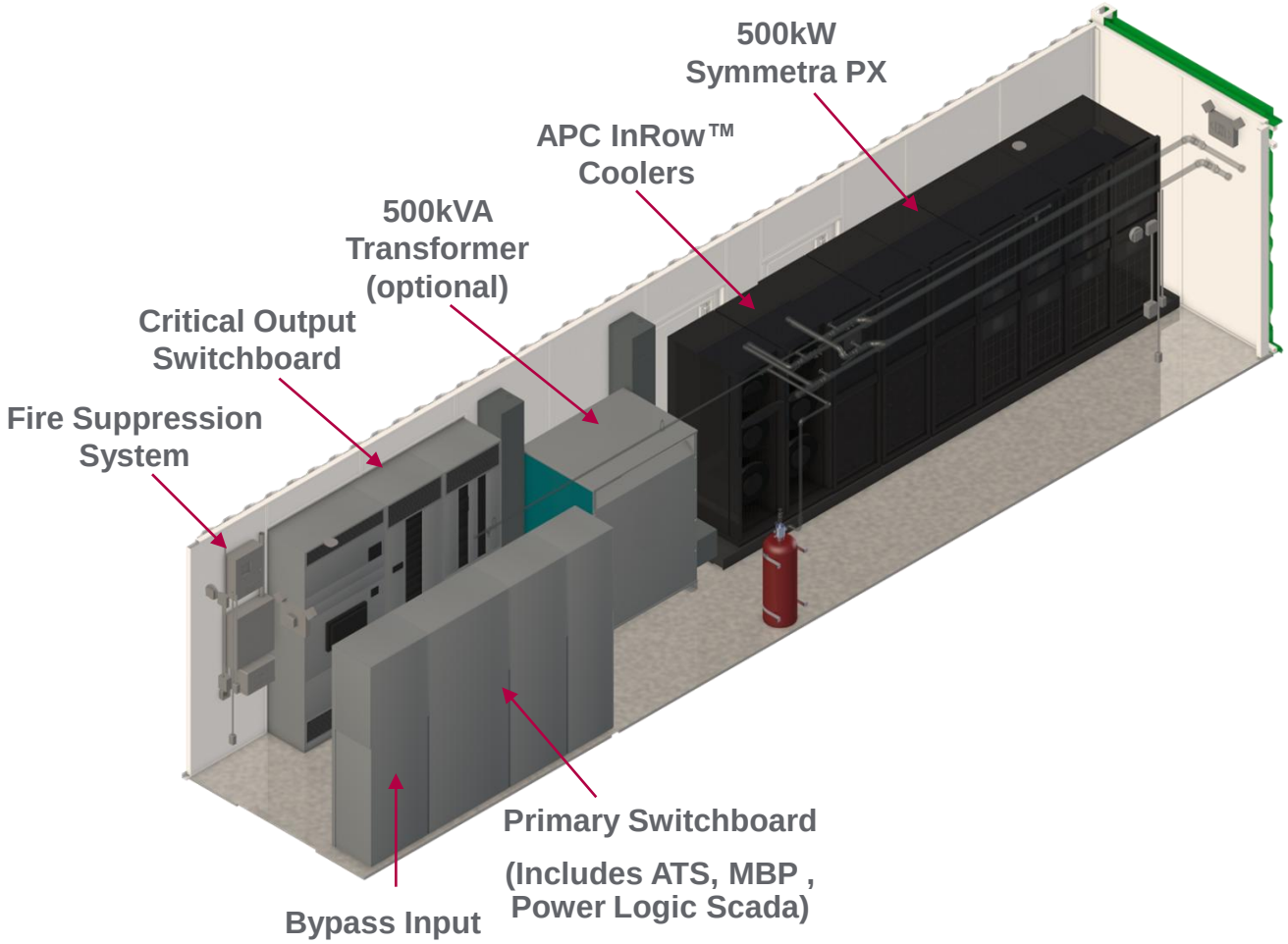
COOLING MODULE
Chilled water
500kW

POWER MODULE
500kW UPS
1000kW Switchgear

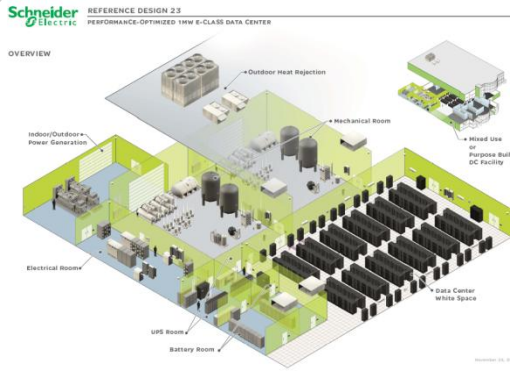
COOLING MODULE
Air
400kW

Power Module Integrated Sub-System

Sub-System Modularity



DCIM Simplified



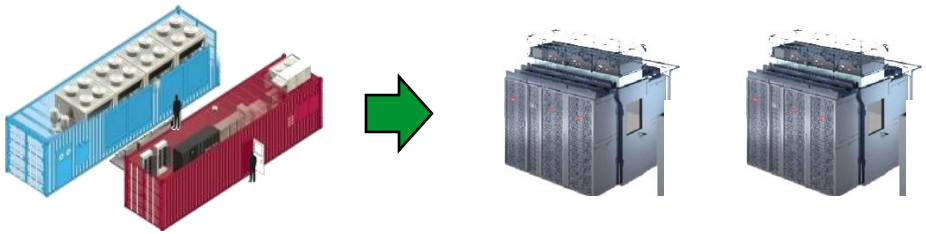
An individual component approach requires programming unique to each datacenter.

SIMPLIFIED by managing the datacenter with centralized management of the integrated sub-systems.

More efficient and easier to manage.

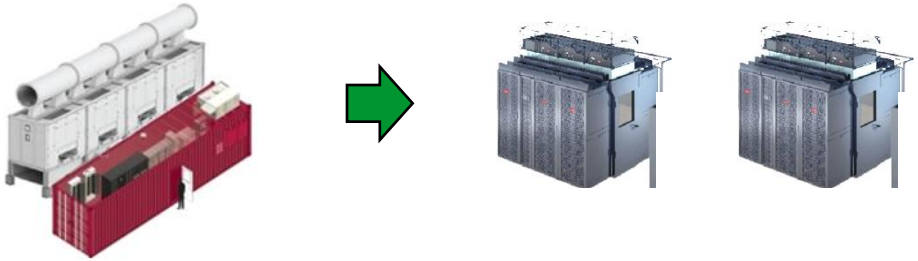
Basic forms of pre-fab modular power and cooling

1



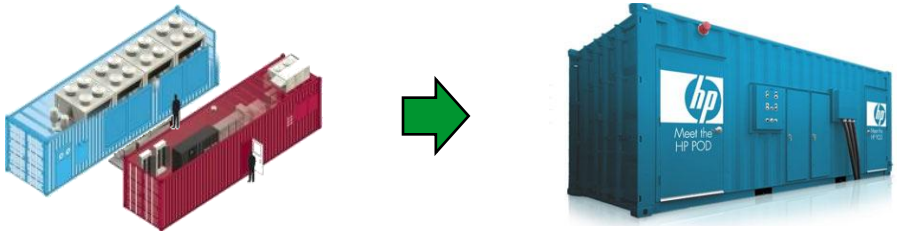
Plant provides power and cooling fluid to liquid cooled IT pods in rooms

2



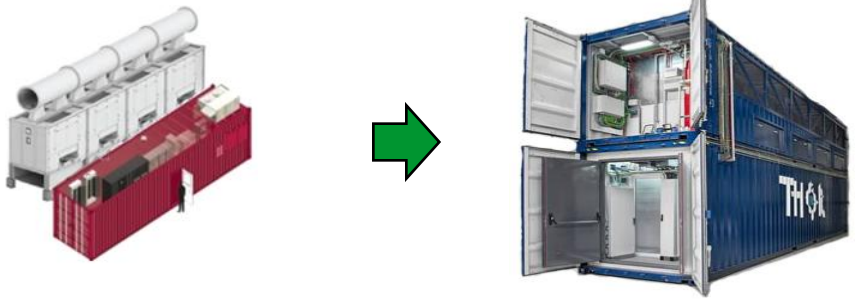
Plant provides power and chilled air to air cooled IT pods in rooms

3



Plant provides power and cooling fluid to IT containers

4



Plant provides power and chilled air to IT containers

Note: All systems designed for IT loads using hot aisle containment

Magic numbers affecting modularity

- 2.25MW: The maximum size generator set that ships on roadways without special permits
- 8 x 8 x 40 ft: The size of an ISO shipping container
- 800KW: The maximum transformer size that does not require supplemental downstream leakage current detection systems
- 3000A: The maximum current rating of switchgear before the design must change to a larger and more expensive system
- 14kW: The maximum size of a 415/240V rack PDU that does not require integral branch circuit breakers
- 10,000 Amps: The maximum fault current of a power bus supplied to an IT space
- 89 degrees F: maximum temp an IT operator can be continuously exposed to

> ***Numbers like these tend to drive modules toward optimal sizes and interfaces that should become standards***

Benefits when modules are standardized

- Simplification of software and design process
- Rightsizing, add capacity with less disruption
- Speed of deployment and commissioning
- Pre-characterized performance
- Pre-fabrication – higher quality
- Mixing of types of IT modules (density, redundancy)
- Simplified maintenance programs
- Lower initial and lifecycle cost

Modular approaches are well suited for retrofits; drop in with less disturbance

Downsides of standardized modularity

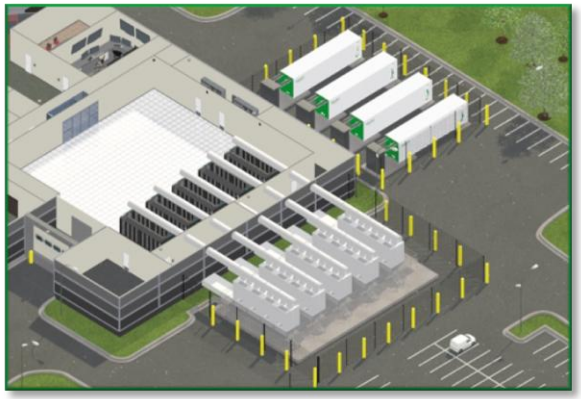
- Customers may need to abandon certain preferences and internal standards
- Customers cannot choose an arbitrary final or step size, because capacity may only be available in certain size increments
- Some building shells or sites may be poorly suited or incompatible with available modules (ceiling height, room shape, accessways, etc)
- Unless standards emerge, customers choosing one architecture may feel “locked in” and find it difficult to move to alternative vendors for future expansion

Possible Growth Inhibitors

- Market Resistance to Change – Existing physical datacenters are expensive and difficult to build, etc. However, they are a proven commodity
- Modularity as the Standard - Vendors must standardize their offerings, or a major hurdle to wide-scale adoption will continue to limit growth potential
- Prefabricated availability– Vendors must build inventories of standardized data centers modules to realize delivery times
- Understanding Costs– Must be able to do ‘apple to apple’ total installed cost comparison versus stick built – not just ‘hardware costs’

The Future of Prefabricated Modularity

- Subsystems eventually packaged into three modules :
  - Power plant
  - Cooling plant
  - IT space



- Differing needs will require different modular architectures:
  - Size increments
  - redundancy
  - climate
  - retrofits
- Industry standards for module interfaces need to emerge
- A common language for specification of modular data centers will emerge

Questions?

Resources

The Specification of Modular Data Center Architecture

Schneider Electric White Paper 160

Containerized Power and Cooling Modules for Data Centers

Schneider Electric White Paper 163