The Benefits and Implementation of Modular Data Centers

James Alvers, HP CFS / November 20, 2013

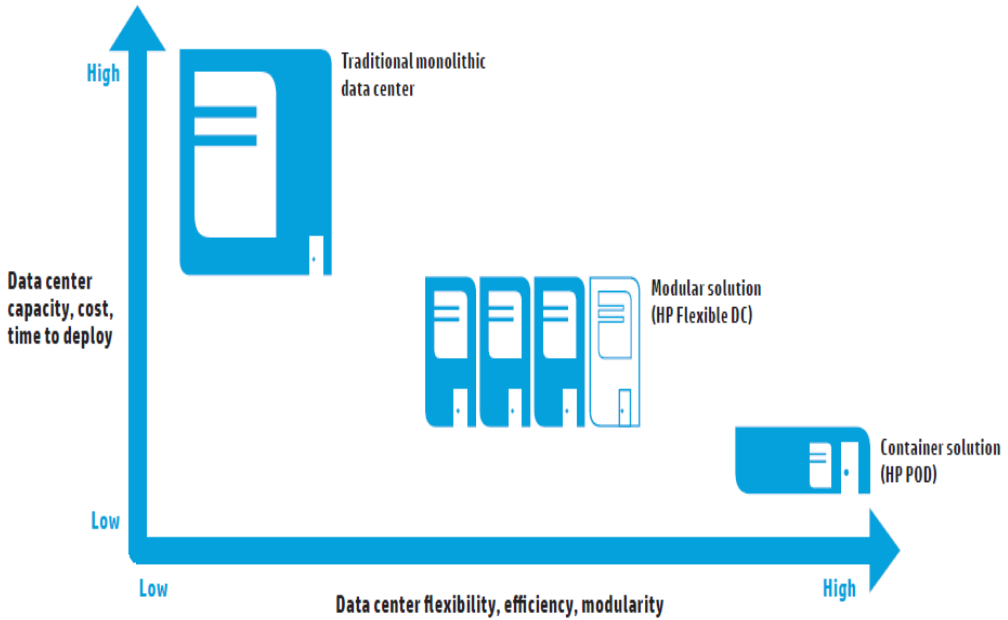
Agenda:

- Modular Data Center Concepts
- IT Evolution
- HP IT Infrastructure Strategy
- Deployment Process & Example
- The Result
- Modular Components Overview
- Application Potential
- Comments and Q&A

Data Center Design Demands

Driving Levels of Modularity: Custom to Appliance

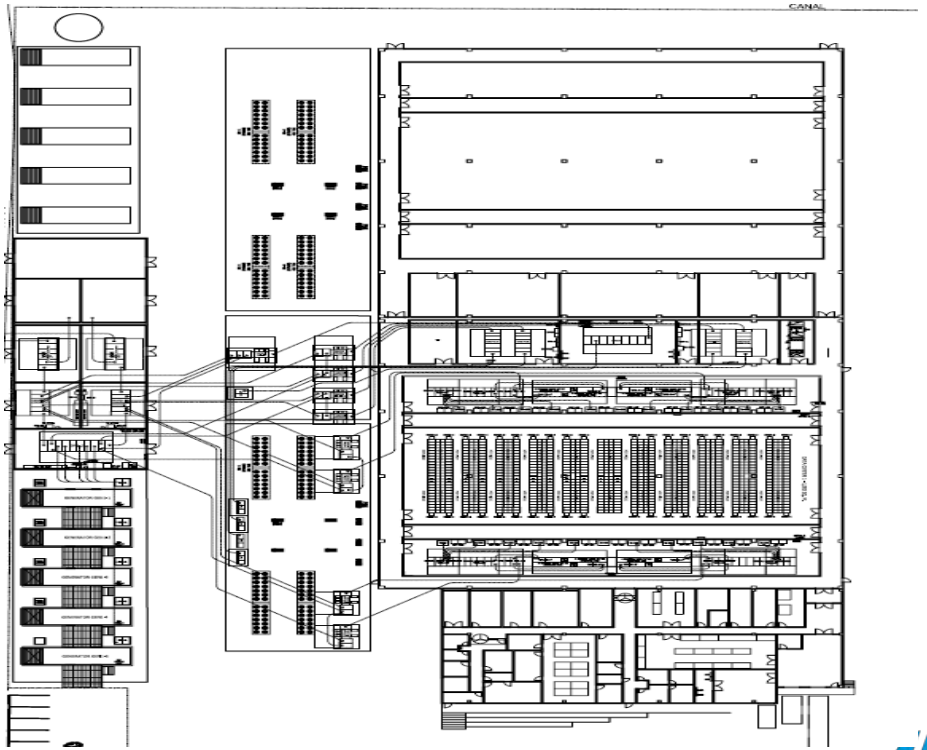
- **Meets the "Business Needs"**
- **Reliable and available**
- **Resource & space and efficient**
- **Converged & "Integrated"**
- **Scalable, modular and elastic**
- **A Shared resource pool, dynamically provision**
- **Fully automated**
- **Speed of design, procurement & deployment**
- **Self-regulating**
- **Standardized processes & policies**
- **Fully available and resilient**
- **Monitoring & control**
- **Fully service-oriented**
- **Adaptable to future IT**
- **Lowest OpEx & CapEx**



Monolithic Brick & Mortar

Unique or with Modular Template

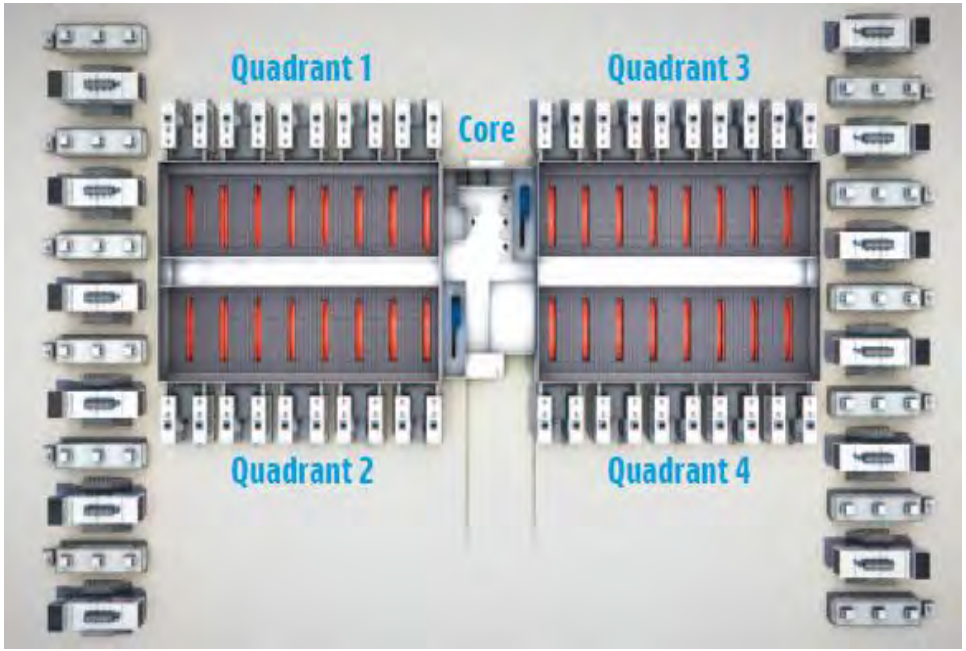
- Custom-built onsite.
- Typical design cycle: 1 year
- Typical construction cycle: 1-2+ years
- Not very scalable
- Highest CapEx and OpEx
- Built now for all future eventualities
- Does offer high customization and creature comforts



Flexible Data Center

The Industrialized Data Center

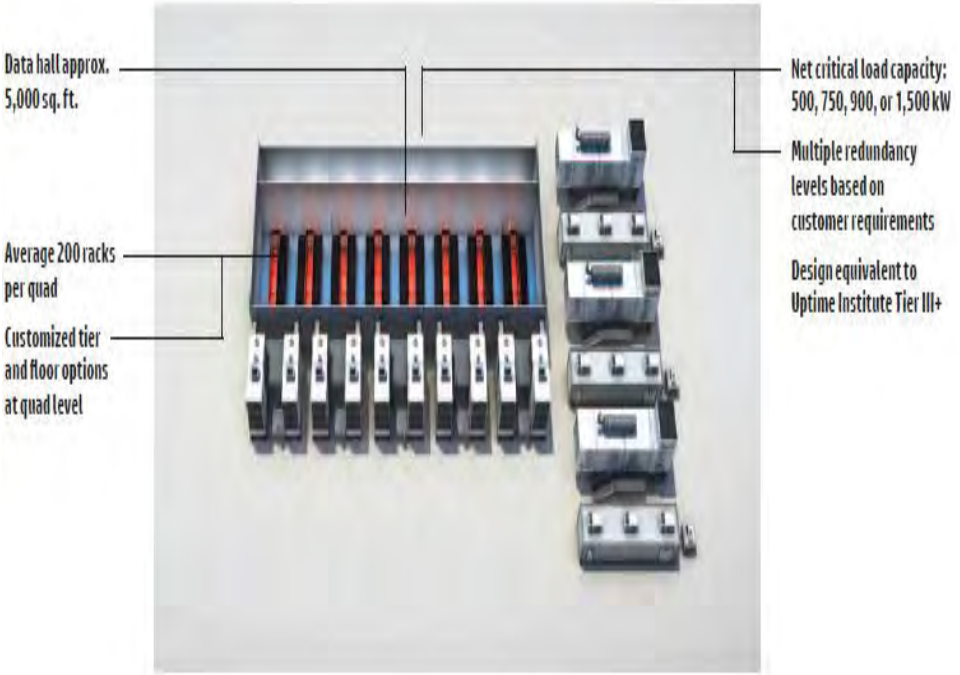
- Efficient tilt-up, precast, or prefabricated construction for core & whitespace
- External power and cooling modules factory built and tested.
- Start with 1 Quad, capability of adding capacity as necessary
- Broad turnkey options: menu-driven selection, quads can have different uses cases, density, tiers etc.
- Standardized set of design, construction materials and prefabricated components from established supply chain
- Reduced design cycle
- Variety of cooling designed for minimum possible energy consumption
- Integrated security and fire protection



Flexible Data Center

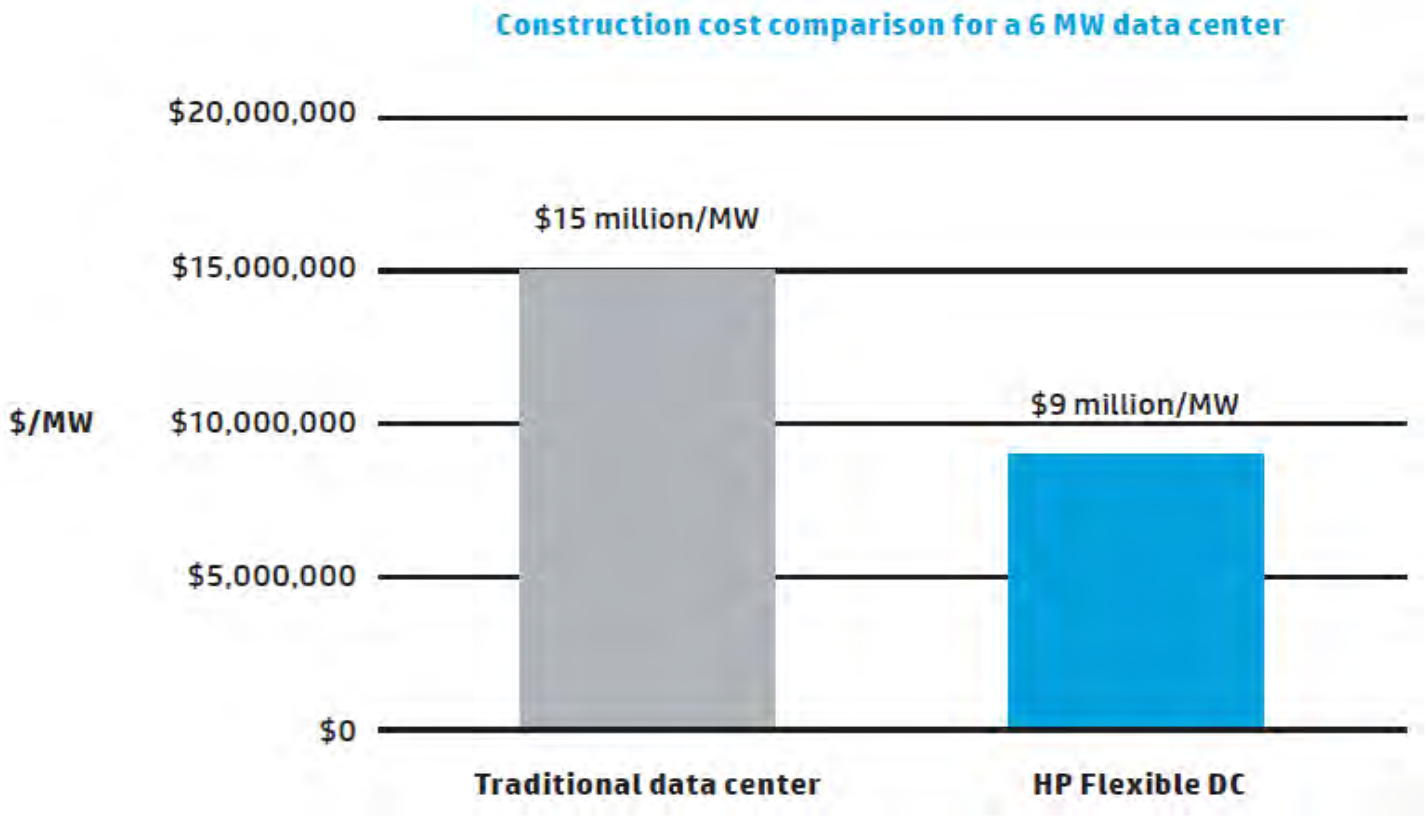
The Industrialized Data Center

- Efficient electrical power supply chain with variety of uninterruptable power supply (UPS) systems with minimum conversions
- Excellent operational efficiency demonstrated by PUEs of 1.2 or lower that signal OpEx cost savings
- Concurrent maintainability and fault tolerance eliminating single points of failure and providing capability for maintenance procedures
- Reduced onsite installation, startup and commissioning cycle
- Possible 1 year deployment



Saving on CapEx

Modular Construction can cut capital cost by 40%



Data Center Site Infrastructure Tier Standards

Modular designs can be configured to any tier rating (Uptime Institute)

	Tier I	Tier II	Tier III	Tier IV
Active Capacity Components to Support the IT Load	N	N+1	N+1	N After any Failure
Distribution Paths	1	1	1 Active and 1 Alternate	2 Simultaneously Active
Concurrently Maintainable	No	No	Yes	Yes
Fault Tolerance	No	No	No	Yes
Compartmentalization	No	No	No	Yes
Continuous Cooling	No	No	No	Yes

Premanufactured DC's

Containerized DC's

- Many types and configurations:
  - All in ones
  - IT/data only
  - Power and UPS equipment
  - Cooling modules
- Can conform to ISO standards for size and transport:
  - 10-, 20-, 40-, and 53-ft lengths standard
  - 9.5-ft width typically
- Non ISO:
  - Can be any size
  - Can be occupied
  - Can meet IFB/IFC codes
- Lowest Capex
- Very Scalable

Premanufactured DC's

Containerized DC's

- Usually built to UL 2755; not occupied
  - Code officials often unfamiliar
- Scalable
- Up to 20 conventional IT racks
- 3 kW to 40 kW per rack and higher
- Maybe built to IFB/IFC codes
- Factory built and tested
- Rapid deployment for emergency, incremental capacity, specific use case (density, HPC), short term needs etc. usually 6 months.
- Installed outside, inside and often relocatable

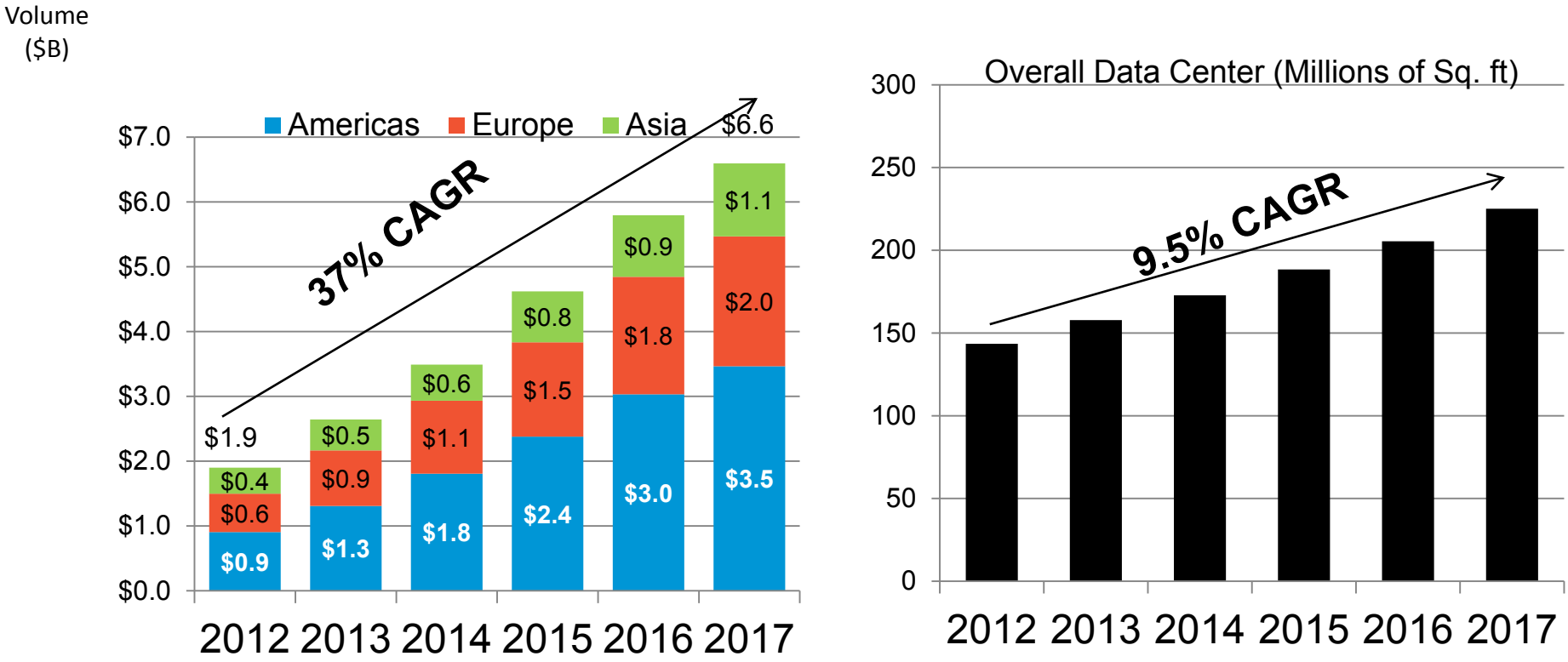
	HP POD 20c	HP POD 40c Std density
Length with clearance	24ft (20ft)	41.5ft (40ft)
Max weight	50,000lbs	100,000lbs
Max non-redundant power capacity	290kW	450kW
Max redundant power capacity	145kW	291kW
Power busways	2 x 225A	4 x 225A
Rack capacity	10 50U racks	20 50U racks
Total U-space	500U	1000U
Equivalent traditonal DC	2000 sqft	4000 sqft
Density	960 Servers or 5400 HDs	1920 Servers or 12,000 HDs
Flow rate of required chilled water	120 gpm	240 gpm

UL Certification

UL2755

To answer the needs from the information technology industry stakeholders such as equipment manufacturers, users and authorities having jurisdiction (AHJs), UL developed the world's first safety standard for modular data centers – UL subject 2755 outline of investigation (OOI). The subject not only covers the installation of servers in a CDC, but also addresses the safety of power distribution, cooling systems and smoke/fire protection systems – basically all of these being used together as a system in one "container" and then viewed as a product that only needs to be evaluated for proper installation in the field.

Container Datacenter Market Forecast



Containers Increasing 37% CAGR , Overall Data Center Market increasing 9.5% CAGR

Sources: IHS Research, "*World Market for Containerized Data Centers, 2012*"
Frost & Sullivan, *"Data Center Market Update 2012"*

IT Evolution

The growing Internet of Things (IoT)

2013

- 416,340 tweets
- 23,148 apps downloaded
- 400,710 ad requests

60 sec

Today

- 2000 lyrics played on Tunewiki
- 1,500 pings sent on PingMe
- 208,333 minutes Angry Birds played

Pervasive connectivity | **Smart device expansion** | **Explosion of information**

By 2020

30 Billion(1) Devices

40 (2)**Trillion GB** DATA

Mobile Apps **10 Million**(3)

(4) **… for 8 Billion**

The IoT is a world where nearly everything is connected to a data center, items like cars, home appliances, glasses, watches, jewelry, clothes…. even packaged goods. Every one of these devices will, one way or another, be connected to a data center for control, management, and analysis. The required data center capacity cannot be served effectively with current data center and server architectures.

The changing IT world

Additional business drivers

Continuous connectivity

- Mobile apps
- Social networking
- On demand services

Advanced analytics

- Big data
- HPC

New revenue opportunities

- Business expansion

The Compute Cloud

Is real and maturing
Has advantages for everyone
Benefits will drive adoption

Object storage (data cloud)

Business and consumer
Anything, (almost) anywhere, anytime
Nothing ever goes away

Preconfigured solutions

Integrated deployments of hardware & software

The Changing IT World

On the other hand, New and Enhanced Types of IT Equipment

Moonshot and future servers

- Moonshot: 89% less energy in 80% less space for 77% cost
- Future servers will provide similar value in other ways
- Next generation servers will offer significant economy as well

Storage evolution and revolution

- Density and power savings continue
- Memristor will be a game changer

Advanced networking and SDN

- Optimized flexibility

Security, backup…

What is the impact?

Benefits to the IT infrastructure organization

Data center power consumption shrinks, dramatically (to perform the same work)

Specific examples from several real world scenarios:

- 89% (9.1X) reduction from current traditional servers to Moonshot
  - 34X (or more) reduction from older servers to Moonshot
- 87% (7.7X) reduction in watts per TB of enterprise storage, over four years
- 96% (20X) reduction moving four year old servers into our Compute Cloud

Similarly, a small fraction of data center physical space is required

R&D engineers are really good at getting more work done per watt…

They are even better at putting things in smaller packages!

- Power densities, especially for servers, continue to rise
- For many new server deployments, very high density space is desirable

What is the impact?

An couple of interesting – and key – effects

The TCO of a unit of IT work continues to decrease rapidly

The cost to do the same work is a tiny fraction of what it cost a couple years ago

The cost to do the same work tomorrow will be a tiny fraction of today

- The IT TCO is much much less – other than network bandwidth
- The facility TCO to run the IT is much much less

Efficiency Breeds Demand

Driving down the cost increases demand

The lower the cost, the higher the demand

- New use cases have a positive ROI
- Incremental deployments achieve revenue and profit growth
- Long desired capabilities become possible and bring value

The Rebound Effect

Jevons Paradox

“Technological progress that increases the efficiency with which a resource is used tends to increase (rather than decrease) the rate of consumption of that resource”

– Wikipedia quote of Blake Alcott, Ecological Ergonomics, 2005

HP IT Infrastructure Strategy

What's in an HP Data Center?

HP IT for HP Internal Operations

HP software

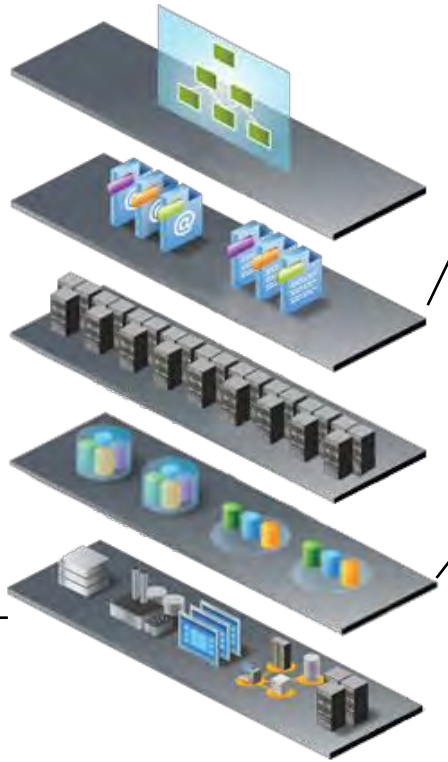
- HP Server Automation
- HP Operations Orchestration
- HP Universal CMDB Configuration Manager
- HP SiteScope

HP servers

- HP Moonshot
- HP ProLiant BL-series Blades
- HP ProLiant DL-series
- HP ProLiant SL-series

HP data centers

- HP 240a EcoPOD
- Conventional Brick & Mortar



HP networking

- HP Intelligent Management Center
- HP Network Automation
- HP Network Node Manager
- HP Networking Switches and Routers
- HP Tipping Point Intrusion Prevention Systems

HP storage

- HP 3PAR P10000
- HP XP P9500
- HP SAN Switches

Why additional capacity?

What is driving the demand for more data center space?

We have six really really good Brick and Mortar Data Centers

Consolidated all business applications into new Next Generation Data Centers in 2007-2009

- The data centers remain excellent enterprise class facilities and we will continue to fully utilize them

We continually transform applications and the underlying IT infrastructure

Focus on Company TCO of the business solution

- Normally, Continual IT Transformation would result in more than enough data center capacity for growth

However, efficiency breeds demand!

Incremental deployments grow revenue and profit

Capacity options considered

We fully reviewed multiple options to determine the best strategy

Traditional brick and mortar

Build an advanced energy efficient but still conventional brick and mortar data center

- Known entity, high initial cost for significant capacity, lengthy funding to IT production cycle

Build a “Flex-DC” using a brick and mortar whitespace with modular infrastructure

Leverage the quality and savings inherent in pre-configured factory built facility infrastructure

- Similar timeline to brick and mortar, new to everyone

Utilize a fully Containerized Modular Data Center approach

Deploy the HP 240a EcoPOD with third party containerized facility infrastructure from partners

- Rapid construction & deployment, factory racked & configured IT, likely most efficient, new to everyone

Selection criteria

Selected HP IT *requirements* for data center space – in random order

Continuously available

100.00% available (or as close to it as humanly possible)

- Meets all HP IT and Real Estate requirements for concurrent maintainability and fault tolerance

Optimally accommodate current and next generation IT

Ultra density space, flexible enough for different types of IT equipment

- Must be capable of supporting our current and future BL-series Blade Enclosures, Moonshot, and future servers

Zero changes to IT or facility support models

Existing processes, policies, and procedures applicable without compromise

- Applies to both deployment and support

Selection Criteria

Selected HP IT *goals* for any data center space – in random order

Low TCO

Low initial cost, low operating cost

Highly efficient facility

Incorporate industry leading energy efficiency practices – low yearly continuous PUE average

"Right sized" units of capacity

Avoid overbuilding expensive data center capacity that may never be used

Rapid timeline (from funding to IT production)

"Just in time" data center capacity

Modular is Not a New Concept

Backup generators have been modular for decades

Making the Selection

Analyzing all factors and weighting, the HP 240a EcoPOD was top in all categories

Unbiased and independent choice

HP IT choose to deploy EcoPODs because it was and is the optimal solution to meet business needs

- Met or exceeded all requirements and schedule, no other option met all
- Did not receive pressure to deploy
- In some cases, education on solution, alternatives, and true costs was necessary gain approval

Factory installation and configuration of IT equipment was and is a great benefit

Initially, we didn't comprehend the benefits of Factory Express and POD Works

- Installation and cabling in the factory saved weeks of schedule and more expensive on-site labor
- Configuration and validation in the factory had similar benefits

Why PODs?

The EcoPOD was the optimal match for all HP IT requirements

Key factors made the HP 240a EcoPOD the clear winner

The EcoPOD met all “must-have” and all “strongly desired” requirements

- Highly available configuration – met or exceeded fault tolerant and continuously maintainable requirements
- No changes in IT or facility processes – looks and supported like a brick and mortar
- Lower cost per kW of usable IT capacity than conventional brick and mortar builds
- Much faster timeline from funded project to production IT – compared to conventional brick and mortar builds. Very short design and construction cycle.
- Efficiency, as measured in year round PUE, exceeded all other candidates
- Perfectly right-sized units of capacity – we choose both 674kW and 1150kW models

IT capacity examples

How much IT fits in an EcoPOD?

An EcoPOD full of HP IT equipment is a incredible amount of IT capability

An HP IT configured EcoPOD solution can support:

- Over 115,000 cloud servers
- Or over 3,000 BL G8 Physical Blades
- Or almost 550 Moonshot chassis with nearly 25,000 server cartridges – or close to100,000 CPUs
- Or any combination of the above or other IT technology

The above is with today's IT technology; tomorrow…

HP IT POD strategy

A summary

Utilize EcoPODs as the foundation of incremental capacity in a hybrid manner

- Continue to deploy low density IT equipment, such as storage arrays, in existing very good data centers
- Utilize EcoPODs for high or very high density IT equipment
  - Cloud deployments
  - Other virtual and physical servers
  - Existing application transformation and new demand
- 1/3 factory populate EcoPODs; add incremental IT equipment as the initial is consumed
- Match incremental deployments insuring additional capacity is on line just before existing capacity fully utilized

We may utilize PODs or EcoPODs for any future deployment anywhere

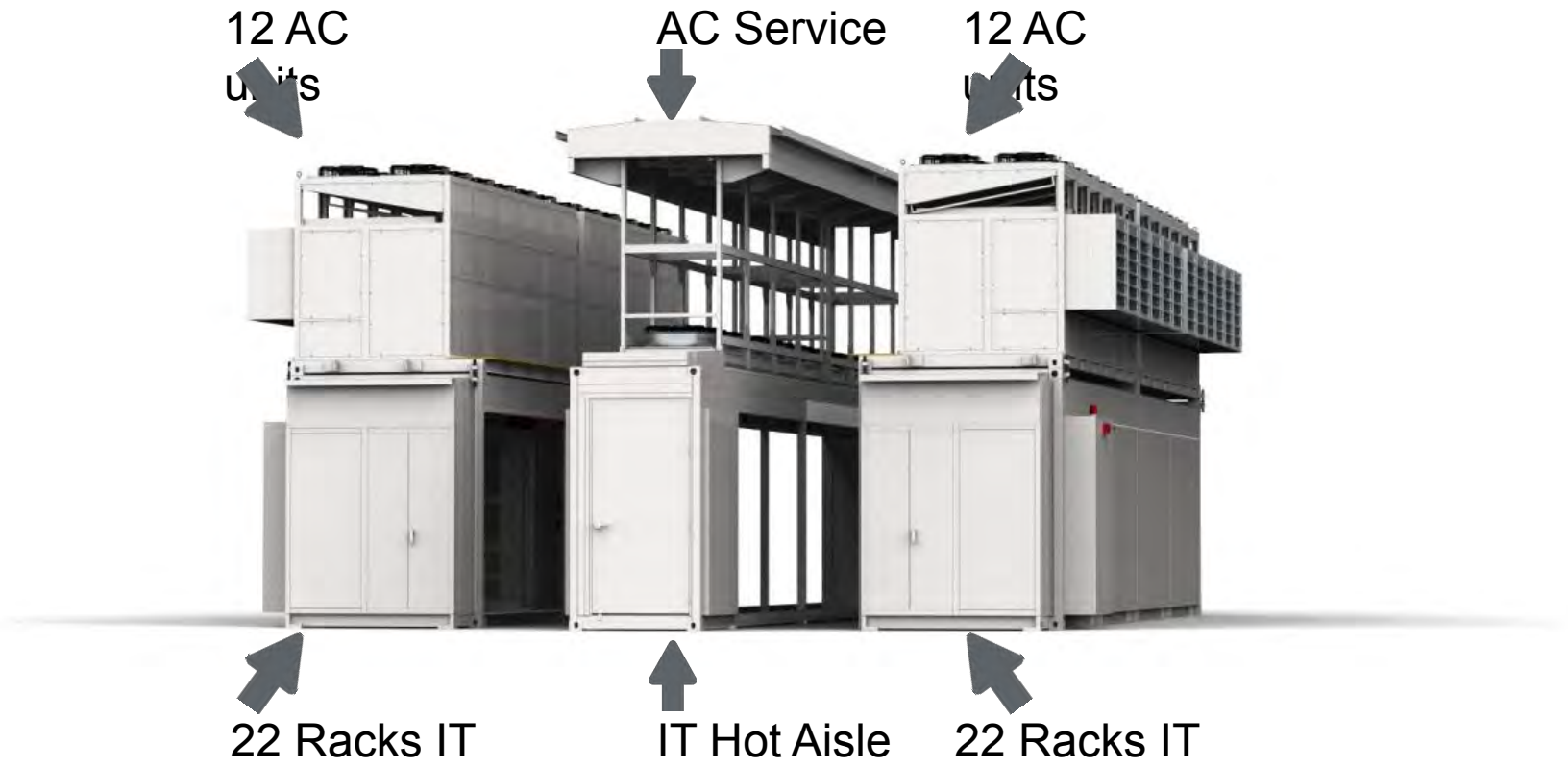
- At existing data center sites or anywhere significant quantities of high density capacity is needed

Deployment Process & Example

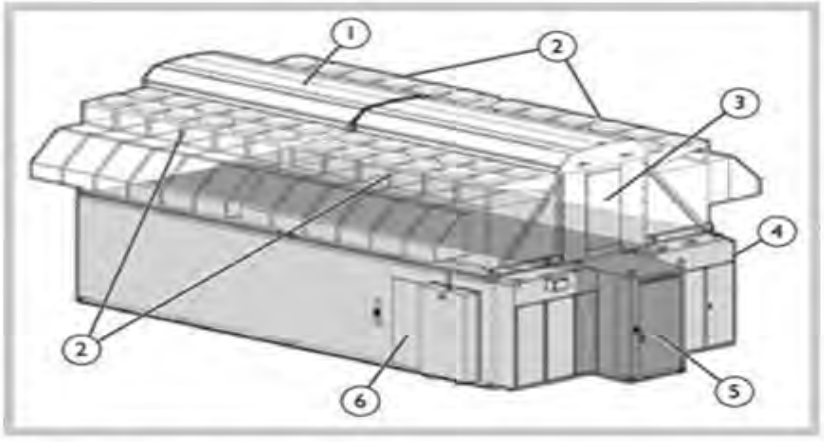
HP IT EcoPOD deployment #1

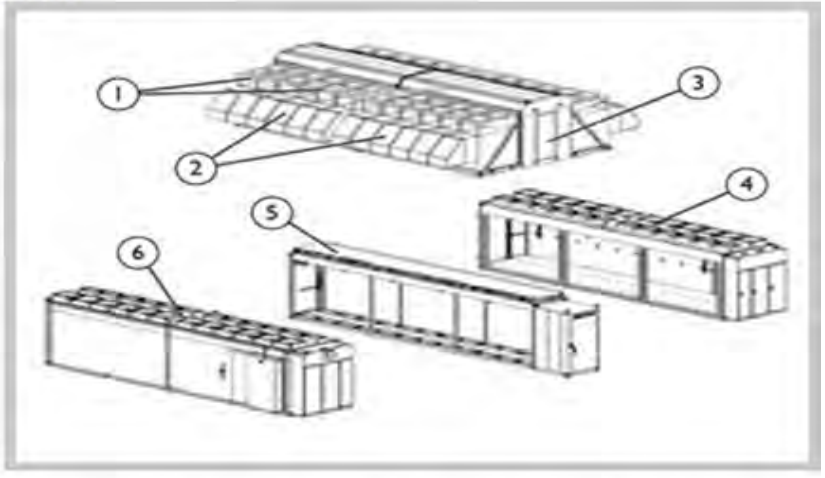
Sketch of an HP240a EcoPOD

Breakout of major EcoPOD components



HP POD 240a





Component View

NOTE: An external service area landing is located at both ends of the top of the hot aisle. Stairs will need to be added for access.

1. Hot Aisle Canopy: The canopy has two 20-ft sections, both installed atop the HP POD 240a.
2. HVAC System: Each of the four cradles contains six DX (Direct Expansion) units.
3. HVAC Service Area: The service area is directly above the hot aisle structure and is assembled at the same time as the cradle walls.
4. Secondary IT Module: The IT module houses racks, fire suppression, and humidification system. Module Adaptive Cooling System automatically optimizes cooling utilizing free air (economizer) and DX cooling supplied air overhead into the cold aisle. Hot and Cold Aisle containment is utilized to maximize capacity as well as efficiency.
5. Hot Aisle Module: The Hot Aisle module is a separate space where hot exhaust air from the servers can be expelled out of the structure or cooled and recirculated. The Hot Aisle module, when assembled to the IT modules, forms an 8' common hot aisle for easy rear rack access and serviceability.
6. Primary IT Module: The IT module houses racks, fire suppression, Environmental Control System and the POD controls cabinet. The closely coupled Adaptive Cooling System automatically optimizes cooling utilizing free air (economizer) and DX cooling supplied overhead into the cold

POD 240A Technical Specifications

Structure	North America
POD length	45 ft
POD width	21.5 ft (base), 32 ft (total with DX units)
POD height	21 ft (with DX cooling units)
Hot and cold aisle width	(2) 39.5 in cold aisles; (1) 8.5 ft hot aisle
Weight (approximated with IT)	257,000 lbs
Enclosure rating	NEMA 3R
Power	
Power distribution	(16) 200 A Busways
POD input voltage	415 V, 3Ø for IT & 480 V, 3Ø for HVAC, 50–60 Hz
Rack power distribution3	30 A or 60 A Metered rack mounted power distribution units
Rack power output voltage	240 V, 1Ø
PUE	1.05 (Economizer mode) to 1.4 (DX closed loop mode)
Cooling	
Cooling technology	Adaptive cooling: Modular direct expansion (DX) with air-side Economizer
Cooling redundancy options5	N; N+1; 2N
POD IT capacity6	1,347 kW (N); 1,150 kW (N+1); 674 kW (2N)
Cooling capacity per rack	30 kW (N); 26 kW (N+1); 15 kW (2N)
CFM per rack	3,545 (N); 3,250 (N+1); 1,772 (2N) CFM

Limited to two power distribution units (PDUs) per rack. 30A PDU Capacity is 17 kW, 60A PDU capacity is 34 kW

POD 240A IT Specifications

- IT Capacity
  - 2,200U of available rack space, (44) 50U racks
  - Average rack densities up to 30kW , and peak racks up to 69kW
  - Offers the equivalent of 10,000 sq ft of traditional data center space, housing over 7,000 server nodes or 24,000 hard drives
- IT Flexibility
  - Racks are standard 19" universal RETMA rails
  - Supports HP and third-party industry-standard hardware with front-to-back air flow
  - Racks can be fully integrated, tested and installed through Factory Express
  - Full cable management and integrated structured cabling can be provided as part of your POD order

Looks and supported like a data center

“Overview” of the deployment process

A team effort involving many parts of HP and third parties

“Summary” of deployment steps for HP IT EcoPODs

- HP IT and Real Estate formed a project team to deploy
- HP CFS (Critical Facility Services) was hired to engineer the site (some external customers use their favorite firm)
- A General Contractor, architect, and other subs were hired to ready the site for the containerized solution
- HP Manufacturing and Supply Chain managed the fabrication, configuration and testing of all HP components
- HP IT and Real Estate performed Factory Witness Tests to validate key factory built components before shipment
- HP Logistics coordinated packaging and shipping to the site, timing deliveries to arrive only as needed
- HP Services managed the offloading and assembly of the solution
- The General Contractor arranged the wiring and electrical coordination of the solution, and utility power
- HP Services managed the start-up of the EcoPOD and other gear sold with the EcoPOD
- HP CFA (Critical Facility Assurance) commissioned the entire solution (an external firm is a possibility)
- HP IT accepted the EcoPOD and completed IT bring-up
- HP Real Estate Operations assumed responsibility for the operation and maintenance of the facility components

The Result

HP IT is a very happy EcoPOD customer

While we may still be the POD teams toughest customer, we're also ecstatic

Our initial deployments, while the first anywhere, were completely successful

They continue to run well, providing continuous availability for the IT inside, since commissioning

We are meeting or exceeding cost and efficiency projections

The deployments have been less expensive than brick & mortar; are as or more efficient than expected

We are running HP mission critical applications and the HP IT Cloud in our EcoPODs

We do not differentiate our deployments; we require all data center capacity to meet our standards

We are continuing to deploy incremental EcoPODs for enterprise use

Based on business need, we will deploy incremental EcoPODs as the lowest TCO solution

HP IT Deployments to Date

2011 initial deployments – in production

Two 674kW HP 240a EcoPODs; one at each of our two Atlanta data centers

- Funding to production IT in less than 12 months

2012 higher capacity deployments – in production

Two 1150kW HP 240a EcoPODs; one at each of our two Austin data centers

- Built foundations for a second EcoPOD at the same time

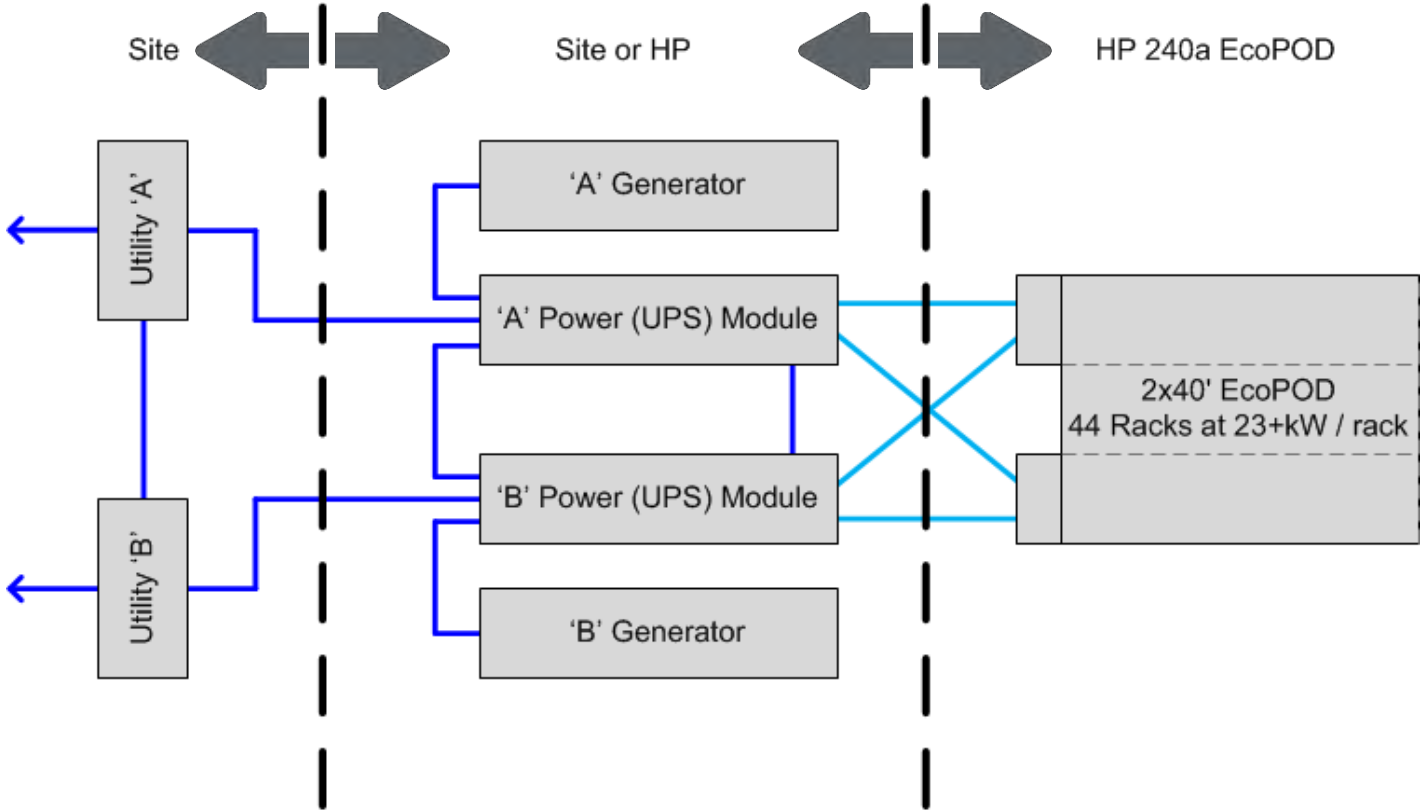
2013 deployments – in progress

Two1150kW HP 240a EcoPODs; one at each of our two Atlanta data centers

Additional EcoPODs as business needs and capacity require

Modular Components Overview

Diagram of HP IT enterprise infrastructure



HP used the GE PowerMOD™ Container

Containerized power infrastructure at enterprise availability was optimal match for all HP IT requirements

The Container met all "must-have" and all "strongly desired" requirements

- **Highly available configuration – met or exceeded fault tolerant and continuously maintainable requirements**
- **HVAC: Ductless CRAC Split DX HVAC System**
  - Complete return air fan & plenum system, yielding premium temp regulation
  - Full 2N redundancy in cooling, fans, & controls. Digital control system, with 2N PLC
  - Economizer "Free Air" Cooling, Direct-drive fans with VFD
- **Power: TLE "Transformerless" UPS 500kW and 1000kW**
  - Up to 97% Efficient in Protection Mode, Up to 99% Efficient in eBoost Mode
  - Unity (1.0) Output Power Factor, EPA Energy Star certification

GE PowerMOD™ Container for Mission Critical

PowerMOD™ Mission-Critical Power System

A self-contained, rigorously designed turnkey solution delivering higher quality and reliability, lower costs and less risk

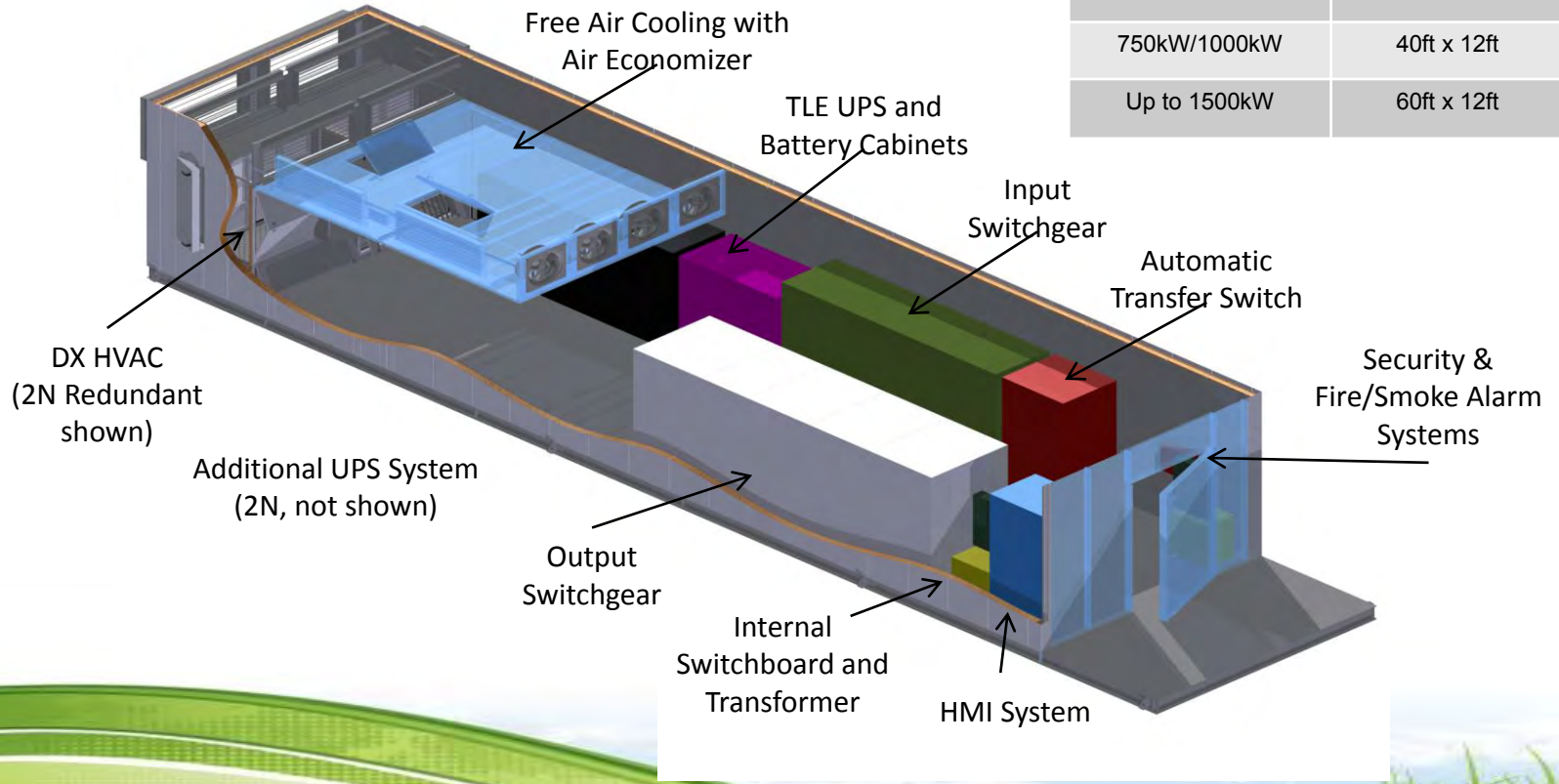
Value & Benefits

- 77% Faster Delivery, 4-5 mos. vs. 18-24 mos.
- 25% Reduced CapEx and spend rate
- 44% Decreased Energy Cost with Highest Efficiency UPS System and Free-Air cooling. PUE of 1.1
- Maximum integration and electrical coordination of all equipment in container
- Quality Control: Container arrives on site from factory pre-tested and verified

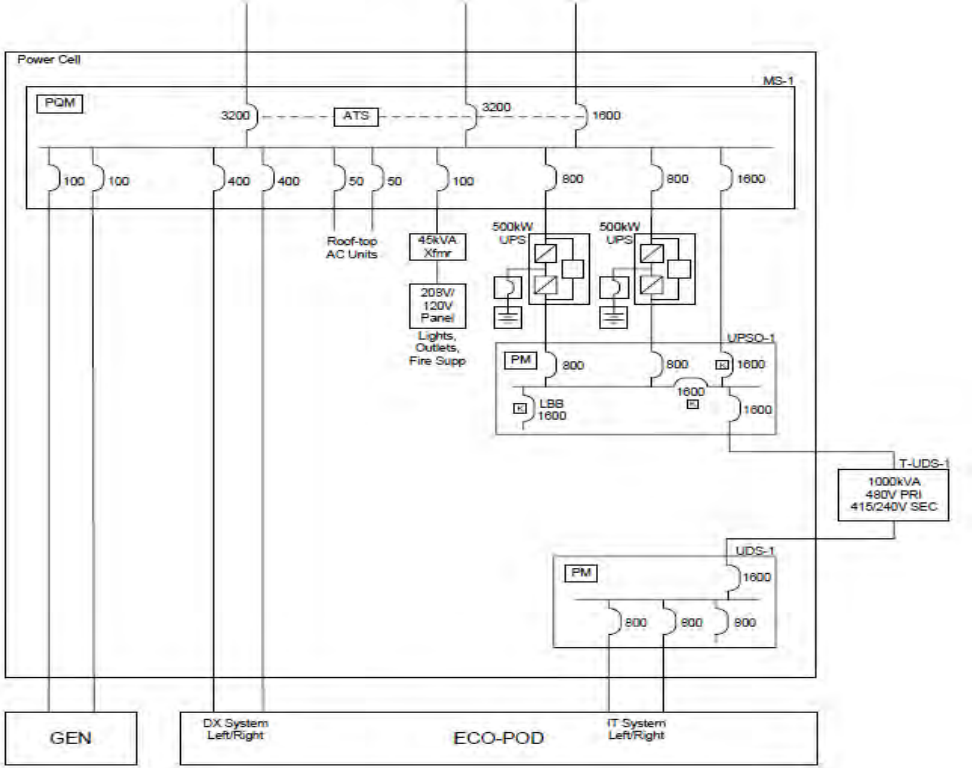
Available in Multiple Sizes & Configurations From 200kW to 1.5MW+, 50Hz & 60Hz

PowerMOD™ Container

Power Rating	Dimensions	Cooling
250kW/500kW	20ft x 12ft	DX
750kW/1000kW	40ft x 12ft	Chilled H_2O
Up to 1500kW	60ft x 12ft	Evaporative
		Combo



Power Container Oneline



Power Containers – Benefits

Saves money

- Shorter depreciation period and lower tax rates
- Reduced labor costs
- Higher efficiencies reduce operating cost

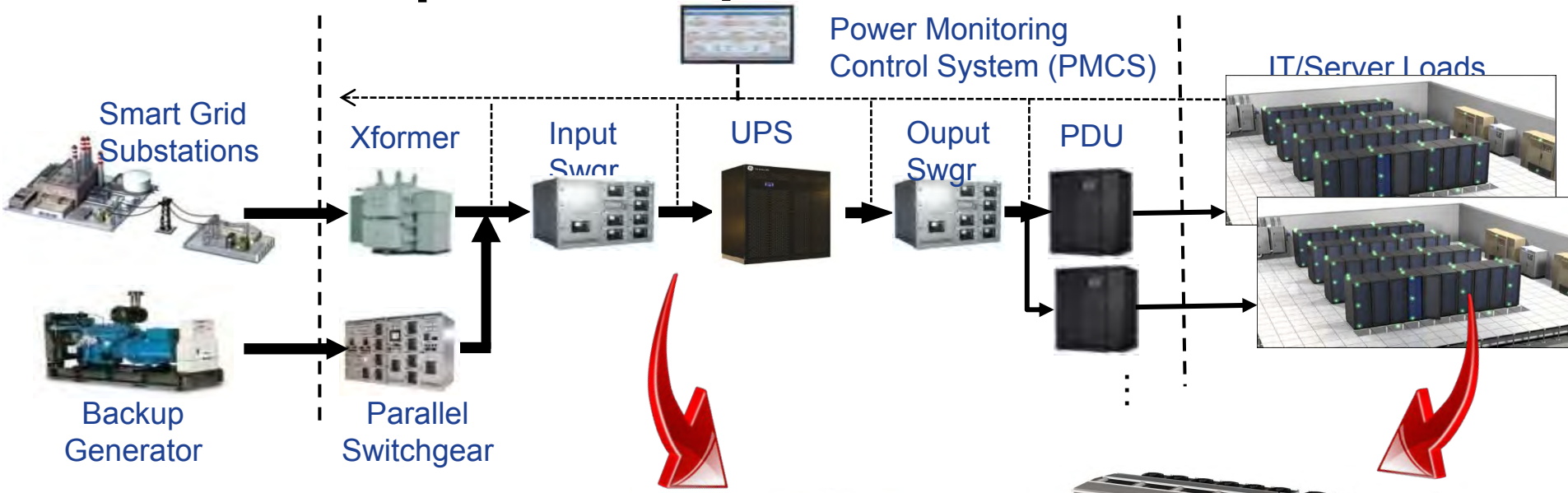
Saves time and hassle

- Single-source responsibility
- Reduced installation challenges, eliminates storage and speeds construction
- Repetitive design points

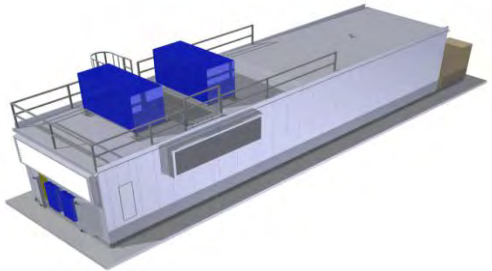
Provides design flexibility

- Requires less space than conventional site-built construction
- Provides portability
- Equipment layout and dimensional splits (when required) for multi-piece units

Modular Simplifies the process



- Fewer pieces of equipment
- Less construction to manage
- Saves time from cabling, testing and validation



UPS Options for Power Containers

Type of UPS configuration	Efficiency rating
Rotary UPS	94% to 95% energy efficient
Flywheel UPS	95% energy efficient
Delta Conversion UPS	97% energy efficient
Double Conversion UPS	94.5% to 97% energy efficient
Efficient Mode (Eco-mode) UPS	98% energy efficient

Modular or monolithic?

TLE Series UPS: Leading technology and Best-in-Class Efficiency (200 – 1500 kW)

Technology at Its Best

• Highly reliable and efficient tri-level conversion • Advanced user interface

• Embedded Superior Battery Management • Smallest footprint

• Front access only design for maintenance

"Best of Both Worlds" Operating Efficiency

• Up to 97% Efficient in Premium • Up to 99% Efficient in Premium Energy

Protection Mode (double conversion) Save Mode (eBoost)

• Unity (1.0) Output Power Factor • High (0.99) Input Power Factor

• Less than 5% Input Current Harmonic Distortion • *EPA Energy Star certification*

Key Component Symmetra PX 250/500kW

Worldwide compatibility

400V in – 400V out & 480V in – 480V out

PX500kW

Two power frames& Hot swappable SSW

Ultra-High Efficiency Power Module

Each delivers 25kW

High Frequency Double conversion

Hot-Scalable by trained user

Power factor corrected

Efficiency (96% at 35% load & 95% at 25% load)

Fans are redundant, variable speed & field replaceable

Estimated Power Cell Efficiency at 400kW IT Load

No Cooling load Efficiency:
Critical Load efficiency at 400kW: 4% loss
Copper and misc loads: .5% loss
Total Efficiency: **95.5%**

Efficiency at 77F outside ambient and 77F in the container:
Critical Load efficiency at 400kW: 4% loss
Copper and misc loads: .5% loss
Cooling load: 4.5kW
Total Efficiency: 400 / [(400/.955)+4.5] = **94.5%**

Full Cooling Load Efficiency:
Critical Load efficiency at 400kW: 4% loss
Copper and misc. loads: .5% loss
Full Cooling load: 16.7kW
Total Efficiency: 400 / [(400/.955)+16.7] = **91.8%**

Typical is over 94%.

Battery System

VRLA Battery system, one for each UPS module:

Each battery system consists of 2 battery strings, and each string contains 48 EnerSys HX540 batteries. Battery bank shall provide **5** minutes backup at 77°F/25°C, 1.67 end volts per cell. 82”H x 193”W x 32”D.

Battery Management System:

Monitors in Real Time: System Voltage, Charge and Discharge Current

Programmable Test & Out-of-Limits Alarms

MODBUS over TCP/IP for simple third-party software integration

(6) User-configurable Dry Contact Alarms

Local: RS-232 and USB

Monitoring for up to 4 strings per BMS.

Power Cell Enclosure Details 1

- 12” C-Channel perimeter base with Macropoxy base frame (black)
- 10” C-Channel floor supports (grey)
- 2” x 2” x 11ga tube steel walls and roof, spaced at 24” O.C.
- Ameriworx: precision milled, solid vinyl tile for computer room flooring, with ¾” F.R. plywood sub layer
- ¼” per ft overall roof slope (3”)
- 24ga Ultra-Ribloc exterior siding (White-Kynar finish)
- Durolast neoprene roofing system, with terminal bars and ¾” F.R. plywood/geotextile sub layer
- 2” Mineral wool insulation
- 22ga galvanized metal interior finish (white)
- 3 Exterior 36” doors with frame, lockset, closer, threshold, hinges, gasketing and panic bar
- 1” x ½” x 1/8” C-Channel for equipment mounting supports
- Lifting: full bottom

Power Cell Enclosure Details pg 2

- Sheet metal backboard for drawings, manual and UL certification information
- (9) 4’ 120V Fluorescent light fixtures and lamps
- All bulk feeders, flex, EMT and chase nipples needed to internally wire the equipment installed in the container
- 16ga Galvanized screw cover wireways
- 4”x 12” Aluminum cable tray
- (2) 3-way Light switches
- (4) Duplex receptacles
- (2) Combo emergency/exit lights
- Fike dry type fire suppression system (HFC- 125/ECARO-25 clean agent)
- Transformer and panelboard
- (2) 17.5 -Ton rooftop mounted HVAC units with lead/lag controller

Power Container Options

Construction options:

Seismic ratings

Wind resistance

Servicing platform/Rails/Stairs

Thermal break

R13-R28 insulation

Static wall liner

Floor tiles

Exterior lights (LED)

Fire suppression system

UL 2755

Access Control

Sensors

Security

Load Bank Breaker

Stacking

Environments

Stainless steel

Paint/epoxy coatings

Explosion proof

Ballistic and Seismic protection

Filtration: MERV 8, MERV 13, HEPA, Charcoal

Electrical & Control options:

Multiple configurations of Input and Output Switchgear

Maintenance Bypass cabinet

Local HMI Panel and type of transfer automation

M&D Control system with Power metering (waveform capture, event logging)

Networking and BMS/EPMS Integration

Modular Data Center Cooling Options

Type of cooling	Details	Best application
Overhead convection cooling	Cooling coils with associated chilled or condenser water cooled mechanical system	No air side supply fan system required; provides isolation from outdoor environment
Direct expansion (DX) + direct evaporative cooling	Supply fan, filters, direct evaporative media, and direct expansion cooling assembly	Most efficient in cold to moderate temperature environments with low to moderate humidity levels
DX + indirect evaporative cooling	Supply fan, filters, indirect evaporative media, and direct expansion cooling assembly	Provides separation between environments with high levels of air pollution due to 100% recirculation, allowing the unit to run a closed air circuit
Air-to-air heat exchanger with DX	Multiple supply and exhaust fans, filters, heat transfer media, and direct expansion cooling assembly	Excellent solution when access to water and/or sewer is limited. Isolates interior from outdoor air, reducing data center contamination

Power Container Cooling

Cooling options:
Direct Expansion
(DX)
Chilled Water
Evaporative
DX + Evap
Chilled Water + Evap

Model: WeatherMaster 50HC by Carrier
17.5-ton Roof-mount Cooling units
2 units for N+1 redundancy
Lead-Lag Controller

STANDARD FEATURES INCLUDE:

- Puron (R-410A) HFC refrigerant
- ASHRAE 90.1 compliant and Energy Star certified
- Scroll compressors with internal line break and overload protection
- Two-stage cooling capacity control on all models
- Units use high performance copper tube / aluminum fin condenser and evaporator coils.
- EER's up to 12.2
- IEER's up to 13.2
- TXV refrigerant metering device on each circuit.
- Exclusive non-corrosive composite condensate pan in accordance with ASHRAE Standard 62, sloping design.
- Standard cooling operation up to 125°F (52°C) and down to 35°(2°C) ambient temperatures.
- Pre-painted exterior panels and primer-coated interior panels tested to 500 hours salt spray protection
- Fully insulated cabinet
- Low pressure and high pressure switch protected.

Cooling Modularity and Energy Efficiency

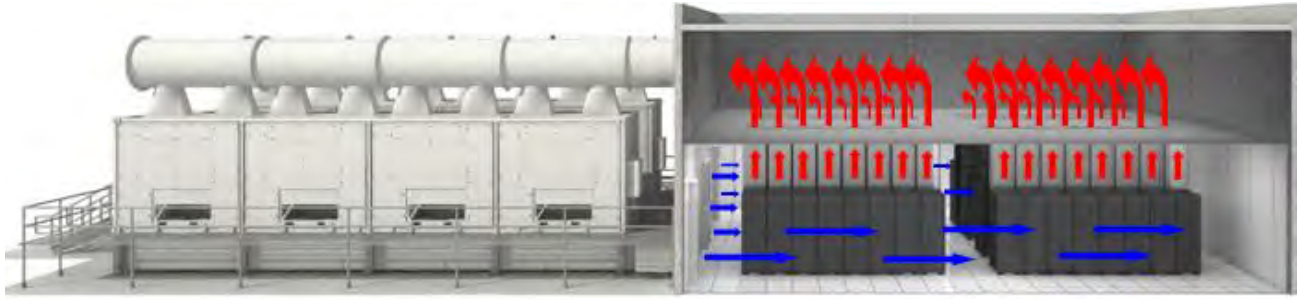
Multiple cooling methods:

- Adaptable to different climate zones
- Tuned to local environment
- Provide highest efficiency for a particular location
- Use external cooling in most climates, reducing power and water consumption

External containers:

- Easier installation, maintenance, upgrade
- Scalable: Add containers or individual modules to conform to increased IT loads
- Protection for critical IT equipment

SE EcoBreeze



- Two forms of Economization
  - Air-to-Air Heat Exchange
  - Indirect Evaporative Cooling
- Proportional DX refrigeration circuit
  - Variable Speed Compressor
- Electronically Commutated Fans
- Zero White Space Solution
- Modular Design for “Pay as you Grow” Philosophy
- Chemical-Free Water Treatment
- 50kW Sensible Cooling Per Module (No Dehumid/Humid)
- IEC Heat Exchanger
  - **No** mixing of IT air and outside air

Thank you