Technology Changes in Data Centers

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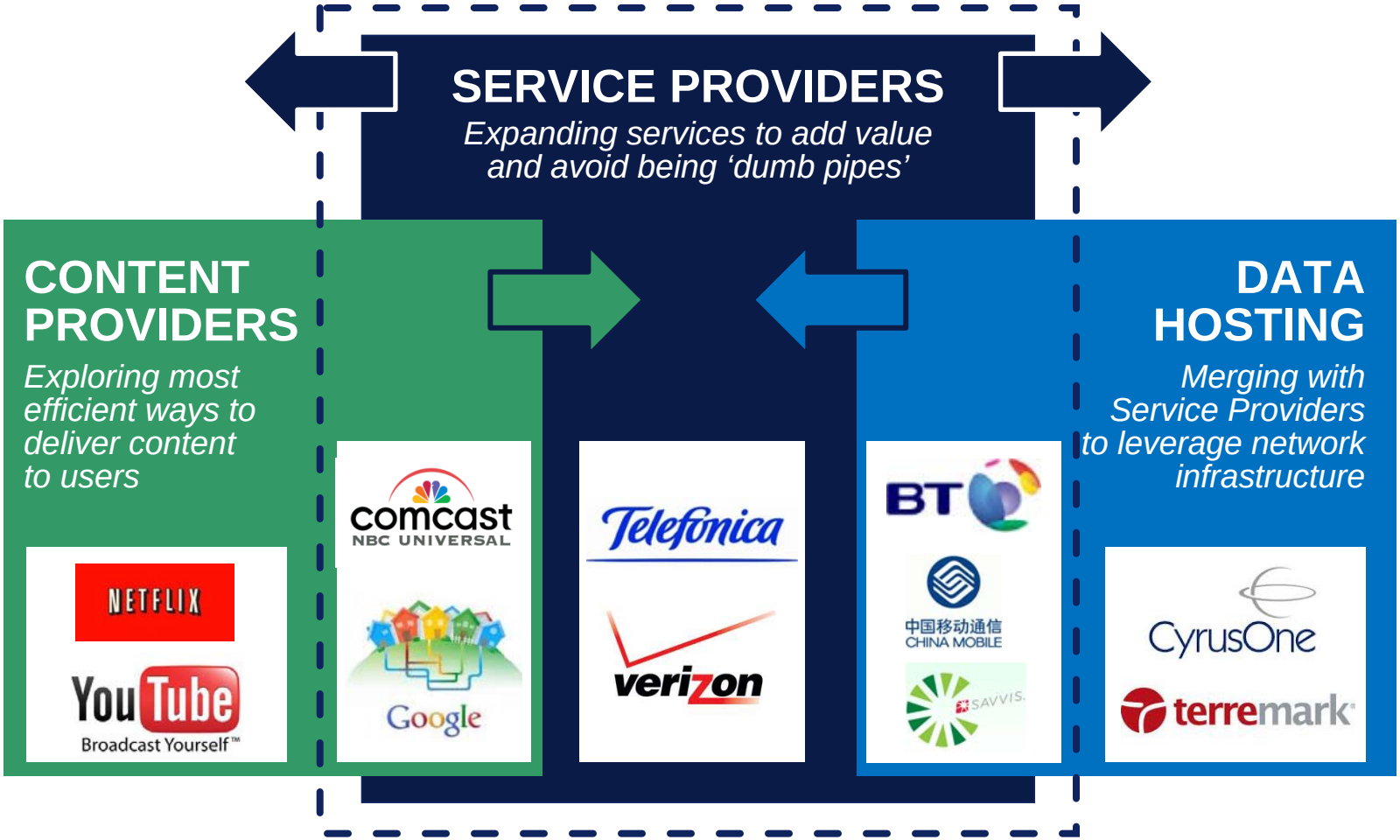
Agenda

- Market trends and impact on data center design
  - Convergence around traditional telecom space
  - Focus on ‘green’ – energy and more
  - Importance of real estate selection
- Technology and design innovations
  - Introducing hyperscale data centers
    - » Common characteristics
    - » Infrastructure innovation
  - Planning for the future – location, energy, construction
- Snowflakes…

Trend: Competitive, Converging Industries Blur Traditional Telecom Space

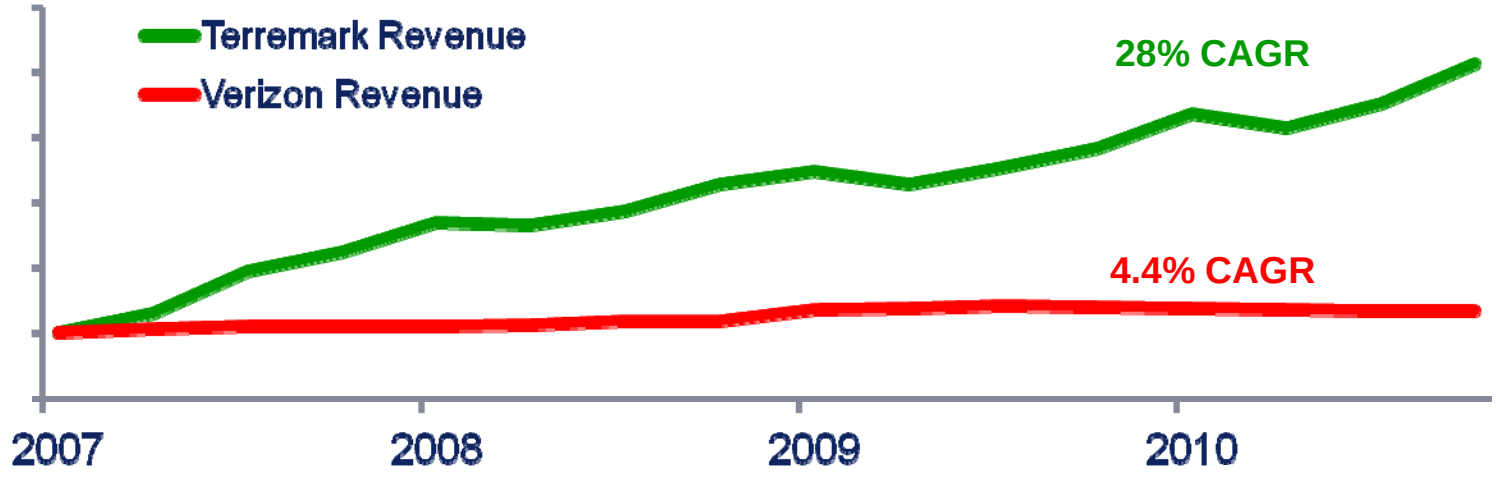


Service providers expanding business models in response to opportunities and competition

Rapid Convergence of Data Center and Traditional Telecom

Timeline →

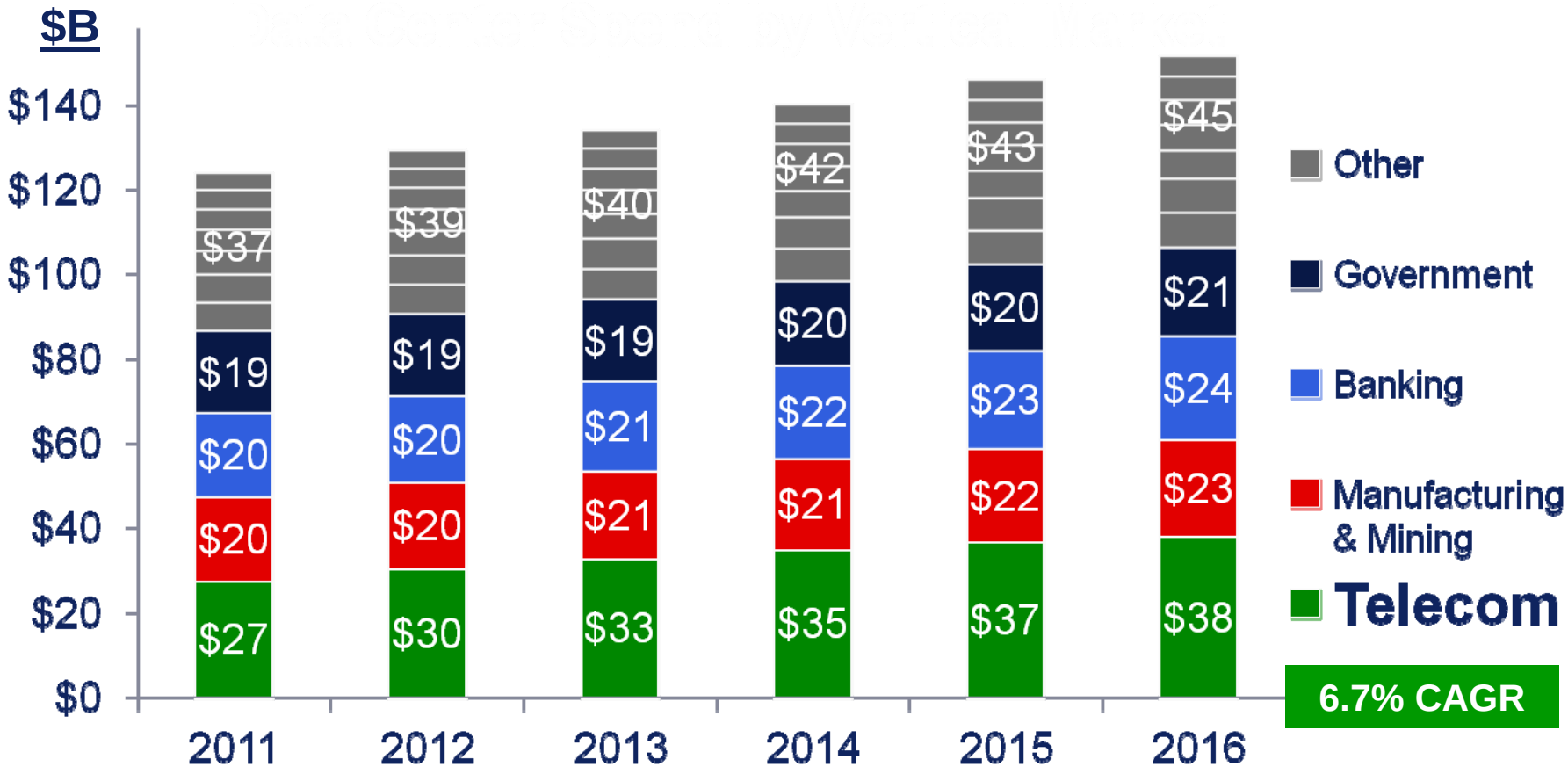
Example: Verizon & Terremark



Data center offerings are an attractive growth area for service providers

Telecom Spend on Data Centers Is Large & Growing

Data Center Spend by Vertical Market

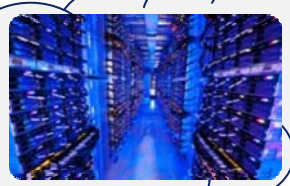


Convergence of traditional telecom with data centers represents significant growth in the market

Trend: New Options for Where and How to Support Applications

Application

Decision Point



On-Premise	Co-location	Public Cloud
Application	Application	Application
IT Equipment	IT Equipment	IT Equipment
Infrastructure	Infrastructure	Infrastructure

Customer Managed

Vendor Provided

Evaluation Criteria

Requirements

- Performance
- Scalability
- Accessibility
- Security

Strategy

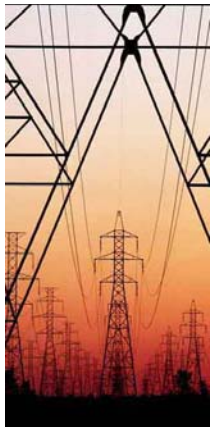
Alignment

Resources

- Budget
- Capabilities
- Existing Assets
- Timing

Trend: 'Green' Energy Source Implementation

- Data center operators targeted for environmental harm
- Large data centers typically require
  - Megawatts: 1 - 50
  - Availability: 24 x 7
- Data centers operate when
  - The sun doesn't shine, the wind doesn't blow, the tide doesn't flow
- Solution: combinations of grid, storage, local production



Trend: New Location Considerations

- Revised decision framework
  - Tax structure and incentives
  - Energy sources (CO_2, water use, renewable mix)
    - » On-site, near site generation, storage
  - Climate, annual, seasonal, variations, 100-year peak
  - Predominant wind direction
    - » Pollen, sand (haboob), fire history, air / water pollution
    - » Snow / ice loading
  - Water table, water rights / access
  - Regulatory / security environment
  - Access, fiber, fuel, security

Defining Hyperscale Data Centers

- "It may not be possible to define a 'Hyperscale Data Center' but I know one when I see it."
  - eBay announces new game-changing data center that will run on alternative energy (ANHosting)
  - Microsoft sets out to build $250M data center in Finland (CNN)
  - Google to increase investment in Finnish data center (Rueters)
  - Apple, Facebook put Prineville on the map (Computerworld)
  - Yahoo's greenest data center opens, PUE 1.08 (PC News)

Very large, purpose built facilities, supporting near homogeneous workloads and IT kit, with just enough 'resiliency' to suggest some level of availability, but failure is an option.

Hyperscale Innovation

- Building data centers for emerging hyperscale applications differs from building data centers for traditional applications.

Scale & Location (Outside – In)

Software Redundancy (Inside – Out)

New Computing and Infrastructure Topologies

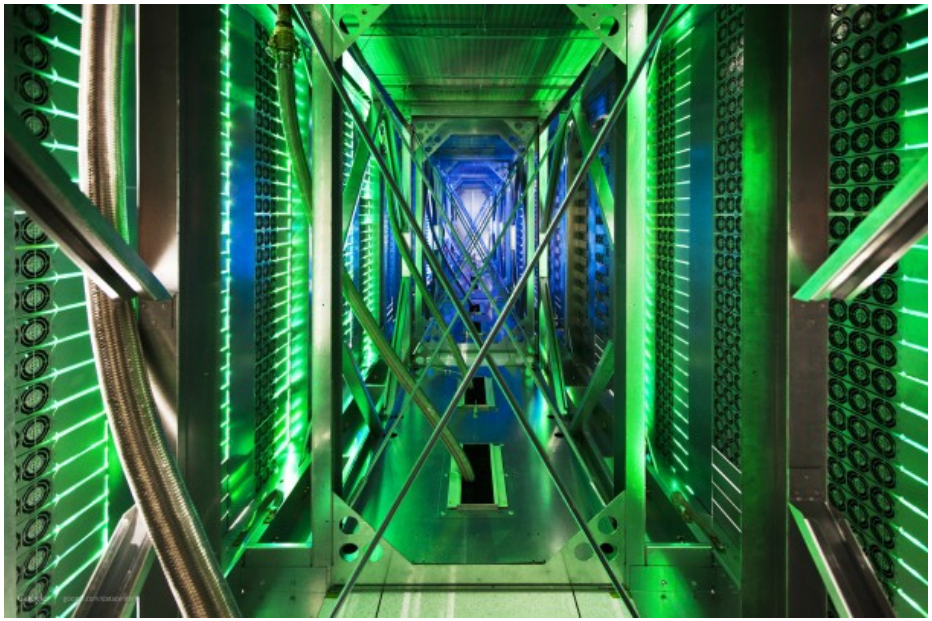
Hyperscale applications combine these innovations to significantly reduce up front capital cost and keep operating costs low

Design Criteria: Location/Scale & Redundancy Required

- Multi-mode design approaches
- Outside – In → Location selection
  - Focusing on finding optimal climate, energy sources, tax incentives, resource availability to drive location
- Inside – Out → Software redundancy
  - Letting technology at the chip, server, storage, and rack level determine best building, mechanical, electrical configuration
  - Purpose built servers, storage, network
  - Using business model, software, etc. to define resiliency

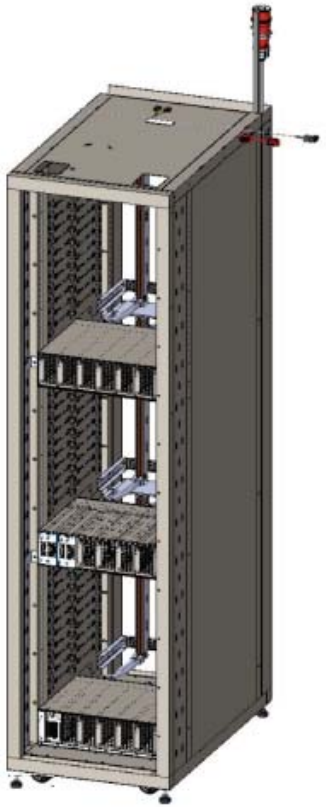
Innovative Infrastructure – Cooling

- ‘Free Cooling’ everywhere
  - In the right location
  - Monitor, filter, and fire-safe incoming air
- ‘Free Cooling’ is not FREE!
  - Massive blowers / air handlers N+X
  - Evaporative cooling has a price



Innovative Infrastructure - Power

- Goal: Achieve ‘availability’ in non-traditional means
- Energy storage in the rack or row: fuel cell or battery
  - Open Rack concept
  - Reconfigured mechanical design for easier thermal management
  - Innovative power distribution (12V DC distributed bus bar)
  - Flexible backup power (in-rack battery backup unit)
- On-site energy sourcing
  - Renewables
  - Fuel cells
  - Utility as ‘back up’ / generator-less

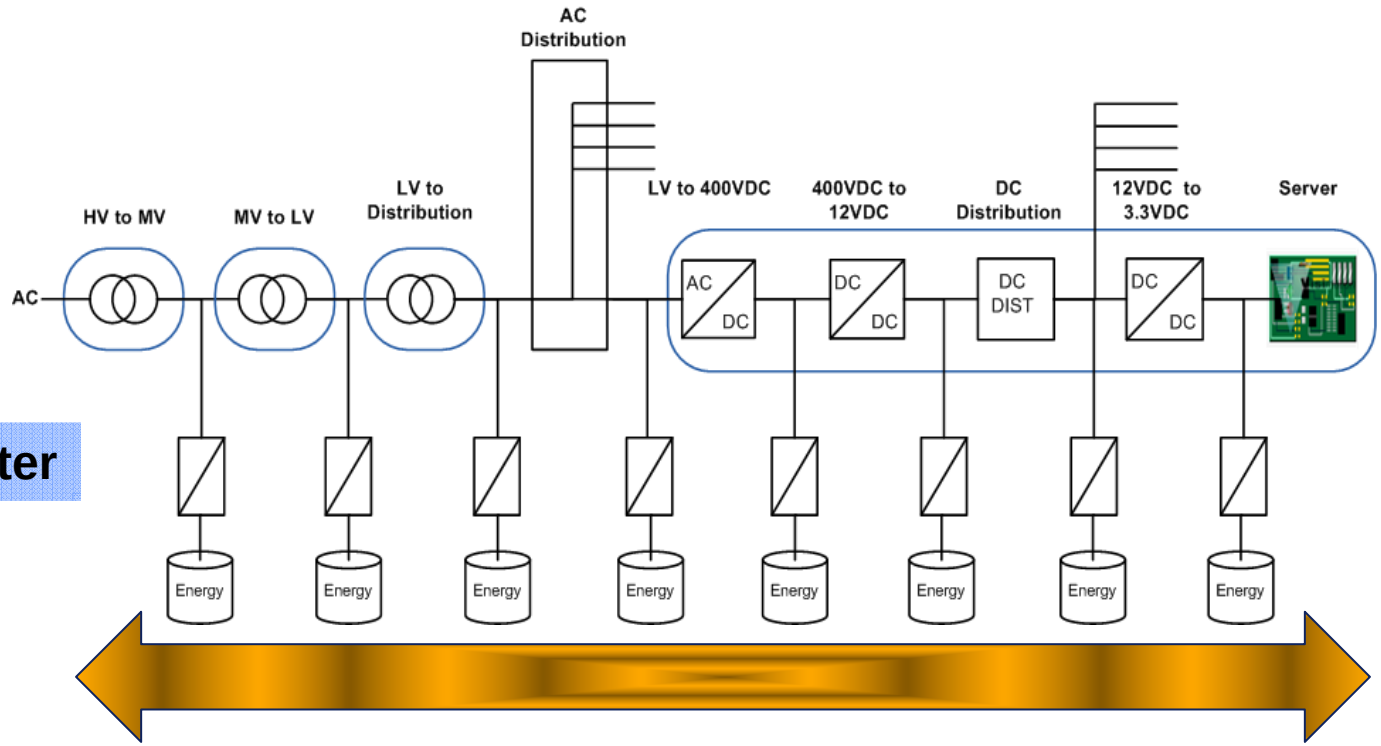


Energy – What's Next?

Conversion Stages

Energy Converter

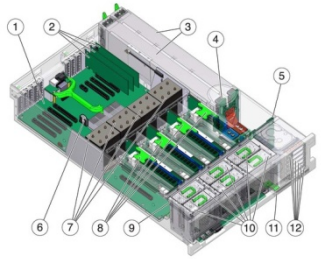
Stored Energy



Grid-attached Storage: Power or Energy Storage

Traditional Storage: UPS AC Distribution

IT Application Storage: Integrated Rack or Embedded Battery Backup



Mission and Values

- **Mission**
  To become the global authority on **resource efficiency** in information technology and data centers.
- **Values**
  - The Green Grid's core values center on business-oriented resource efficiency that enables economic prosperity and ecologic sustainability.
  - The Green Grid is **data driven**, vendor neutral, collaborative and transparent.
  - The Green Grid addresses resource efficient IT by providing **metrics, tools, best practices, specifications and standards** for self-improvement within businesses, and better informed policy making in government.

Members Include Over 145 Companies Worldwide

the green grid®
get connected to efficient IT

Technical Committee Structure

the green grid®
get connected to efficient IT

Technical committees complimented by:

- Programs Committee
  - Provides strategic guidance & oversight
- Interest Groups
  - 8 Areas of Strategic Importance
    - » Data Center Maturity Model (DCMM)
    - » Data Center and ICT Utilization
    - » Software Efficiencies
    - » Water Usage
    - » Data Center Certification
    - » Regulatory
    - » Cloud Computing
    - » Data Center Lifecycle
- Discussion Groups

Alternate Deployment Techniques

- Traditional "Stick-Build"

  Design *Build* *Install*

  – Build = creating physical structure
  – Install = adding mechanical/electrical plant and IT eqpt.

Emerson Data Center

- Containerized Solution

  Design *Manufacture* *Install*

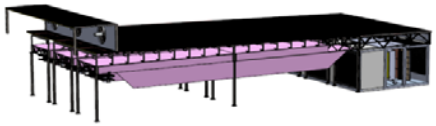
  – Manufacture = pre-fabricating container in factory, including mechanical/electrical plant
  – Install = placing container inside or outside a structure, connecting mechanical/electrical plant, adding IT eqpt.

NBN Australia Data Center

- Modular Constructed Data Center (MCDC)

  Design *Manufacture* *Assemble*

  – Manufacture = pre-fabricating structures in factory, including mechanical/electrical plant
  – Assemble = combining structures into one superstructure, connecting mechanical/electrical plant, adding IT eqpt.



The MCDC *becomes* the building!

Containerized Solutions

- Small node
  - Base station (telecom mobile)
  - Transmission (telecom, gas & oil)
  - Analyzer (gas & oil)
- Remote units
  - Repeater, distribution (telecom-optical)
  - Remote instrumentation (gas & oil)
- Switching & control centers
  - Optical main node (telecom)
  - Control center (gas & oil)
  - Automatic switchgears (gas & oil, mining)
- Energy center
  - Power conversion and backup (telecom, IT)
- Data center
  - Bank, telecom, IT, gas & oil, insurance

Modular Constructed Data Center

Just Like Snowflakes…

- No two data centers are the same

- Multi-directional innovation
  - Outside-in (climate, energy eco-system – in)
  - Inside-out (processor – out)
- Energy generation and storage will continue to drive data center design

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