



## Vertiv™ in the Telecom Space:

Future-proofing Telecom Networks  
for 5G and Edge Deployments



## Ensuring the continuity of today's and tomorrow's vital applications

Nearly all aspects of our lives involve the use of technology. It is how we work and play and do anything in between. This connectivity or use of data is built into the very fabric of our society. It is vital to human progress. Vertiv believes there is a better way to meet this accelerating demand for data — one driven by passion and innovation. As industry experts and Architects of Continuity, we collaborate with our customers to envision and build future-ready infrastructures. We leverage our portfolio of hardware, software, analytics, and services, to ensure our customers' vital applications run continuously, perform optimally, and scale with business needs.

## Our focus on Communication Networks

Provide smart, fast, flexible solutions for advanced networks and network management.

- Innovation enabling flexible architectures
- Fast deployment, turnkey solutions, seamless service
- Intelligent systems for smart, holistic network management
- Future-forward solutions supporting 5G and a variety of sites including: Small Cell, Macro Site, Central Office and Data Center

A leading provider of innovative power, thermal and IT infrastructure solutions and services for digital infrastructure.

- Recognized leadership across served markets, offerings and geographies
- Strong project management capabilities differentiates Vertiv from other market participants
- Rewarded by customers for the ability to collaboratively work to provide solutions for critical needs
- At the forefront of energy efficiency applications
- 10 awards won as independent company

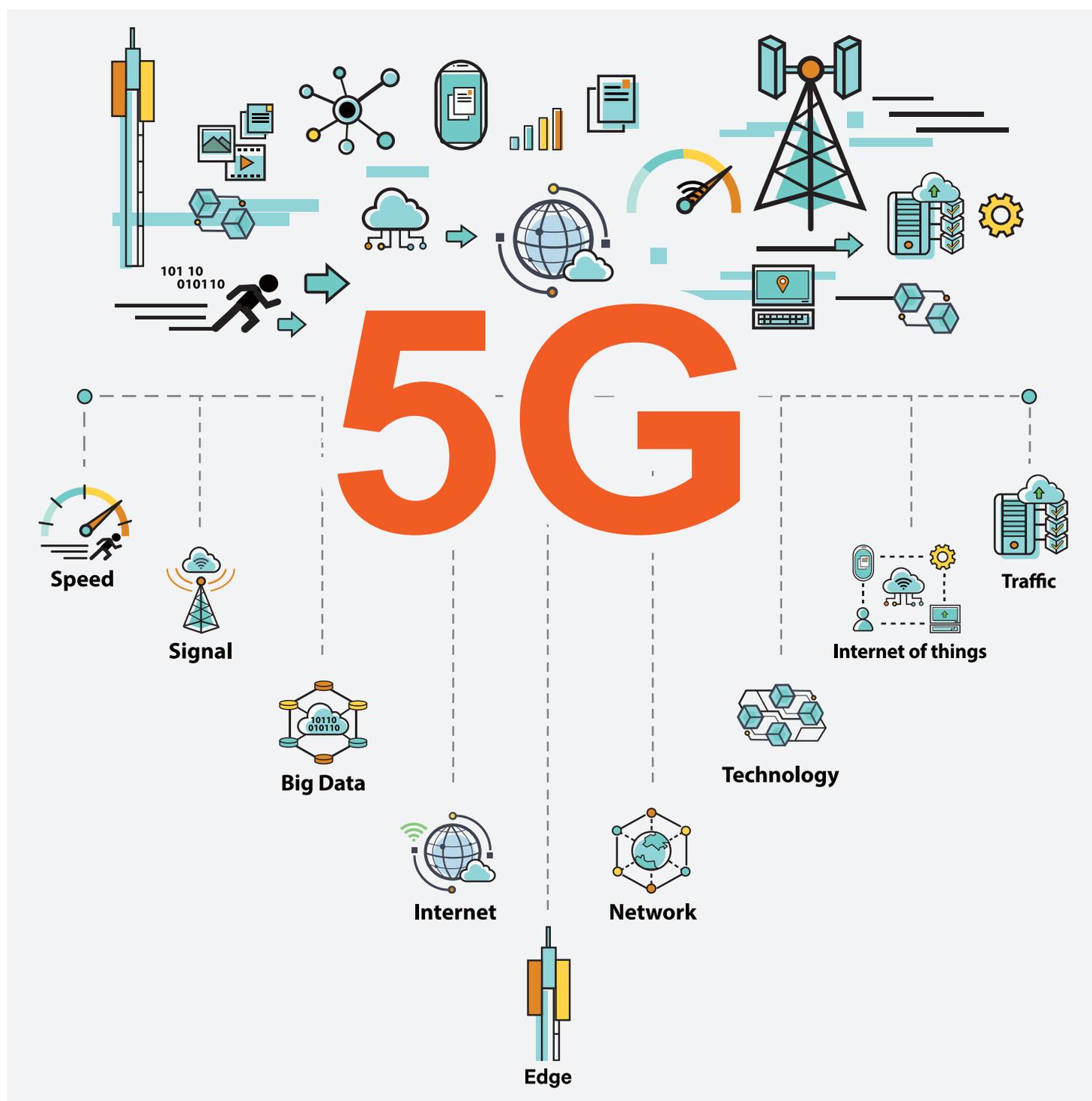
## Awards



The CEO Forum Group has selected Rob Johnson and Vertiv for the 2020 Transformative CEO Award in Innovation in the category of Communication Infrastructure. This is bestowed for excellence in building and protecting the critical telecommunications networks around the world and in data security and delivery of uninterrupted power. Most significantly, Vertiv's communication infrastructure has become our backbone during the COVID-19 crisis.

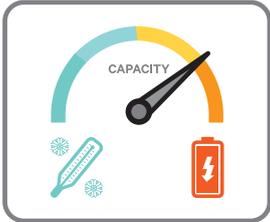


Anticipation for 5G networks has reached fever pitch as mobile operators are racing against time to be the first to deploy next level ultra-fast, low latency connectivity to billions of mobile subscribers. In fact, 5G will arrive sooner rather than later as initial deployment is expected to arrive as early as 2021. Many countries in Asia are leading the way in developing 5G architecture, including South Korea, Japan and Australia. For telecom operators, this presents a multitude of challenges that needs to be addressed both on Greenfield and brownfield sites. Ultimately, having the right infrastructure is critical for the success of 5G deployment.



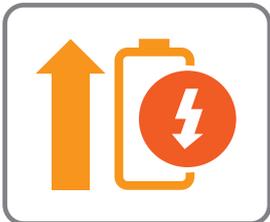
## Preparing your network for the 5G and Edge deployment

Many telecom operators are faced with the challenge of having to improve upon existing sites to get them ready for 5G architecture. For example, the power and cooling systems that exists today will need to be expanded and, in some cases, upgraded, to ensure the long-term reliability, maintainability and profitability of 5G network technology. Energy efficiency strategies also need to be revisited and existing sites reevaluated to ensure 5G preparedness. Below are some areas that telecom operators need to evaluate to ensure they are prepared for 5G:



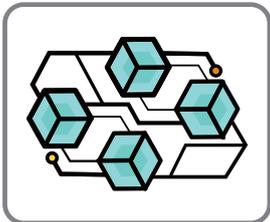
### 1. Ensuring adequate power and cooling capacity

From minimizing AC-DC conversions; deploying powerful uninterruptible power supply (UPS) systems to handle the spike in power density; upgrading from VRLA to lithium-ion batteries; to investing in new cooling techniques to combat the expected increase in energy costs, operators would need to adopt new solutions to support the demand expected from 5G technology.



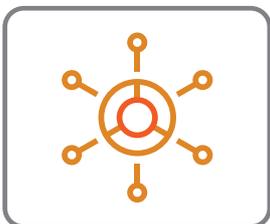
### 2. Mitigating high energy consumption

Telecom operators will need to get more aggressive in deploying energy-saving technologies to mitigate the impact on operating costs resulting from the higher energy consumption of 5G technology. The move to 5G is likely to increase total network energy consumption by 150-170 percent by 2026, with the largest increases in macro, node and network data center areas.



### 3. Preparing existing sites for 5G deployment/architecture

While it is expected that the transition from 4G to 5G infrastructure is not immediate, operators would need to reevaluate their existing 4G sites to ensure that these are able to handle the initial phases of 5G deployment. These can be addressed through retrofitting without having to establish or invest in new site deployments immediately.



### 4. Expanding existing battery capacity for power continuity

According to a report from 451 Research titled, "Telco Study on 5G Reveals Industry Hopes and Fears: From Energy Costs to Edge Computing Transformation," upgrades from VRLA to lithium-ion batteries are expected to increase from 66 percent of those surveyed to 81 percent five years from now. Lithium ion batteries will be an important tool as networks densify to accommodate the shorter distances 5G millimeter waves can travel.

Read the full **451 Research** report and all about the future of 5G deployment at [www.Vertiv.com/Asia5G](http://www.Vertiv.com/Asia5G)



### 5. Minimizing cost of 5G investment

Ultimately, with the opportunities presented by 5G, operators need to keep in mind how to maximize their investments into 5G architecture. Basic infrastructure readiness, site access and quality interconnection will be the main considerations to efficiently deploy 5G and edge topologies.

## Infrastructure Challenges

### Telecommunications Center

The core telecommunications network supports a variety of functions within the network, from supporting and enabling web and mobile services, cloud hosting offerings and sharing sites, as well as managing business IT backup requirements. By supporting different IT functions, the telecommunications hub becomes more prone to high temperature densities due to increased computing requirements.

The 5G network ceases to be a myth and operators must re-evaluate their existing infrastructure to ensure it can support a high-density computing environment.

Many operators' data centers have been designed in a confined space, making them prone to thermal challenges due to the high-density computing generated by the 5G network and IoT.

Therefore, the challenge is to optimize the existing infrastructure for maximum reliability and efficiency, ensuring flexibility and adaptability for future needs.

Power and cooling solutions, as well as state-of-the-art racks and cabinets that can protect critical equipment and confidential data, are vital.

As mobile and wireless services become increasingly critical, downtime is unacceptable. It is essential to have a disaster recovery plan with the proper infrastructure.



### Edge Computing

Nowadays, the customer need more data and faster broadband speeds. In this context, operators face the challenge of expanding the space occupied by the network and offering close connectivity to customers to avoid losing them.

With a large network in dispersed locations, operators must reduce latency to their customers and ensure data sovereignty.

Relying on the central data center alone may not be efficient or profitable for telecom operators. It is necessary to consider strengthening network edges.

Fully integrated and convergent solutions are ideal for edge sites, with fast installation capabilities, fully configured design and less space taken up.



### Access network

Telecom operators are offering connectivity to consumers in rural and remote areas. However, installing or connecting electrical cables in remote areas can be a great challenge. Managing and maintaining electrical supply in remote locations requires the use of generators and fuel delivery can be hampered by poor weather and other causes of delays.

When resources are available, hybrid / alternative energy sources are an option. Protecting vital broadband cabinets from the hostile environment is extremely important to maintain connectivity and reliability.

Maintaining efficiency and less space taken up in these areas is also essential. High efficiency rectifiers are an option in these locations.

Functions can be customized according to location and customer needs.



## Infrastructure Solutions for 5G Deployment

Vertiv has a range of infrastructure solutions to help enterprises and telecom operators transform 5G plans into reality. Deploying data and analytics to design highly reliable and efficient systems that are simple, sustainable, and future-ready, Vertiv collaborates closely with our customers to ensure infrastructure solutions meet the exact requirements of the application.

## Solution for Access Macro/Micro Sites



### Access Site - 5G Greenfields

More Compact, Smaller Footprint, Highest Power Density for the future-proof power needs

### For Indoor & Outdoor Application



#### NetSure 731 A91

540A, 5U High

- Easily Adaptable
- High Efficiency
- ECO Mode
- Advanced Battery
- Multiple Communication
- Flexibility to upgrade to hybrid power

### For Indoor Application



#### NetSure 731 CK2

1000A, Indoor Cabinet

- 1000A Power Capacity
- Small footprint at 600mmx600mm
- Single user / multi user management
- Peak efficiency 98%
- Remote monitoring enabled



#### 5G 34kW Power System

- 700A, Indoor Cabinet
- 4 battery shelves with protection
- Voltage boost 40V to 57V, provides constant voltage to eliminate low battery end voltage issue and supports smaller cable to reduce cabling and installation cost.

### Access Site - 5G Overlay Power

High-density mini-sized DC power for embedded application and outside plant enclosure



#### NetSure™ 2100

60A @48V, 1U high

- Light weight≤6kg incl. rectifiers, saving room space and installation cost
- Short depth at 240mm to fits in tight space
- 19"rack mount / wall mount enabled



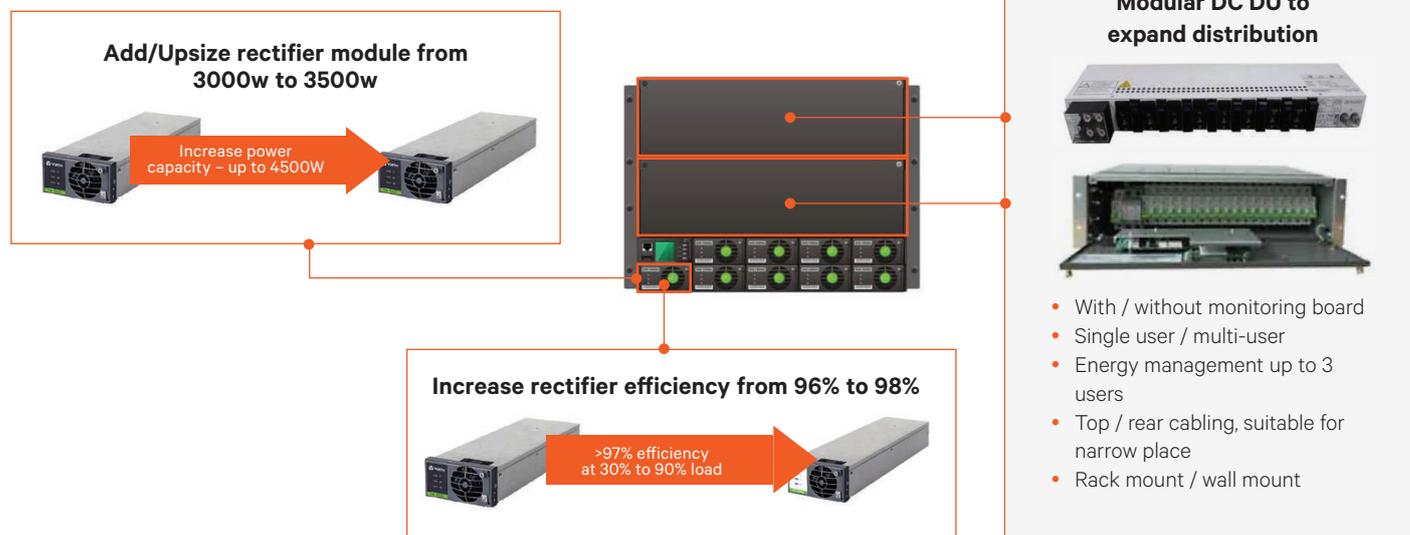
#### NetSure™ 531 A32

125A @48V, 2U high

- Light weight≤13kg incl. rectifiers, saving room space and installation cost
- High availability in harsh temperature, able to output full power up to +65°C
- 19"rack mount – suitable for both indoor/outdoor application

## Access Site - 5G Upgrade with Modular Architecture

Smooth evolution to 5G with no downtime required in power and load distribution expansion



### Inverter Solutions

1230-1200 and beyond

Highly reliable and efficient AC power back up with fewer power conversion steps. Use same -48 VDC battery bank as DC load to save CapEx and space

### Inverters

NetSure inverters for telecom access and edge applications efficiently aggregate both AC and DC power in the highest density, shortest depth single package in the industry. Leveraging a converged AC and DC power system eliminates the need for a stand-alone UPS and makes it possible to use a single battery bank so that you have less infrastructure to maintain and more floor space for revenue generating needs.

## NetSure 731 Series



**NetSure 731 A61-S1**  
8U, 18kW



**NetSure 731 AA1-S1**  
9U, 30kW



**NetSure 731 AA1-S2**  
10U, 36kW

Compact power systems designed to deliver reliable and uninterruptible DC power sharing demand of multiple operators for TowerApplication.

- High power output, up to 600A

- Compact design, integrate AC/DC distribution, rectifier & controller module
- Perfect battery management, which prolongs the working life of battery
- Wide input voltage range (85 to 300VAC), strong ability in adapting power grid

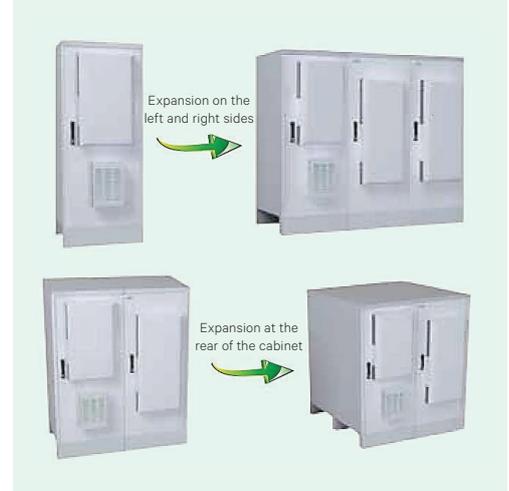
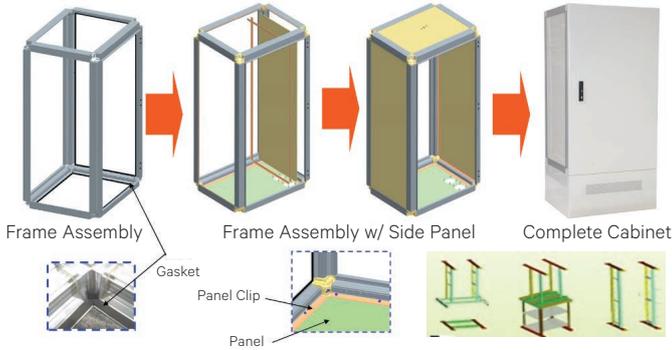
- Flexible configuration up to maximum of 12 Rectifiers
- RS232, Ethernet enable to remote monitoring
- Support up to 4 users with independent power management

# Vertiv™ in the Telecom Space

## Access Site - Upgrade with Future Proof Solution

Modular design — Rapid and smooth expansion with business growth

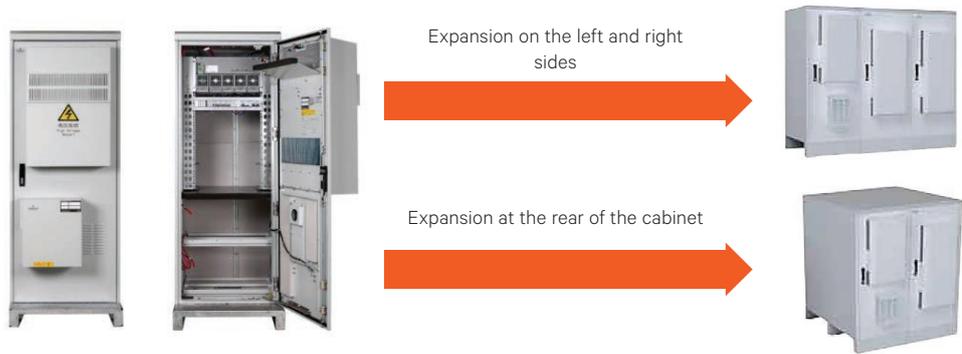
- Multiple cooling options – HEX, FV, Aircond, TEC
- IP55 protection
- Supports flat pack mode delivery - field assembly/disassembly for different application
- Integrates most energy efficient power system with built-in monitoring system



## Outdoor Cabinet Expansion

### Outdoor total solution

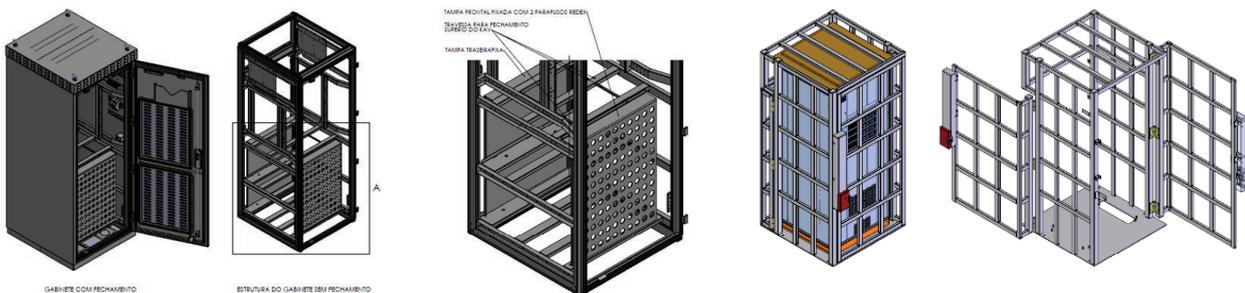
- Power and battery ready
- Space for telecom equipment
- IP55 enclosure
- Size customized for environment



## Kit Antivandalismo (KAV's)

The Vertiv Outdoors Cabinet can be integrated with KAV (anti vandalism kit) for use internal or external, to provide warranty, security and integrity for your systems.

The internal kits are designed to protect the battery compartment and for more extreme cases, the external kit is recommended, formed by a frame that surrounds the cabinet, protecting the entire system against vandalism.



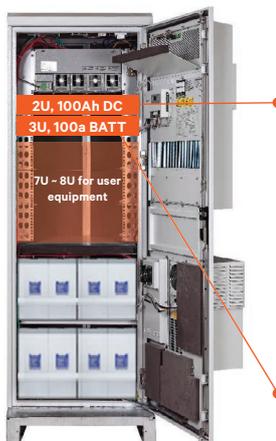
### Scenario 1

#### Fast 5G Overlay Power Solution

- Independent power and backup for 5G band
- No cutover engineering
- Fast & simple deployment



Before



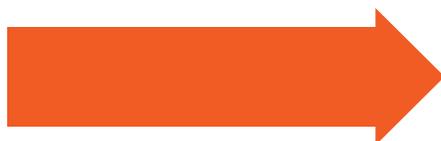
After



### Scenario 2

#### Upsize Power System in the Same Footprint

- Upsize rectifier system: 200A to 450A/540A
- Replace Lead-Acid Battery to Lithium Battery: 16U, 300Ah to 15U, 525Ah



### Scenario 3

#### Upgrades to 5G with More Room Space

#### Phase 1 - 3G/4G

200A DC Power  
300Ah Battery



Integrated Cabinet

#### Phase 2 - 3G/4G/5G

300A DC Power  
400Ah Battery



Integrated Cabinet

Equipment Cabinet

#### Phase 3 - 5G Expansion

500A ~ 600A DC Power  
600Ah ~ 800Ah Battery



Battery Cabinet

Power Cabinet

Equipment Cabinet

## Access Site - 5G upgrade with Retrofit Subrack

Maximize Investment, Minimize Engineering to Enjoy Latest Technology and Higher Efficiency

### Indoor Retrofit

**Before** → **After**

Saves up to  
30-40% CAPEX  
+15% OPEX

Subrack replacement    System replacement

*\*Savings may vary depending on the capacity and actual site conditions*

- Saving on the cutover engineering cost
- Eliminates legacy rectifier support issues
- No impact on live network
- Increases efficiency up to 97%

### Outdoor Retrofit

**Legacy OSP**

**NetSure 731 A41-S50, 6U, 14kw**

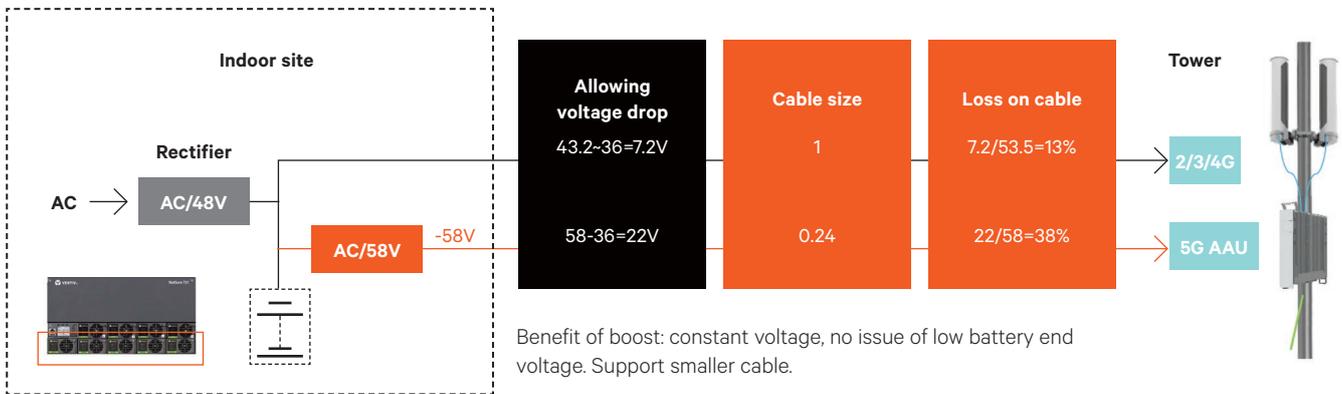
## The Situation: Remote radios are requiring more power

48 VDC rectifier/battery plants provide power to remote radio heads (RRHs) at wireless base stations, which are connected through an extended cable length, up to hundreds of feet.

- Distance between power system and RRHs results in voltage drop (longer cable, higher drop)
- Voltage drop is causing RRHs to shut down before the battery reaches end of discharge
- Voltage drop results in lower operating efficiency
- Required hold-up time is not being met
- As RRHs continue to evolve and require more power, all of these issues will intensify

### 1500W 48/58V converter

- Isolated topology between 48V and 58V
- Conversion Efficiency: 96%
- Hot pluggable – facilitates future extension
- Ideal for upgrading legacy DC power plants



## Edge Solution – Modular Remote Power



### IP55/IP65 Modular Solution

- Natural cooling, silent operation, maintenance-free
- IP55 or IP65, robust environment proof
- 1kW, 2kW module (expandable up to 6kW)
- Power de-rating from 55°C
- AC & HVDC input
- 48Vdc output
- Peak Efficiency 95%
- Max. 6 fuse output



### Optional:

- IP55/65 Lithium Battery Box, up to 20Ah
- Sun shield to improve reliability and prolong the life of PSU and battery
- Customizable color for camouflage



### IP55 Integrated Cabinet

- Flexible power 1kW ~ 9kW
- Configurable distribution: fuse/ MCB
- Easy expansion, hot pluggable
- Battery: different type optional (VRLA, lithium...)
- Remote monitoring enabled
- Pole mount / Wall mount

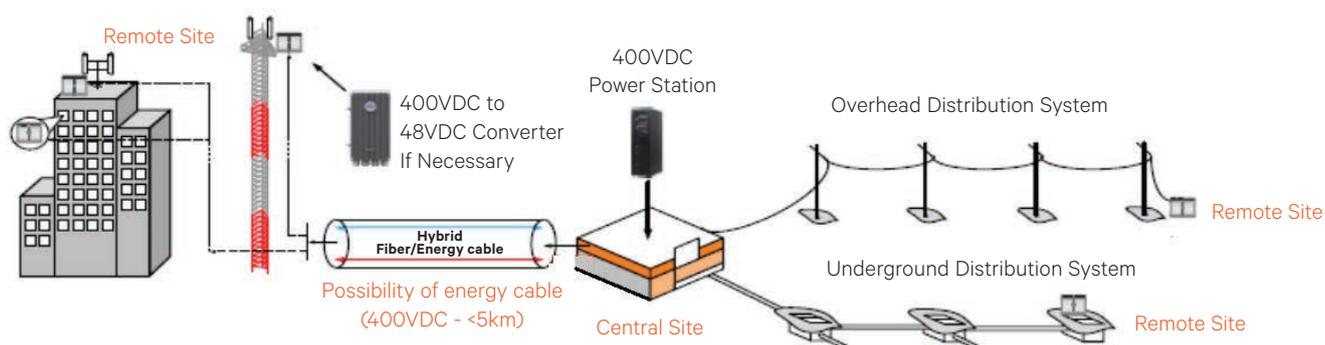
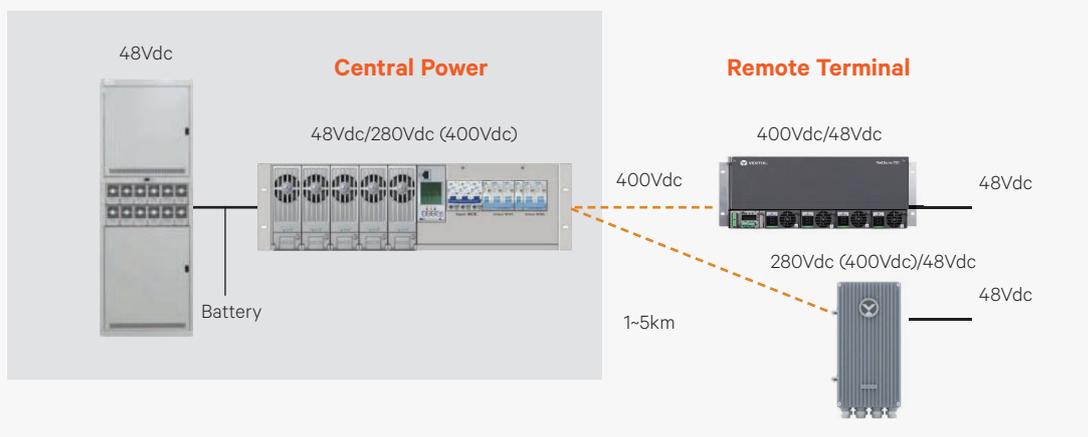


## Edge Solution - HVDC Span Power

### When Distance > 100m

#### HVDC Span Benefits

- One grid access
- One battery
  - Less maintenance
  - High reliability



*To serve the insatiable global demand for connectivity, telecom providers are continuing to expand their networks while looking to cut costs and become better eco-citizens.*

## Stay on top of energy trends

As the cost of operating and maintaining access sites continues to rise, renewable energy offers a way to minimize the burden. Leveraging solar as the primary or supporting source of energy enables operators to divert precious OPEX dollars towards other critical maintenance functions. Concurrently, they can operate in a manner that reduces their carbon footprint and makes them better corporate citizens.

## Adopt integrated energy solutions

Intelligent technologies that minimize the use of expensive energy and enable flexible, yet reliable power delivery are available now. Optimal energy use with high availability requires integrated managed site solutions designed to adapt to the power demands of the network and the local conditions at the site.

## The smart path to success

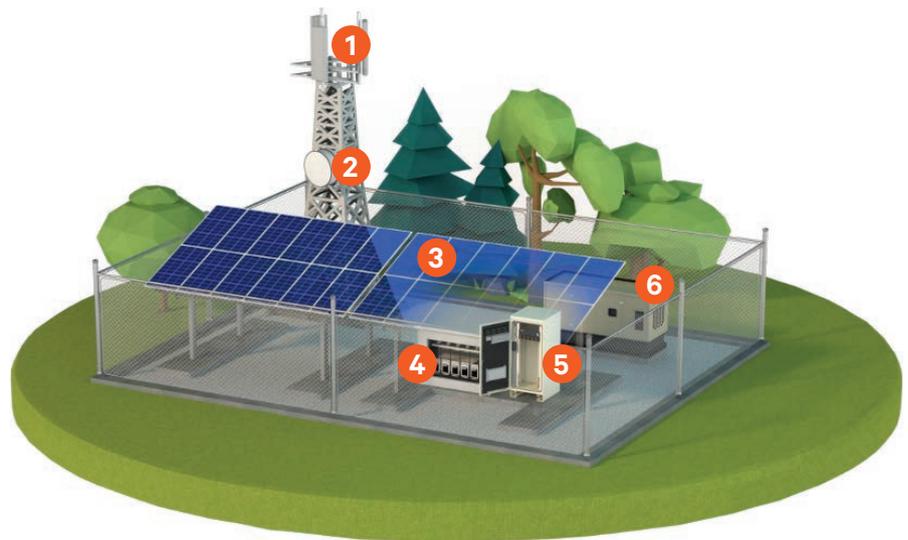
Vertiv believes the path to profitability involves a fully integrated solar solution that is:

- **Simple.** Quick and problem free installation resulting from intelligent engineering and design
- **Flexible.** Meets today's needs while being prepared for the unknown needs of tomorrow
- **Reliable.** Reduces the costs associated with unplanned site visits
- **Comprehensive.** Delivers a total integrated energy management
- **Supported.** Professionals are always on hand, from installation training to monitoring
- **Efficient.** Contributes to the short, medium and long term operational cost saving objectives

## Leverage an industry expert

In this hyper-connected, technology dependent world, you can't afford for your critical network infrastructure to go down. The success of your business depends on it. Vertiv's team of experts brings together a global reach with local knowledge to take on your most complex challenges, creating solutions that keep your off-grid solar solution running—and your business moving.

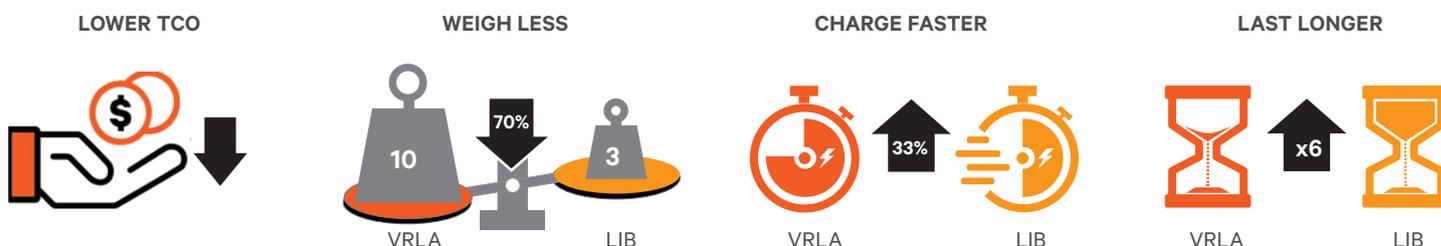
- 1 Remote radio heads
- 2 Microwave repeater
- 3 NetSure™ Solar Array
- 4 NetSure Solar Battery Enclosure
- 5 NetSure 5100 HybridSystem
- 6 Generator



## Vertiv Battery

### Lithium Batteries for Telecom

Lithium-ion batteries (LIB) are becoming an effective and attractive alternative energy storage solution for various telecom applications. In general, LIB's weigh less, charge faster and last longer than valve regulated lead acid (VRLA) batteries - all without outgassing.



### Lithium Benefits VS. VRLA

- Lower total cost of ownership
- Weigh less
- Charge faster
- Last longer
- No outgassing



### Lower Total Cost of Ownership (TCO)

While the advantages of lithium batteries come with a higher initial acquisition cost, total cost of ownership (TCO) savings are quickly seen with reduced maintenance costs and generally are fully realized after the first comparable VRLA replacement cycle.

Vertiv has been working with LIBs in both core and access applications for over 10 years. This has allowed us to gain valuable experience and knowledge that can be applied as lithium's footprint in telecom applications continues to expand.

If your NetSure™ Power System is equipped with an NCU controller it is generally compatible with LIBs that utilize a battery management system. Typically, only normal system set-up adjustments within the NCU are required to facilitate proper LIB operation. However, depending on battery and application, in some cases additional fine tuning of the parameters are required to ensure proper operation.

Because the LIB market is quickly evolving and there are many new entrants, Vertiv has instituted a Telecom Lithium Battery (TLIB) Qualification Program. This program is designed to review, test and qualify lithium-ion batteries to help ensure they operate safely and harmoniously with our NetSure Power Systems.

### Battery - 40Ah / 100Ah / 165Ah / 190Ah / 200Ah

#### Features

- 10 years battery life at 25°C
- Bar code tracking system
- Front terminal batteries with strong rope handles
- Long storage life (1 year @25°C)
- Thermal runaway resistance
- Tested according to IEC60896-21:2004 and Bs6290 Part4:1997
- UL94-VO flame retardant material
- Very high purity lead formed active material

#### Benefits

- Competitive price



## Data Center Smart Solutions for Telecom Edge Applications

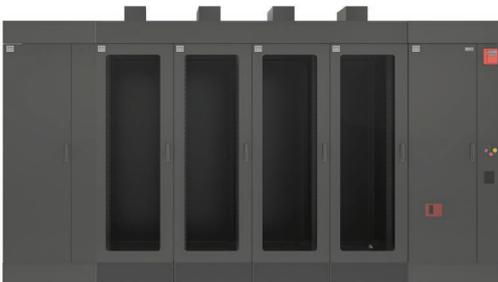


### SmartCabinet™

Self-contained, pre-configured, pre-engineered and factory-tested infrastructure for data centers and telecom networks

#### Features:

- **Fully integrated** - Factory assembled and tested for power, thermal management, rack enclosure, power distribution, monitoring and management, and security for IT applications. No dedicated IT room required
- **Dust protection and noise insulation** - Fully closed operation, cold/hot air is circulated within the rack for better temperature and humidity control, expanding lifespan of IT equipment, low noise level. Highly suitable for office environment
- **Highly Efficient** - Built-in high efficiency UPS and cooling equipment, that uses DC frequency conversion technology for energy savings
- **Fast deployment** – Ready to use from day one, removing the need to build, construct and design computer rooms which dramatically reduces the required deployment period compared to a traditional IT facility build



### SmartRow™

Fully-integrated data center infrastructure in a row-based design

#### Features:

- **Complete Integrated Infrastructure** – All products integrated in the system-thermal management, monitoring, racks, optional UPS/Power Distribution and rack PDUs- work together to optimize capacity, efficiency and availability
- **Industry Best Practices** – Employs best practices known to work well in top-performing data centers; Hot aisle / cold aisle separation; High availability, high efficiency UPS; Highest efficiency cooling
- **Space-saving, minimal footprint** – Modularity for flexibility and easier expansion
- Integrated monitoring and control for efficiency in planning and management
- **Simplified Project Management** – Network of local data center experts and service teams make ordering, installing and servicing the SmartRow Plus solution easy





### SmartAisle™

Fully-integrated edge data center solution for high density telecom applications

#### Features:

- Suitable for telecom central offices with existing white space for data center infrastructure
- Fully-integrated design eliminates the need to construct a data center from the ground-up — easy to deploy and install
- Integrated with high-efficiency power, thermal management and monitoring units
- Can be scaled up depending on future requirements
- Option for AC or DC Power configurations or CW or DX cooling applications



### SmartMod™

Flexible platform, optimized for simplified deployment of your critical IT assets.

#### Features:

- Modular and scalable Liebert® EXM UPS power protection
- Close-coupled in-row Liebert CRV thermal management units with intelligent iCOM controls
- Flexible Vertiv VR racks
- Vertiv rack PDUs
- Thermal containment to isolate hot aisle and cold aisle airflows for optimum thermal performance
- Automatic Transfer Switch (ATS) to reliably select normal or emergency power sources
- Clean agent fire suppression with optional VESDA early smoke detection
- Overhead infrastructure, including piping, electrical distribution, and fiber ducts
- All subsystems are factory installed into a secure, weatherproof and transportable enclosure – simplifying and drastically shortening on site time required to install and startup, and reducing the potential for risk, quality, or schedule delays
- Configuration options are available to provide desired redundancy and battery runtime. In addition, when deploying multiple units or at multiple locations, having a common look and feel, layout, and equipment kit simplifies maintenance and operations activities. And Vertiv backs it all up with the service and support network you have come to expect from us

## Wall mounted (HPW)

High Performance Wall Mounted Air Conditioning



### Efficiency, Compactness, Flexibility

Liebert HPW is a high performance wall-mount cooling solution ideal for Mobile Telecom Network remote access nodes in shelters and containers:

Direct expansion solution granting the highest efficiency in a wide range of external environmental conditions as a result of its heat exchanger surface design.

Freecooling with the highest energy saving combining the advanced circular damper system with downflow air distribution.

- Limited energy consumption
- Site conditions always under control
- Reduced installation impact
- Cooling availability also in emergency situation
- Solving unfavorable installation situations

## Other 5G Solutions: Core System Upgrade

### Core Power capacity expansion

#### NetSure 801 CAA

- Scalable Up to 6000A
- Using R48-5800e 96% high efficiency modules
- NCU Controller
- Top & Bottom Cabling
- Include shunts current detection



#### Extra Large Power System (XLPS)

- Compact Design
- 210kw per Rectifier Cabinet, max up to 420kw Capacity
- Using G3 High Efficiency Rectifier R48-3500e3
- Compatible with G4 Rectifier R48-3500e4 for 98% efficiency
- Top entry cabling access
- Controller NCU M830B
- Individual shunt monitoring
- Dimension per cabinet: 2200H x 600W x 600D

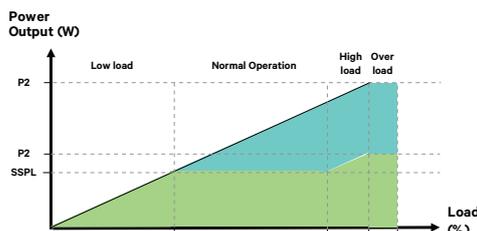


### Power Split

Upgrade to high efficient Core Power system with minimum footprint

"Pay as you grow" philosophy realized from Power Split function in NCU

- Allows extension of VERTIV and Non-VERTIV DC power systems
- Easy live interconnection between existing Power system and new NetSure system
- Optimize investment cost and ensure that systems can always be expanded



**SSPL= Slave System Power Limit**  
50%~90% Slave system capacity

- Slave system output
- Master system output
- P1=Max. slave system output
- P2=Max. slave + master output

- The total load is shared between the master and slave systems
- The slave will bear the load until it reaches 90% of its capacity
- Additional load will then be borne by the Master system



## NetSure™400VDC

### Power Solutions

#### The Path to Optimized Site Architecture

As the nature of the telecommunications and computing industry evolves, so too must the infrastructure that supports it.

Whether you are trying to contain expanding costs, increase energy efficiency, streamline power distribution, or manage an increasing mix of telecom and IT equipment, 400V DC power technology can enable meeting your site goals.

This technology combines the proven benefits of 48V DC power – modularity, scalability, ease of integration – with the cable and installation savings benefit of higher voltage distribution design



Integrated Systems  
(Max configuration 375A @  
400 VDC)



Distributed Systems  
(Max configuration 2250A @  
400 VDC)

## NetSure™ RDB Series

### 48V Zero Rack Unit Power Distribution

Featuring plug-and-play connectors for simple field installation, NetSure™ RDB Series, 48V Rack Distribution Units are designed for ultimate ease of use.

- Space Saving Design
- Robust, tool-less, easy to use



## Intelligent Load Management (ILM)

### Visualizing DC Load Use at Core Telecom, Cable and Data Center Facilities

Enables increased visibility and detailed understanding of all loads in your telecom central office or data center, providing early warnings of potential overload and preventing load buildup.

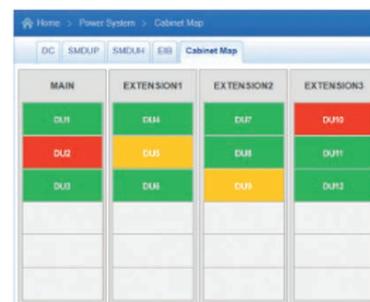
Intelligent Load Management is a patented optional capability in Vertiv's NetSure™ Control Unit (NCU) that enables comprehensive real-time monitoring of your DC power network infrastructure.

This advanced functionality enables you to visualize load location, power performance, and distribution inefficiencies in order to optimize the DC power supply, control cooling and avoid overload. Securing power availability is critical at core sites such as central offices and data centers. With Intelligent Load Management from Vertiv, high availability can be achieved while optimizing efficiency and saving cost.

- Securing power availability
- Improving cost control
- Optimizing Energy Efficiency

### Application

Intelligent Load Management is the ideal solution for core network facilities, including telecom central offices and data centers that need to secure power availability while undergoing rapidly changing load conditions. With full power consumption control over each individual load and rack, network providers can operate shared/hosted co-location sites with full energy cost control.



## Site Monitoring

### Features

- B/S architecture makes all functions accessible in IE without installing the customer software convenient for accessing the system
- Extra large capacity to support 50,000 BTSs
- Hardware processing unit greatly reduces the number of equipment in the monitoring center, saving space and maintenance workload for the system
- Data flow utilizes an active reporting mechanism enabling timely response
- Multi-channel data transmission enables real-time monitoring, preventing failures caused by database errors
- DS server support multi-unit backup, while the automatic load balance avoids bottleneck of widespread faults caused by traditional monitor master
- Third-level storage safeguard and automatic memory ensures data integrity of the centralized power and environment monitoring system

