Data Centre Planning & Engineering in Telecom Facilities
DC Power versus AC Powering Option

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Robert Szasz, P.Eng. – MTS Allstream Inc.

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Objective/Overview

- **Objective**

  The objective of this presentation is to gather support of all end users and specifiers of Internet , IP telephony and data communications products to purchase and install DC Powered equipment in Telecom Facilities as their First Choice.

- **Overview**

  In the last few years Telecommunications networks within MTSAllstream and worldwide have evolved rapidly into systems carrying Internet ,IP telephony and other data traffic in addition to traditional voice telephony. Internet and IP telephony is handled by servers, routers and modems ,which are furnished by vendors of the computer/data centre industry.

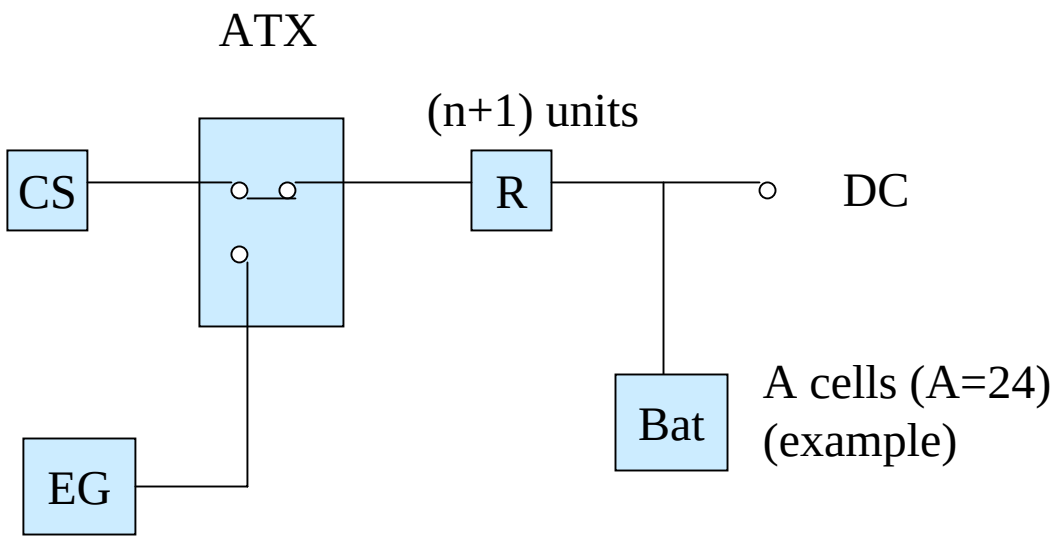
Overview

- Datacom equipment is typically operating from AC mains with Uninterruptible Power Systems (UPSs) with several minutes of battery reserve power
- The telecom equipment however is powered by traditional -24, -48, or -60 volt DC power plant with several hours of battery reserve time
- The Reliability and Reserve time of the UPS typically is not compatible with the need to provide continuity of service during mains outages
- The public expects the reliability of telephony for all services associated with telecommunications
- The need for extended interval DC Powering option is therefore urgent.

Present situation

- MTSAllstream as well as many Telecom operators are adding large quantities of equipment for Internet and IP telephony to their networks
- The new equipment is often collocated in the same room ,cabinet or rack as conventional telecom equipment.
- There are differences in terms of power supply, battery reserve times, grounding, distribution ,reliability and maintenance.
- **Power supply for Traditional Telecom Equipment CO**

Figure 1 System Configuration of DC Power Supply



CS: Commercial Power Source EG: Engine-generator set

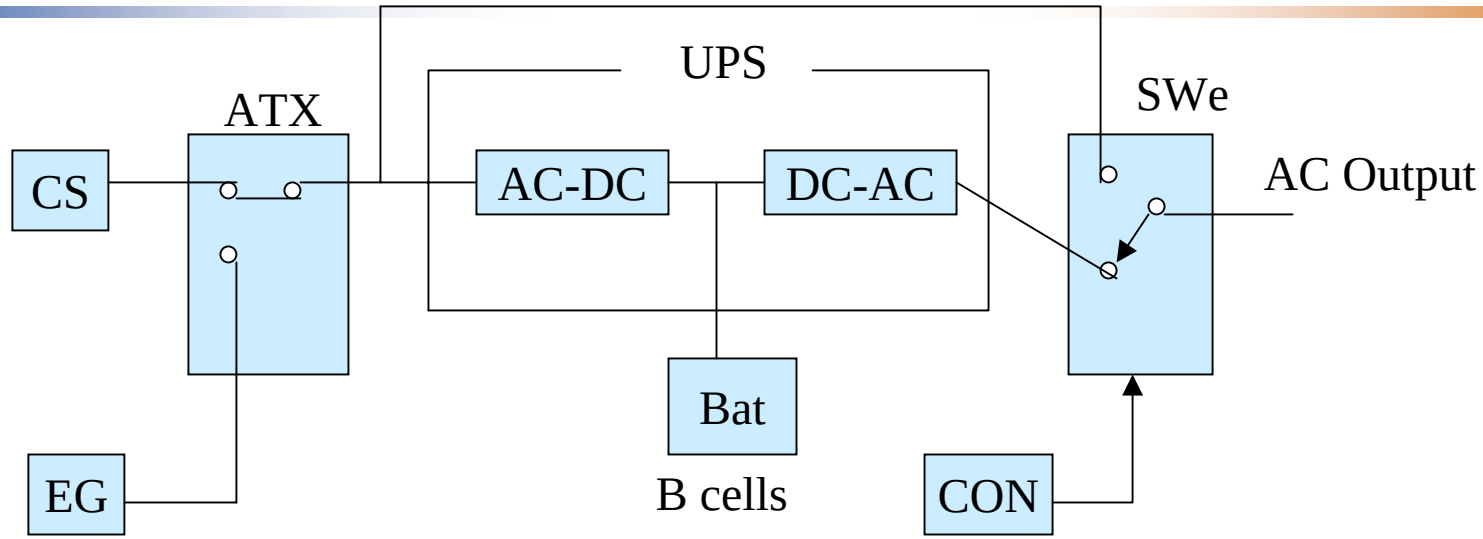
ATX: Automatic Transfer Switch R: Rectifier

Bat: Battery

Present situation (continued)

- **Power supply for Datacom Equipment** at CO
- Permanent Engine-Generator set (s)(1000-2000KW) ,AC UPS (s) (100 -500KVA) typically with 30minutes to 1-2 hours battery autonomy –Figure 2
- The lower reserve time sets the limit for series-connected elements resulting in unacceptable values for availability of service.
- **Grounding**
- DC systems are not grounded in same way as AC systems.The different standards result in practical problems in the implementation of safe and proper grounding equipment.

Figure 2 System Configuration for AC Power Supply



ATX: Automatic Transfer Switch EG: Engine-generator set

UPS: Uninterruptible Power Supply Bat: Battery

CON: Control Circuit for Swe Swe: Static Switch

Present situation (cont)

- **Distribution**
- With the -48V DC system the telecom and datacom equipment are always galvanically isolated from mains
- In by-pass operation with a UPS the telecom and datacom equipment are directly exposed to the mains, without any protection against disturbances
- In on-line operation with all power passing through rectifier/inverter it might be necessary to shift to by-pass to clear fuse associated with a short circuit in secondary distribution system. A mandatory condition for fuse clearing is the use of automatic bypass equipment.

Present situation (cont)

- **Reliability**
- The annual unavailability allocated to the power supply system of a telecom installation is 15 seconds.[1]
- All power supply must comply with this value in order to be compared and evaluated on equal terms for service in public telecom networks.
- According to a comparative reliability studies -48V DC systems show higher availability rates than comparable UPS systems.

Present situation (cont)

- **Maintenance**
- Maintenance costs are higher for two battery systems and two different types of power electronics, double storage of spare parts,etc.
- The quality of batteries in different systems varies and maintenance cannot be performed in a systematic manner
- Maintenance of different systems becomes more difficult and mean-time-to –repair (MTTR) longer, due to complexity of the installation

Advantages of DC power

- **Technical Simplicity**
- It consists of a numbered of paralleled rectifiers connected to two or more paralleled battery strings.
- In the event of mains outage or rectifier failure the critical load continues to operate from the batteries without switching or interruption.
- Distribution originates at the point where the batteries are paralleled with only fuses or circuit breakers interposed.
- The datacom or telecom load has buil-in DC-DC converters or board-mounted modules

Advantages of DC power

- **Modularity and Maintenance**
- Easy to connect modular rectifiers and several batteries in parallel due to low voltages and no need to consider phasing
- Simple and inexpensive maintenance of installations by persons with limited training on power systems
- **Established World Standards and Safety**
- The battery voltage for most telecom switching equipment is -48volts. It is universal defined by ETSI and ANSI
- For AC power there are 14 different voltages across the world [1]

Advantages of DC power

- The -48volt DC standard allows work on live conductor with a minimum risk for personal injury and without special safety measures.
- **Installed Base**
- **MTSAllstream** together with all Telecom operators in the world have millions of highly dependable -48volt DC installations in use.
- Economically and technically it would be an absolute mistake to rebuild these installations to equip them with AC UPS systems

Advantages of DC power

- **Distribution and Isolation**
- Galvanic isolation in the rectifiers and the large batteries prevent mains disturbances from reaching the load
- **Reliability**
- According to a comparative reliability studies -48V DC systems show availability rates more than twenty times higher than comparable UPS systems.[1]

Cost Analysis

- The following is the summary of Cost Analysis Table 1 at (2) typical MTSAllstream Telecom facilities for provisioning of a new UPS system or a -48V volt DC Power plant driven by datacom and IP telephony equipment growth.
- Unit cost of AC solution is significantly higher mainly due to availability of the existing DC Install base.

Table 1 Typical Telecom Data Centre - Cost Analysis

Telecom / Data Centre	Power Capacity (80% loading)		Present Load		Unit Cost of AC vs DC		Comments
	AC	DC	AC	DC	AC	DC	
Facility #1	325 / (260)kVA	6400 / (5120) A	201 kVA	3605 A	$186k / 65kVA*	$80k / 1000A**	*This figure is for a new 65kVA UPS system, or 48V 1000A DC plant. **Existing DC plants have some spare capacity, cost shown is for distribution of 1000A only.
Facility #2	30 / (24) kVA	2200 / (1760) A	23 kVA	1327 A	$143k / 30kVA*	$95k / 500A**	*Cost shown is for 30kVA UPS. **Cost shown is for upgrading DC plant including distribution to cover additional 500A requirement.

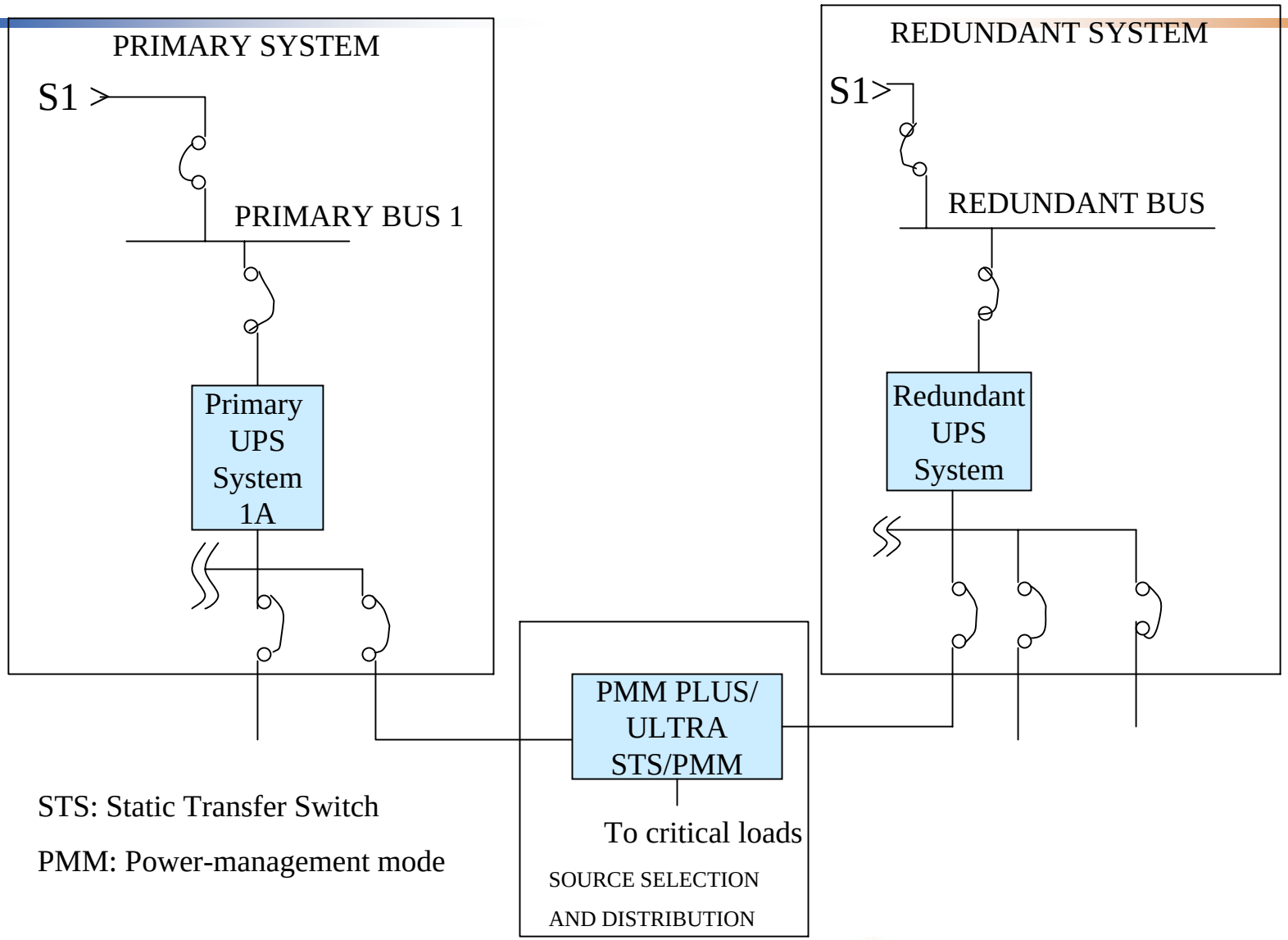
Case Study

- Case #1
- This is to compare 20KVA DC versus 30KVA AC solution implemented recently at two GPOP within MTSAllstream Telecom facilities powering datacom and internet equipment as specified by two different multinational customers.
- Both assume same type of Utility supply and single generator back-up .
- Both solutions are for new dedicated DC or AC power systems within seggregated space within CO.

Case Study (cont)

- Customer (1) requested to supply and install 2x30KVA UPS,2xSTS,2xPDU,battery 30minutes – Total max load 24KVA (80% of 30KVA) – Distributed redundant configuration – Figure 3
- **Total cost $260,000**
- Customer (2) requested to supply and install -48V 500Amp e/w 8x48/50A rectifiers, Distribution,Two battery strings each 200A/3hrs- Figure 1
- **Total cost $160,000**
- Cost benefit of DC solution is significant being 50% less expensive than AC solution. Both AC & DC can achieve calculated five nine availability [1] and [3] but DC is modular and has 3hrs reserve time

Figure 3 Distributed Redundant Configuration



STS: Static Transfer Switch

PMM: Power-management mode

Case Study

- Case #2
- This is to compare 120KW DC versus 128KW AC solution quoted recently at one CO within MTSAllstream Telecom facility powering datacom and internet equipment
- Both assume same type of Utility supply and single generator back-up .
- Both solutions are for new dedicated DC or AC power systems within seggregated space within CO.

Case Study (cont)

- Option (1) is to supply and install 2x200KVA UPS,2xSTS,2xPDU,battery 60minutes – Total max load 160KVA (80% of 2000KVA) or 128KW –Fig 3
- **Total cost $705,000**
- Option (2) is to supply and install -48V 3000Amp frame e/w 15x48/2000A rectifiers, Distribution, Seven battery strings for a total 2124A/4hr-Fig 1
- **Total cost $600,000**
- Cost benefit of DC solution is less significant than Case #1 but still 17.5% less expensive than AC solution and the DC arrangement is modular and has 4 hrs battery reserve versus 1 hr of UPS

Conclusions and Recommendations

- We have reviewed the problem with installing datacom equipment in Telecom facilities.
- We have demonstrated through recent Case studies within MTS Allstream Facilities that DC solution is less costly and more reliable than AC UPS solution.
- The growth of IP telephony leads the customers to expect same level of service on the Internet as they receive on the traditional circuit-switched telephone networks.
- This expectation mandates that all data and telecom equipment that provides communication services must have four to eight hours of battery reserve.

Conclusions

- MTS Allstream is calling to the end users and specific participants of the 2006 Infobatt to demand DC power equipment from datacom vendors.
- Power engineers must identify the organizations in their companies that specify datacom equipment and use this presentation as one of the tools to convince them to insist on DC power supplies.
- MTS Allstream is calling the Datacom vendors to design their datacom equipment with –48V DC power option

Q&A

- **Questions /Comments :**
- **End users**
- **Specifiers (Consultants)**
- **Vendors of DC and AC UPS**

References

- 1. Technical Subgroup on Telecommunication Energy Systems of the Power Electronics Society of IEEE , “Powering the Internet , Datacom Equipment in Telecom Facilities: The Need for a DC Powering Option “,1998
- 2. W.Pitt Turner IV,P.E, John H (Hank)Seader P.E. and Kenneth G.Brill, “ Industry Standard ,Tier Classifications Define Site Infrastructure Performance”
- 3.Alan Katz ,MGE UPS systems “Powering the Internet” ,Power Quality 2000 Proceedings ,Boston 2000

The End!