

# France Telecom Energy consumption, HVDC, cooling improvement

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# A bit of history of HVDC (1)

- 1880's: Edison-Tesla, initial HVDC electricity network, then AC
  - 1980-85 France Telecom **GEODE PROJECT** high voltage DC cabinet was imagined but modular decentralized 48V was developed
  - 1988 IEEE/INTELEC HVDC paper by Fujitsu
  - Several Intelec DC workshops (Yokohama, Berlin, ... ): concern for IP powering with Deutsch Telecom, NTT, Bells France Telecom...
- **Presentation of ETSI EN 300 132-3** by Wilfried Schulz DT EE2 chairman in Yokohama at ETSI
- **It seemed HVDC could be better solution**

# A bit of history of HVDC (2)

- 1997 300VDC option presented at IEEE/INTELEC by France Telecom and Alcatel
- 1999 INTELEC, HVDC paper from NTT-f
- 2000 Alcatel 312 VDC - 30 kW power station for ATM and servers systems presented in ETSI meeting (2000) and IEEE/intelec, NTT paper on 270 Vdc cabinet
- 2006 DC workshop N°1 WashingtonDC: Intel, Sun, EPRI, BerkeleyLBNL, NTT, ETSI, UPN, ... ETNO demonstration by Intel R&D
- **NTT-f Sendaï project : 1 MW site with PV and HVDC**
- **2007 USA DCworkshop N°2**

# Power consumption ?

FTgroup -ORANGE 2006 : 3,5 TWh for the group about 2 TWh in France, (0,4% of national consumption)

## 2006 very rough estimations

	GWh	kWh/client/year	Possible evolution
FT fix network (phone, DSL, FTTH)	350	10 to 30	VoIP with standby
FT mobile network	300	10 to 20	Radio efficiency, Standby
FT datacenters	300	10	Better server use, passive cooling, HVDC
FT terminals	300 ?	0 to 100	Standby
PC+TV	?	100 to 1000	?
World servers (without storage)	126 000	<b>126</b>	I2C data (Koomey thesis) ?

## How to master power consumption ?

→ Code of Conduct + standards to define measurement methods (ETSI, ...)

# ETSI EN 300 132-3 (2003) 400 V HVDC option

- A common power supply interface
- Interworking of different types for telecommunications and data communication equipment
- Very high power efficiency
- Facilitate the installation, operation and maintenance in the same network of equipment from different origins (servers, NGN, ...).
- Simple and reliable

# Power architecture and efficiency comparaison

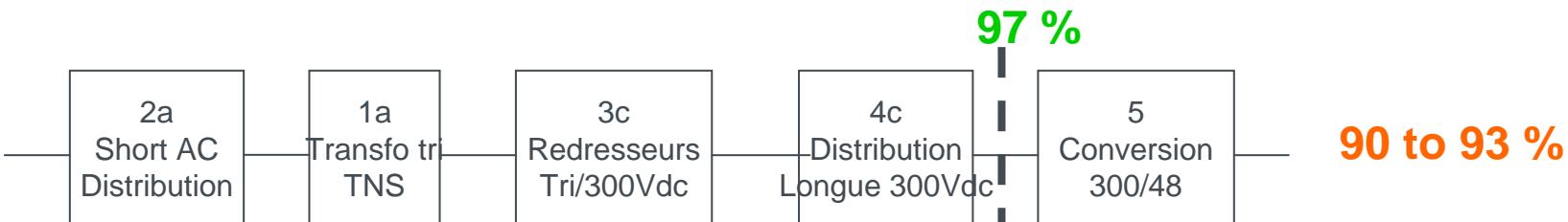
a) centralised 48 V (R+B with a1: thyristor mode and a2: HF switched mode)



b) Decentralised 48 V (R+B cabinet)



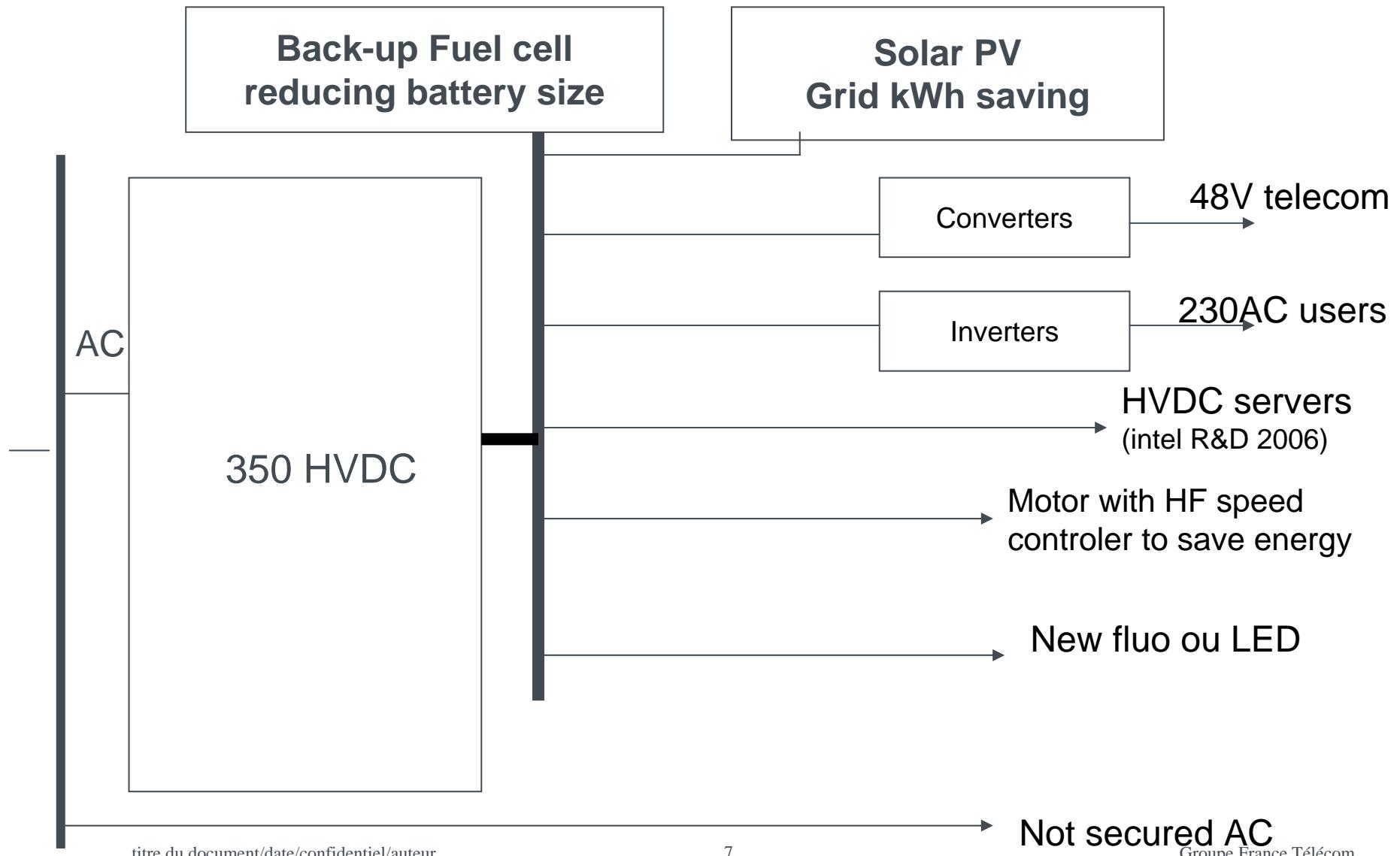
c) HVDC (direct use or decentralised 48 V production)



For Comparaison :

on line UPS = 85 to 92 %  
off lineUPS = 97 %

## HVDC Architecture : AC UPS replaced by DC UPS + DC BUS



# France Telecom first feeling about HVDC

- cost < 230 V UPS and 48 V DC
- compared to 48V:
  - 30 time less copper
  - 6 time more compact rectifiers
  - battery centralization compared to decentralized 48V:
    - cooler area for battery →, lifetime gain
    - no pb of weight
- compared to UPS:
  - supressing UPS inverter stage
  - simpler for engineering and operation
  - more reliable
  - offline UPS is also an efficient solution one disturbance filter is lost

# ETSI EN 300 019

Suite of ETSI standards defining thermal environment:

- Large temperature range is accepted by telecom equipment (5-40°C on site)
- That allows very important savings in telecom rooms till 100 kW using outside fresh-air + passive building inertia
- It can be partially proposed for servers, because :
  - + 1°C saves about 10% power consumption, servers can work till 30 to 35 °C
  - BUT 20 °C is used to give time to repair cooling system (today we observe + 1°C per mn, ie 15 mn till first servers failures)

So, some points under study :

- Better air management in the room (e.g. ETSI TMG Thermal Management group documents)
- Manufacturers are thinking to better heat management inside servers cabinets
- Passive inertia can be enhanced at the level of servers

# Further steps

- Improving datacenter power consumption understanding
- HVDC:
  - experimentation
  - standardisation (Cenelec, IEC) :      Plug and protections
  - site engineering impact : Datacenter and new generation telecom
  - migration from AC to DC : cabling, HVDC Acceptability investigation
  - Deeper comparative economical study
- Cooling ingeneering and system improvement