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Keeping Your Phone Working When The Lights Go Out

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- B.Sc. (EE) & M.Sc. (EE) Queen's University
- 40 years in design, develop, and management with telecommunication power suppliers

  'keeping your phone working when the lights go out"
- Registered Professional Engineer in Ontario
- Presently an IEEE Life Senior Member & retired (sort of)
- Active IEEE volunteer, especially STEM Outreach

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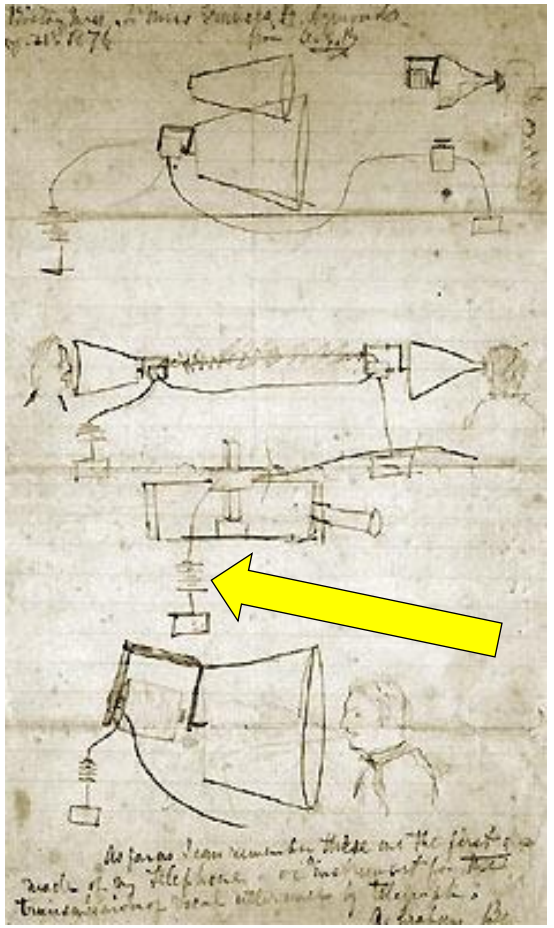
History of Telecom Power - Powering Bell's Phone

- The original phone was battery powered
- Battery was local (at the phone) and switching was manual – using jacks



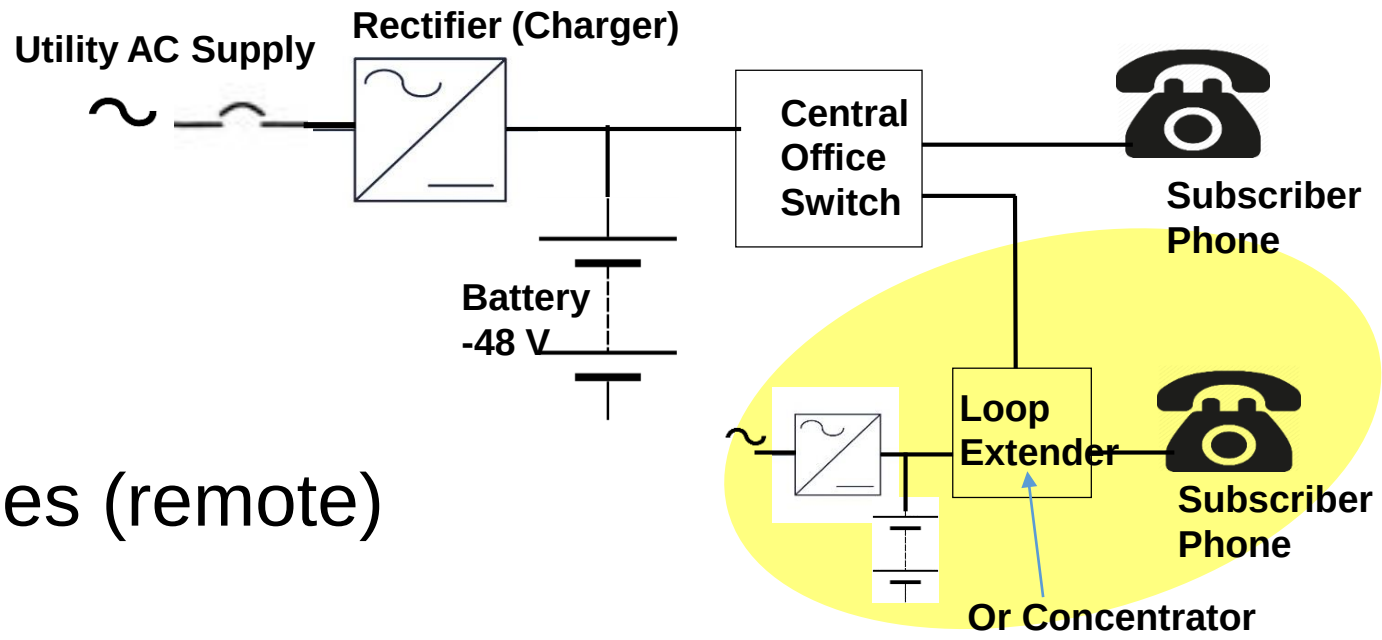
http://www.powerqualityworld.com

History of Telecom Power - Centralization

- As switching was automated, the “offices” were powered by battery plants (centralized)
- As cities were electrified, the battery plants were charged from AC.
- For reliability (life line services) power for the local phone was supplied from the central office.
- Powering from central office had limited reach (10-15 miles [16-24 km]) and capacity (single phone)
- -48V standardized as compromise between reach and safety (some jurisdictions used 60V until 1970s)

History of Telecom Power - Decentralization

- Limitations on reach to customer ➡ loop extenders
- Growth in customer base ➡ concentrators



- More batteries (remote)

Utility AC Supply Outages & Availability

- TELSTRA (Australian) Data from 1994

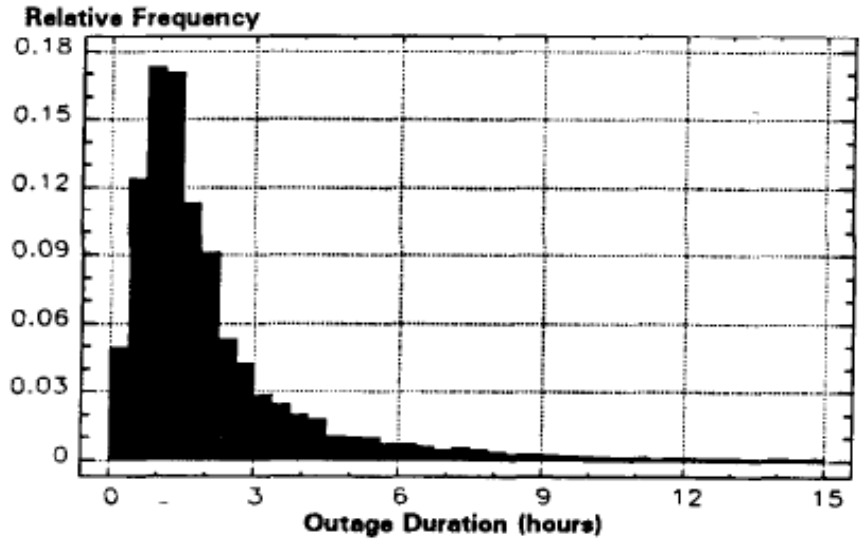


Figure 5. Relative frequency of accidental AC power outages.

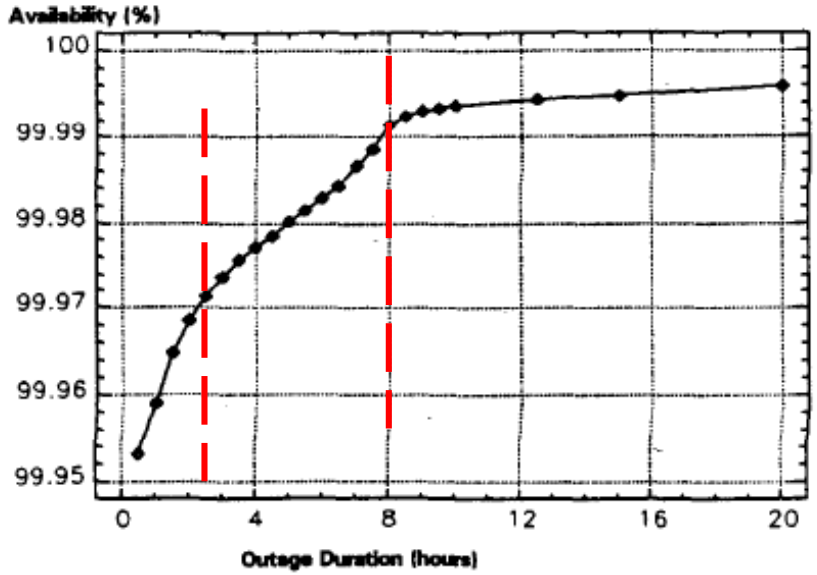


Figure 2. AC Availability

Source – Battery Reserve Sizing for FITL…, J. Hawkins, INTELEC

Reliability - Availability

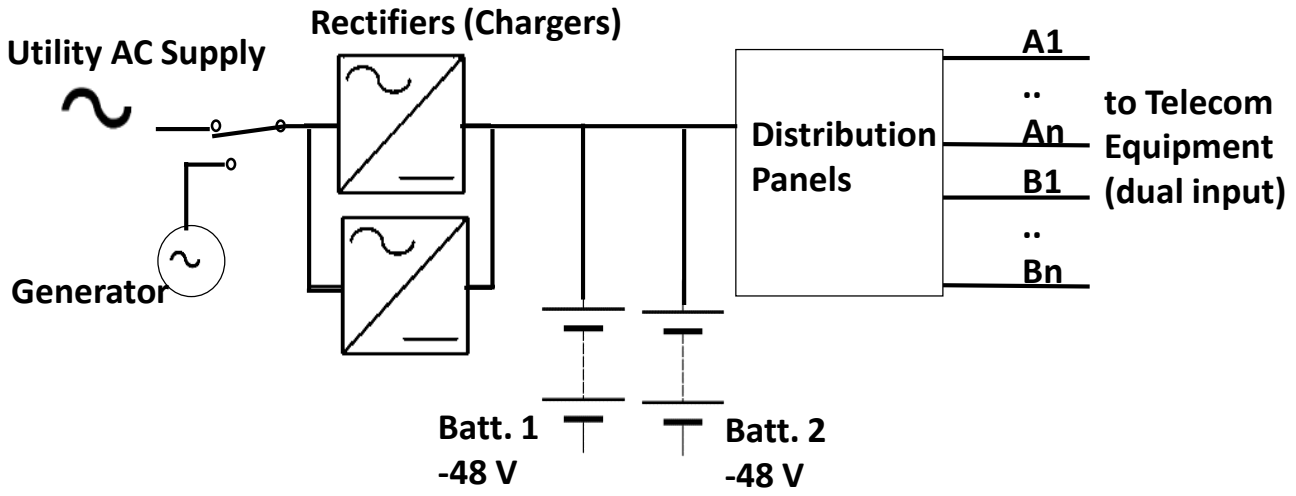
- For a telco operator, their focus is on availability – expressed in %
- A perfect system is available 100% of the time
- Outages are reflected as Unavailability = 100% - Availability

AVAILABILITY (%)	# of 9s	OUTAGE (/year)
99.9	3	8 hr. 50 min.
99.97	$3\ ^1/_2$	2 hr. 37 min.
99.99	4	53 min.
99.999	5	5.3 min.
99.9999	6	0.5 min
99.99999	7	3 sec.

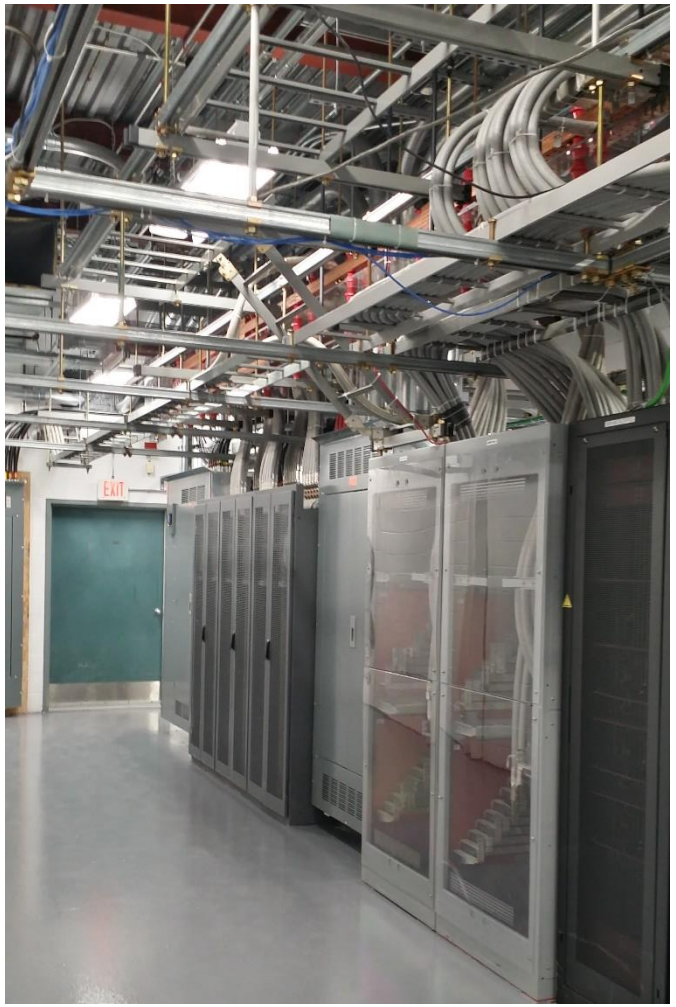
- Availability is often referred to by the # of 9s
- Telco's look to have 5 9s or 6 9s, even 7 9s in very critical locations
- Achieving this depends heavily on repair time (MTTR) and maintainability

Modern DC Power Systems

- Modern DC power system consists of:
  - utility supply
  - transfer switch
  - generator(s)
  - rectifiers/chargers/PCU
  - batteries
  - distribution (protection)
  - interconnections between these



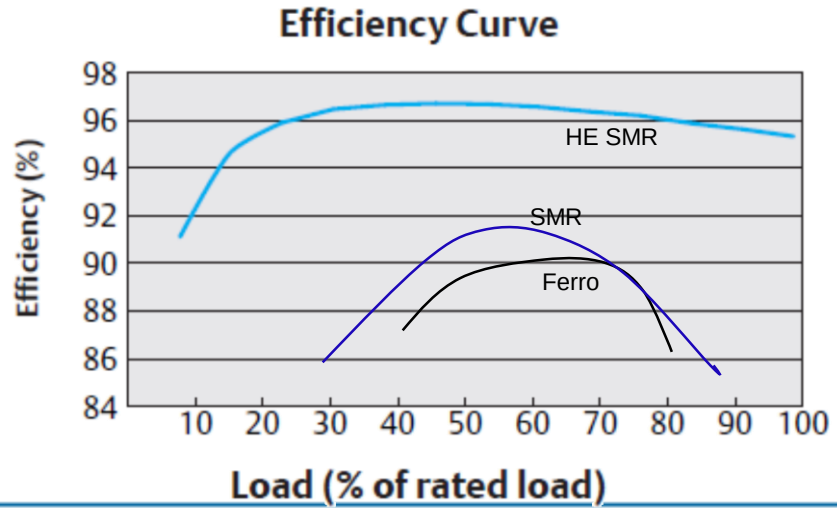
Modern DC Power System



Rectifiers – Technology Comparison

- Comparison of various rectifier technologies
  - impacted by changes in components, manufacturing processes, and locations
  - some impact by design choices

Technology	Vintage	Size (dm^3 /kW)	Wt (kg /kW)	Eff. %	PF	Cost ($ /kW)
Mag Amp	‘50	55	40	83	.70	$2000
SCR	‘60	55	36	85	.80	$2000
Ferro	‘70	55	40	88	.93	$2000
SMR (gen1)	‘80	12	8	90	.85	$1000
SMR-PFC	‘90	4.8	6	92	.99	$400
HE SMR	‘10	2.4	4	96	.99	$240



Estimates by M.MacDonald

New Milestone in Process

IEEE Milestone

THE TRANS-CANADA MICROWAVE SYSTEM, 1958

On 1 July 1958, the Trans-Canada Microwave System introduced both live network television and direct-dialled long distance telephone service to Canadians from coast to coast. Comprising 139 microwave relay towers spanning more than 6275 kilometres, it was, at time of completion, the longest such network in the world. Later extended and upgraded, its impact on Canada, its society and its economy was immense.

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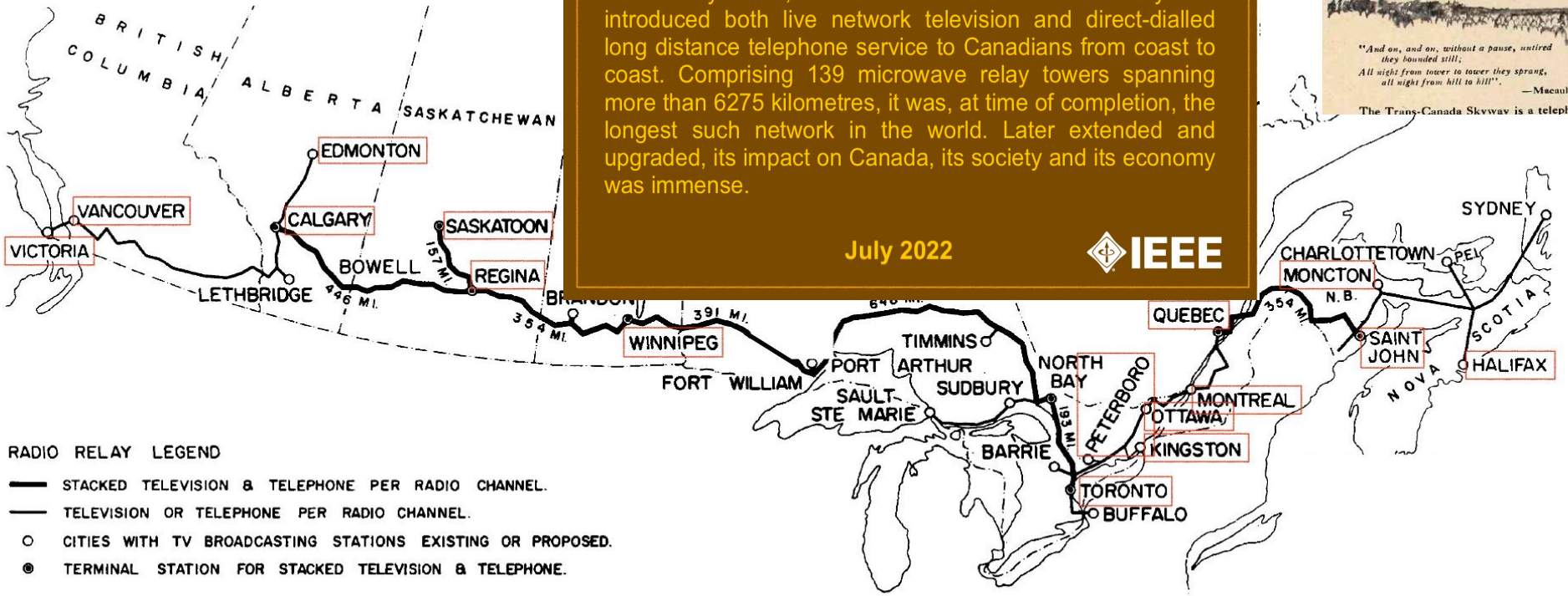

Fig. 1. Trans-Canada TD-2 radio system television and telephone network routes

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Questions?

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