IEEE 802.3 DTE Power via MDI

Power Delivery Calculations and Proposals

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Objective, Assumptions

- Objective: Better understand the ramifications of and make proposals regarding
  - power and current levels
  - one Vs two pairs for power
  - power supply capacity/power delivery efficiency
- Power is assumed applied to one or two spare pairs
- Load is assumed to be a constant power sink of either 12 , 15, 20, or 25 watts, continuous
  - Addresses the range of limits most parties have mentioned*

* Some parties, including P. Holland (“Proposed DC Power Requirements for Power via MDI”, Sept 31, 1999) have proposed addressing higher power levels

Power Level Requirements (at the load)

Application	***Prevalence***	***Max. Cont. Power, Watts***
IP Telephone	High	5-12
IP Terminal Adapter	Med	?
Wireless base stations	Low	25
Web Cams	Low	?
Building, Industrial Controls	?	Sensor: 0.5 Actuator: 6.0*
Sensors, Badge Readers	Low	Proximity: 12 Swipe: 1
Wall displays/monitors	Low	?
Laptop (54-42v compatible)	Med	25

* Intermittent, not continuous.

Assumptions, Proposals

- *A nominal 54 volt* and, importantly, *worst case 42 volt* enterprise power source is proposed
  - Keep voltages <= 60 volts (CEI/IEC 950 or UL 1950)
  - To stay <= 60v with tolerances, maintain 54 volts and charge emergency back-up batteries to 54 volts
  - This maximizes battery hold-over life life before dropping to 42 v
  - Below 42 volts, battery damage can occur
  - **We propose 42 v minimum operational source voltage**
- Cable current Limits
  - Keep current per conductor < 1 amp* (conservative)
  - Keep total current in 4-pair cable <= 3.3 amps**
  - **We propose operational currents**

    <= 0.82 amp/conductor for power over 2 pairs

    <= 1 amp/conductor for power over 1 pair

* Charles Belove, “Handbook of Modern Electronics and Electrical Engineering”. This sites UL 60º C cable ratings.

** FCC Data. CFR Section 68.215

Loop Resistance

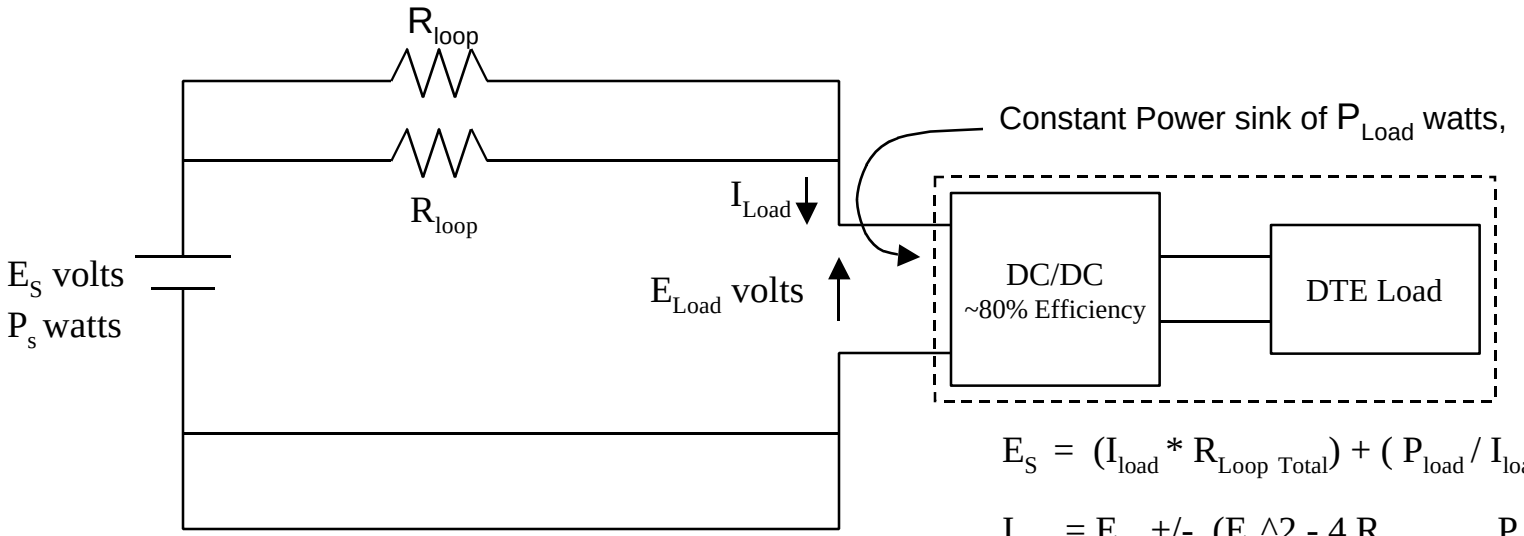
- Assume Cat 3 or Cat 5 24 gage cable
- DC resistance per 100 meter loop (through two conductors) at 20^{o} C = 18.76 ohms*
- Increase in loop resistance per ^{o}C = 0.393%
- 50^{o} C conductor temperature is a reasonably worst case assumption, consistent with building ambient
- Temperature rises due to ~ 0.8 amp currents are small (~ 3^{o} C) relative to the assumed worst case ambient

Temp (^{o}C)	Loop R (ohms) (single loop)	% increase
20	18.76	0
40	20.2	7.9%
50	21.0	11.8%

Assume 21 Ohms for 100 meter loop

*ANSI/TIA/EIA-568-A, Section 10.2.4.1, DC Resistance: The resistance of any conductor, measured in accordance with ASTM D 4566, shall not exceed 9.38 ohms per 100 m (328 ft) at or corrected to a temperature of 20^{o} C.

Power Calculations

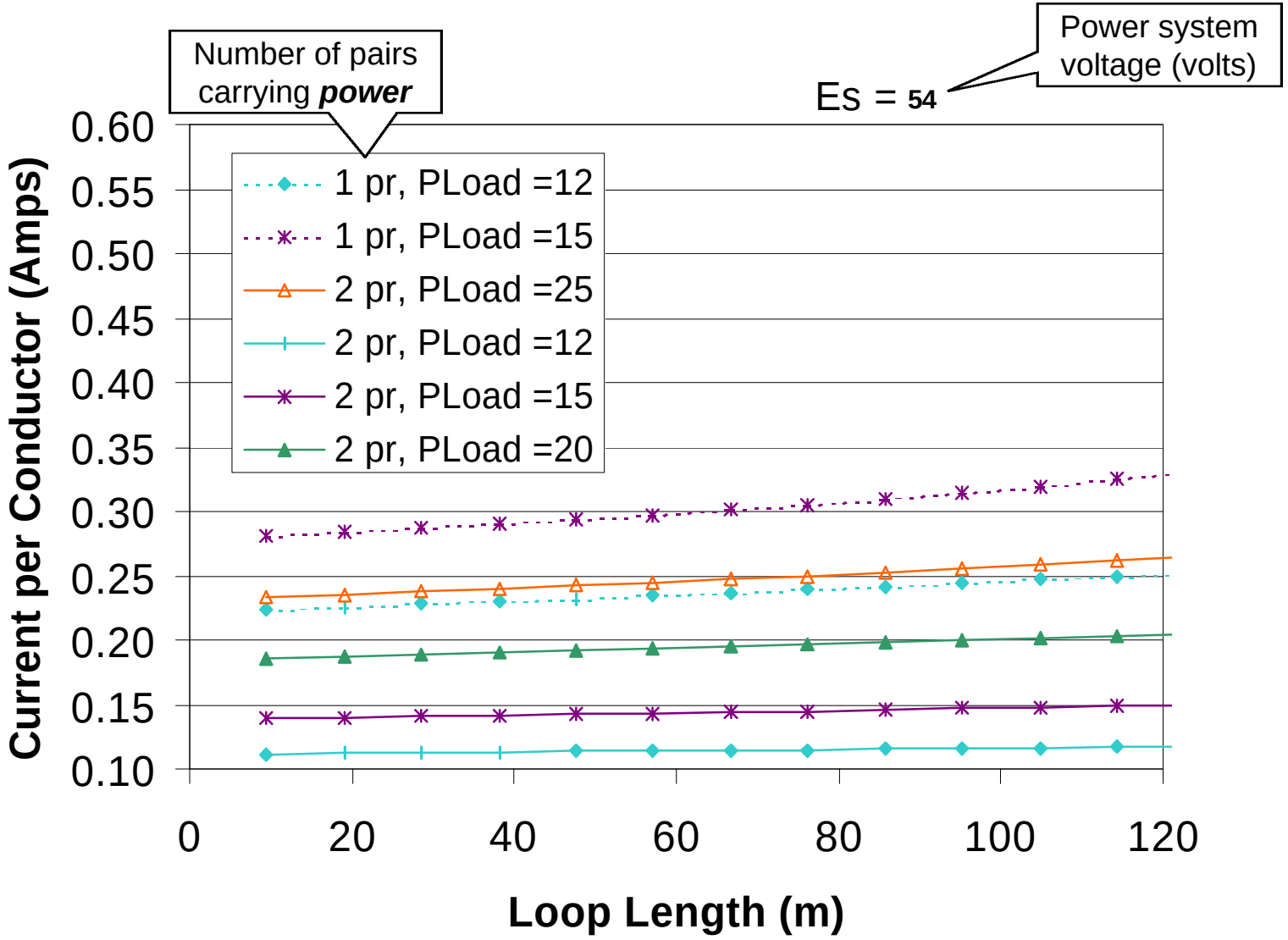


$$E_S = (I_{load} * R_{Loop\ Total}) + (P_{load} / I_{load})$$

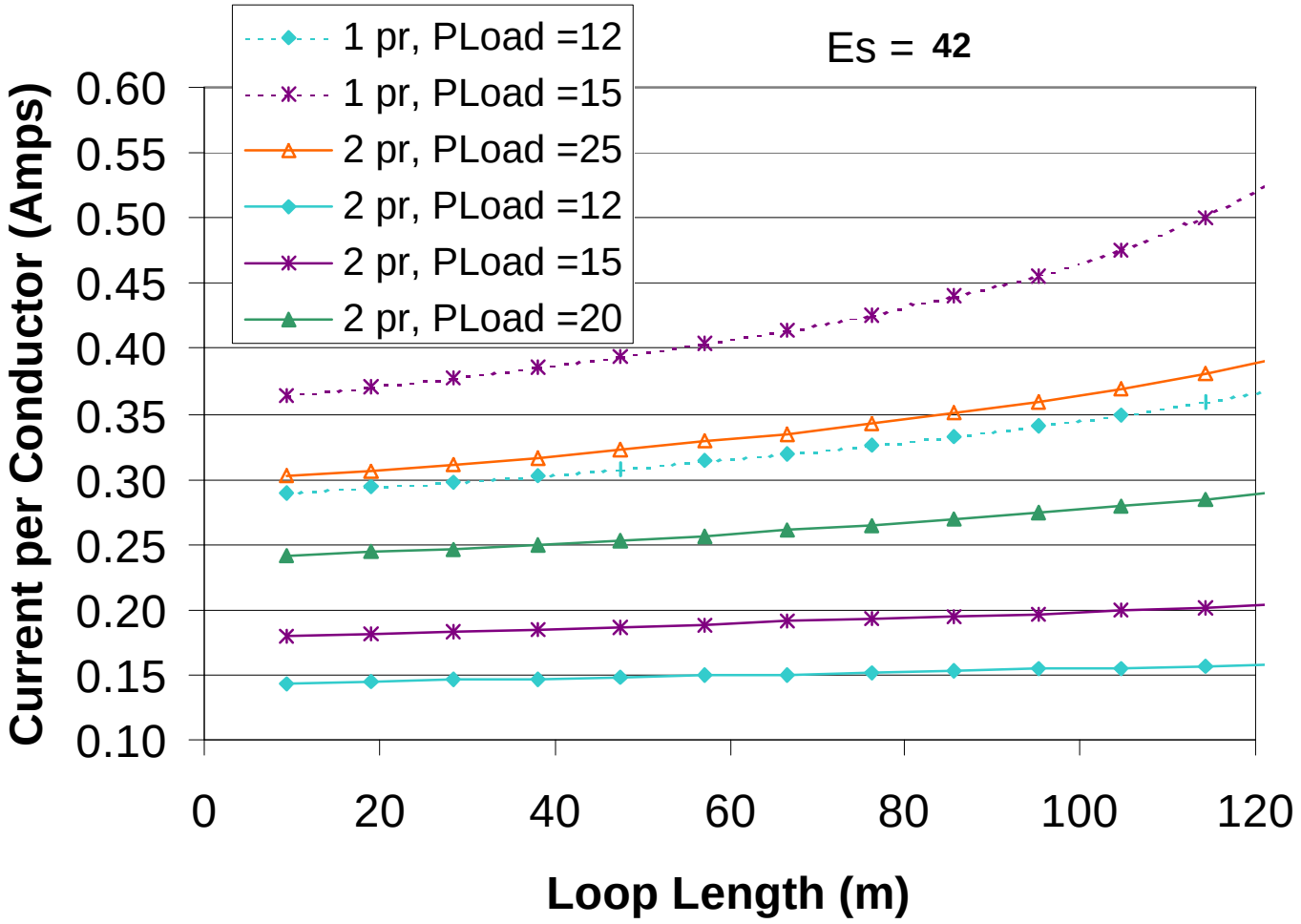
$$I_{load} = \frac{E_S \ +/- \ (E_S\text{^}2 - 4\, R_{Loop\ Total}\, P_{load})^{1/2}}{2\, R_{Loop\ Total}}$$

- One and two loops carrying power are examined
- Calculations assume 21 ohms for single pair, 10.5 ohms for two pairs (100m loop length)
- Calculations assume 54 v (nominal) and 42 v (worst case) from source (E_s)

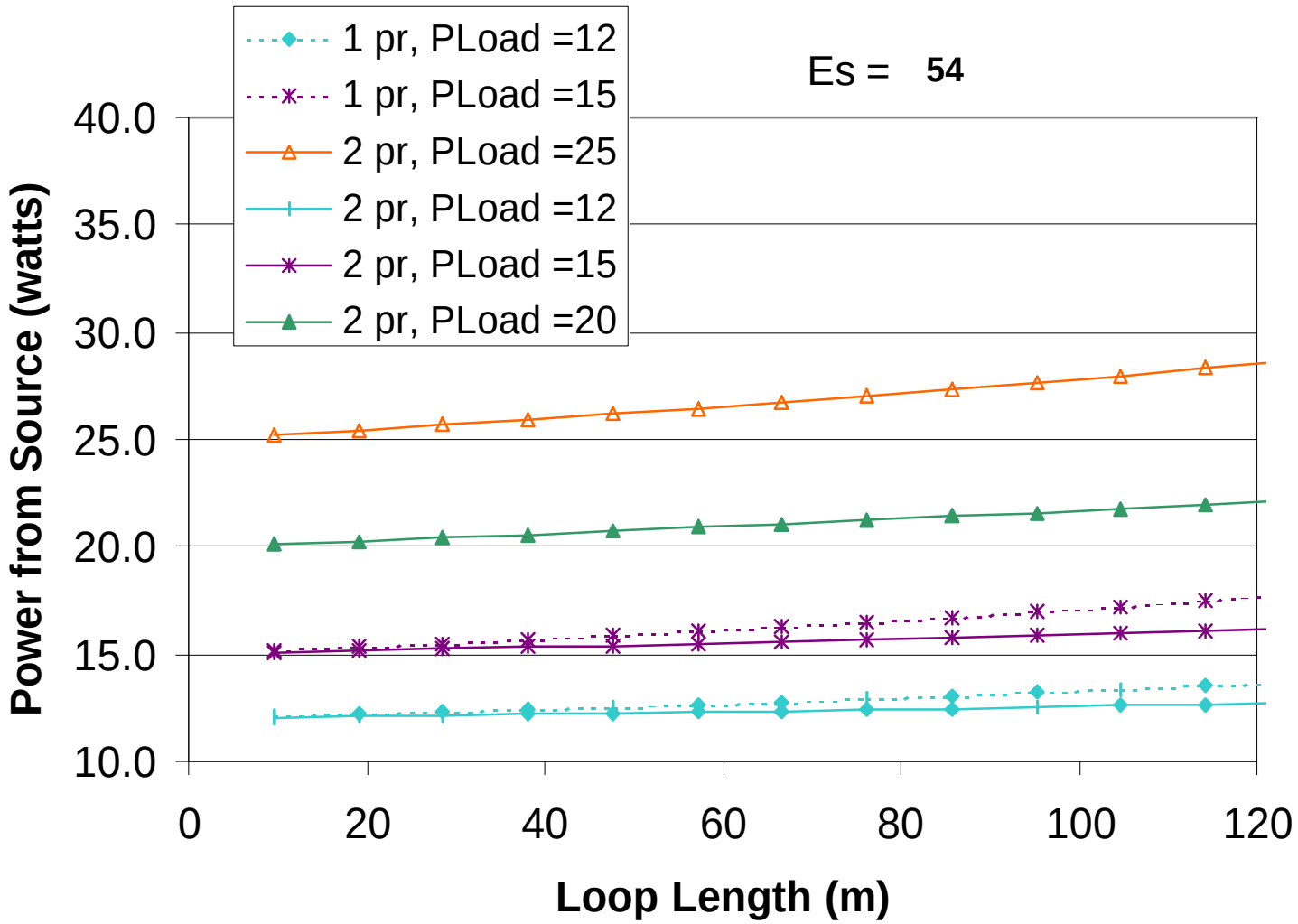
Current Per Conductor Vs Loop Length



Current Per Conductor Vs Loop Length



Power from Source Versus Loop Length



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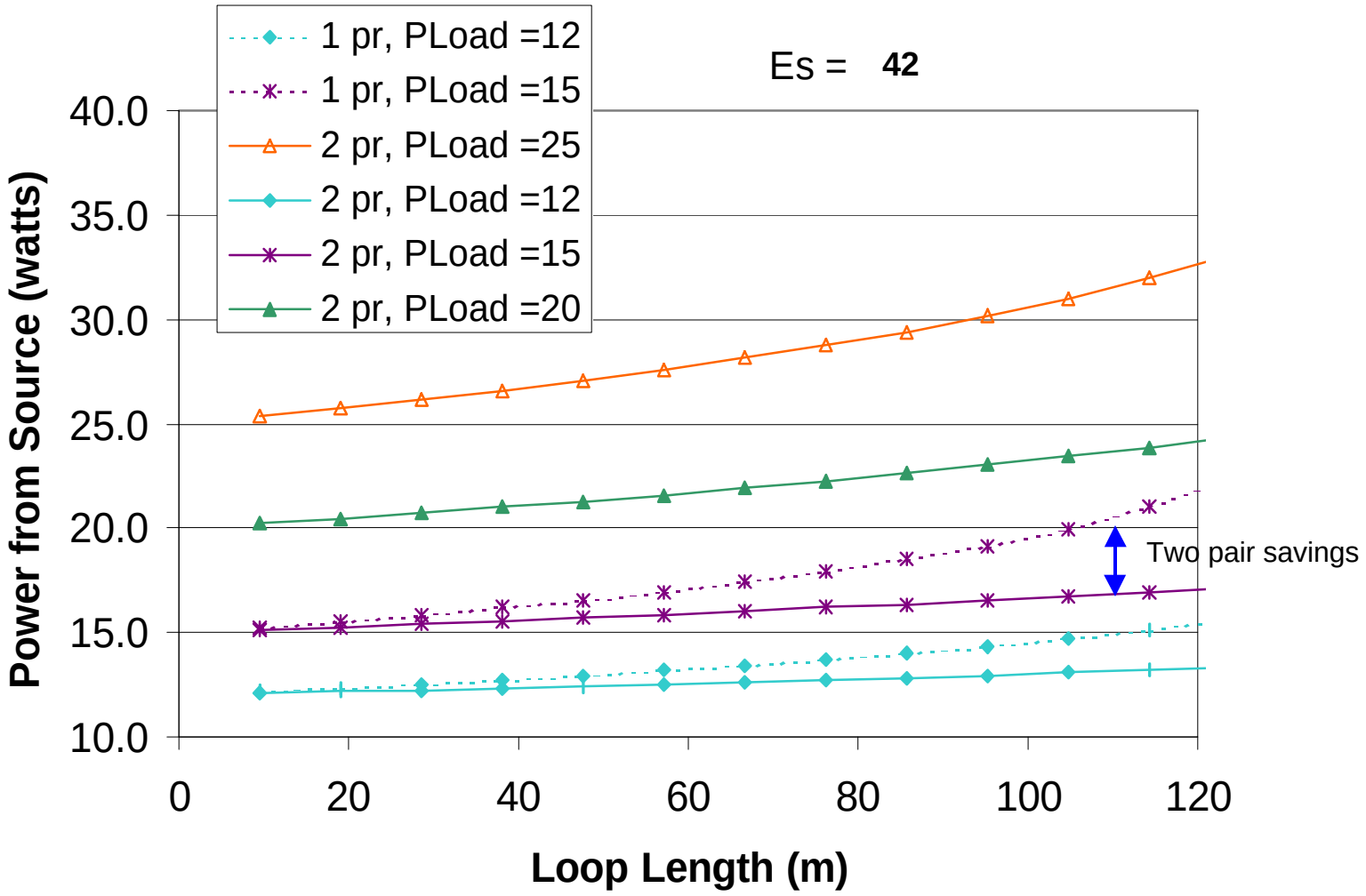
Power from Source Versus Loop Length



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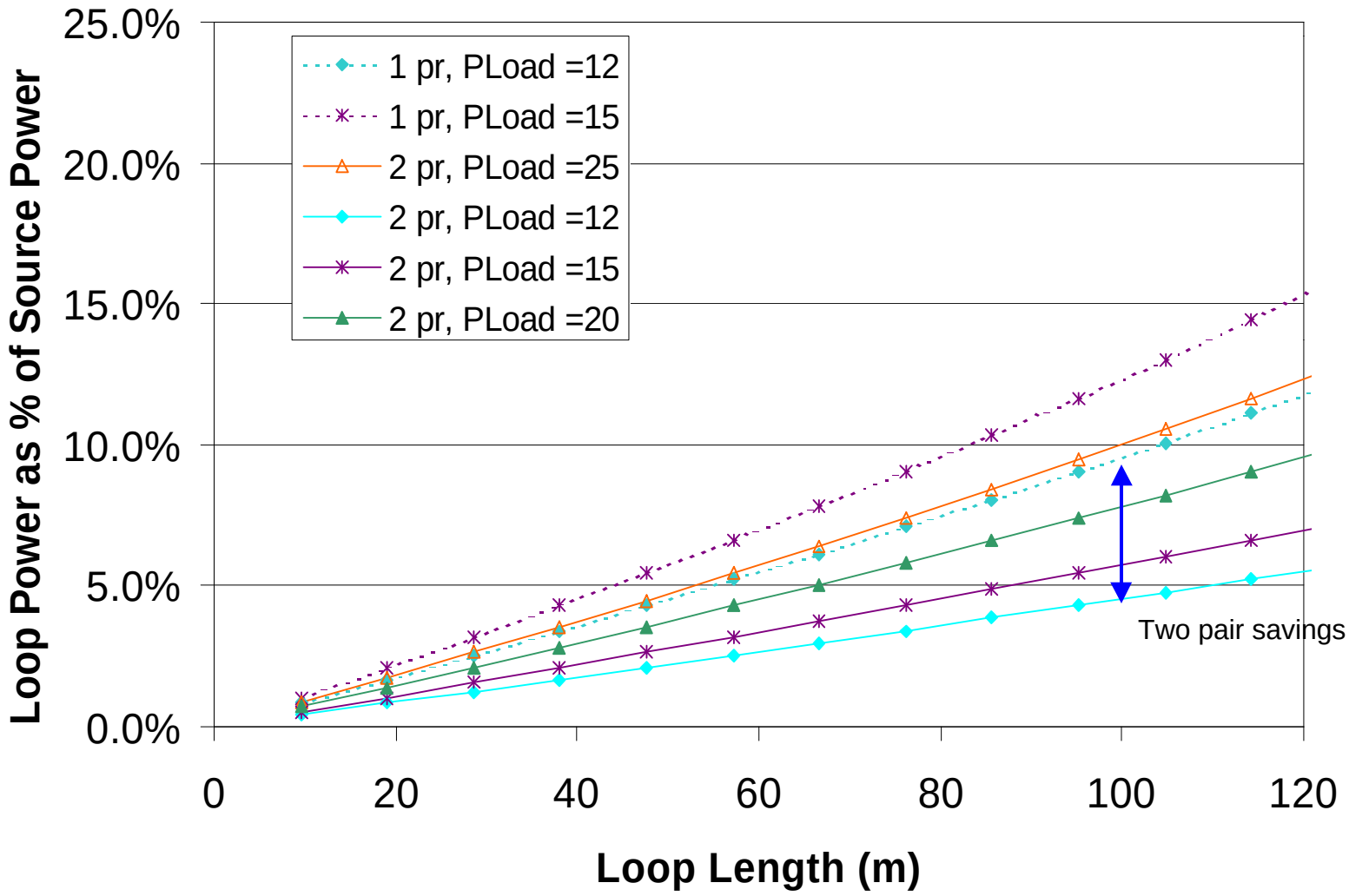
Power Disipated in Loop as % of Source Power

Es = **54**



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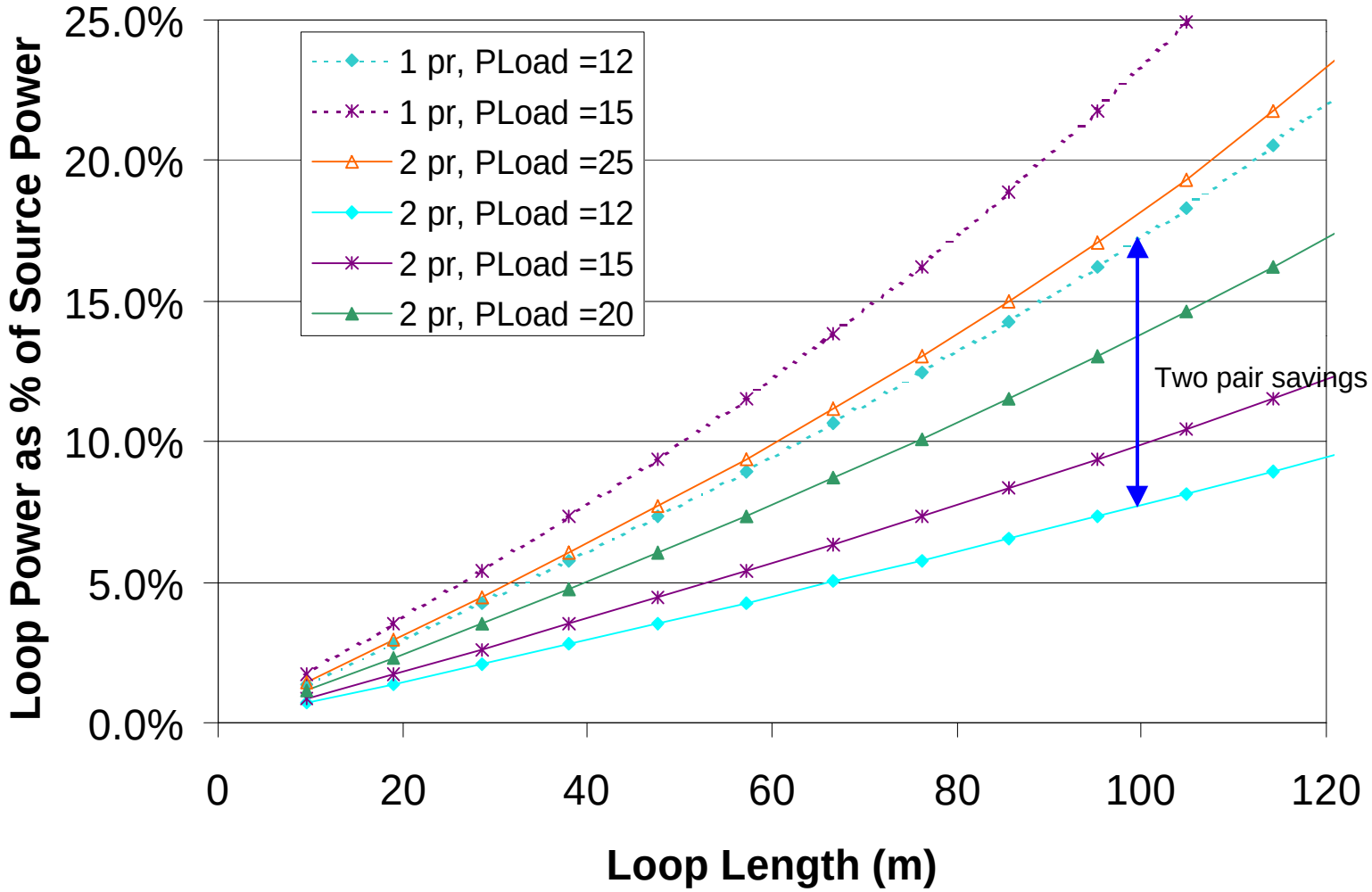
Power Disipated in Loop as % of Source Power

Es = **42**



Voltage, Current, and Pair Proposals

- Standardize on 54 v (nominal), 42 volt (worst case) power source
- Keep current per conductor <= 0.82 amps
  - Consistent with using two pairs for power
- Use *two power pairs* instead of one
  - Allows <= 40 watts to DTE while staying <0.8 amps*
  - Lowers the required power supply capacity, lowering costs
  - Maximum one pair can support to DTE at 100 meters: 20 watts**
- **Proposal: support <=25 watts to the DTE**
  - Large enough to encourage new applications

* At Worst Case 42v
** The 42 v worst case voltage limits the current to 0.8 amps at 100 meters