

Number of Cables in Bundles for 100 Watt 4-Pair Power

Wayne Larsen
CommScope

Supporters

- George Zimmerman, CME Consulting
- Jeff Schindler, Seen Simply
- Dave Dwelley, Linear Technologies
- Jeff Heath, Linear Technologies
- Koussalya Balasubramanian, Cisco

Proposal

- The maximum number of cables in a bundle that is used to support Type 4 power (up to 100 Watts) shall not be greater than 40 (independent of cabling category).

Reasons for proposal

- A standards based requirement needs to be clear and easy to understand and implement. Making the requirement dependent on cabling category may lead to errors and dangerous installations.
- Engineers can still take advantage of the extra capacity of higher categories of cable in going beyond the standard, as is done today in other respects.
- In the field, cables of different categories are sometimes combined in the same bundle. This proposal avoids confusion as to the maximum bundle size, in this case.

Justification of proposal - outline

- Experimental data
 - Test Method
 - Resulting data
- Empirical analysis of experimental data

Summary of experiment

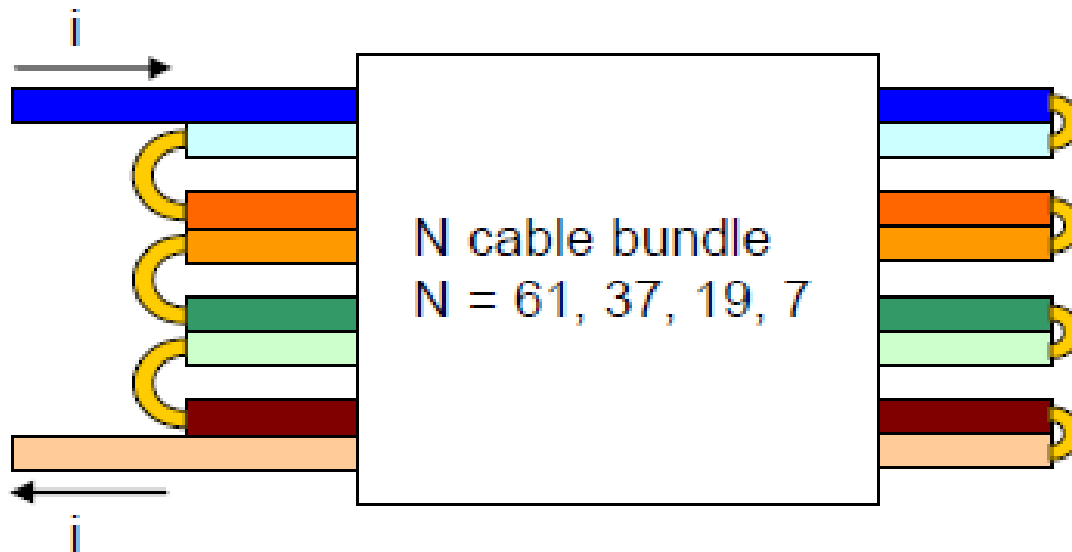
- In one experiment, categories 5e, 6, and 6A, were studied, with three different current levels and four different bundle sizes

Procedure



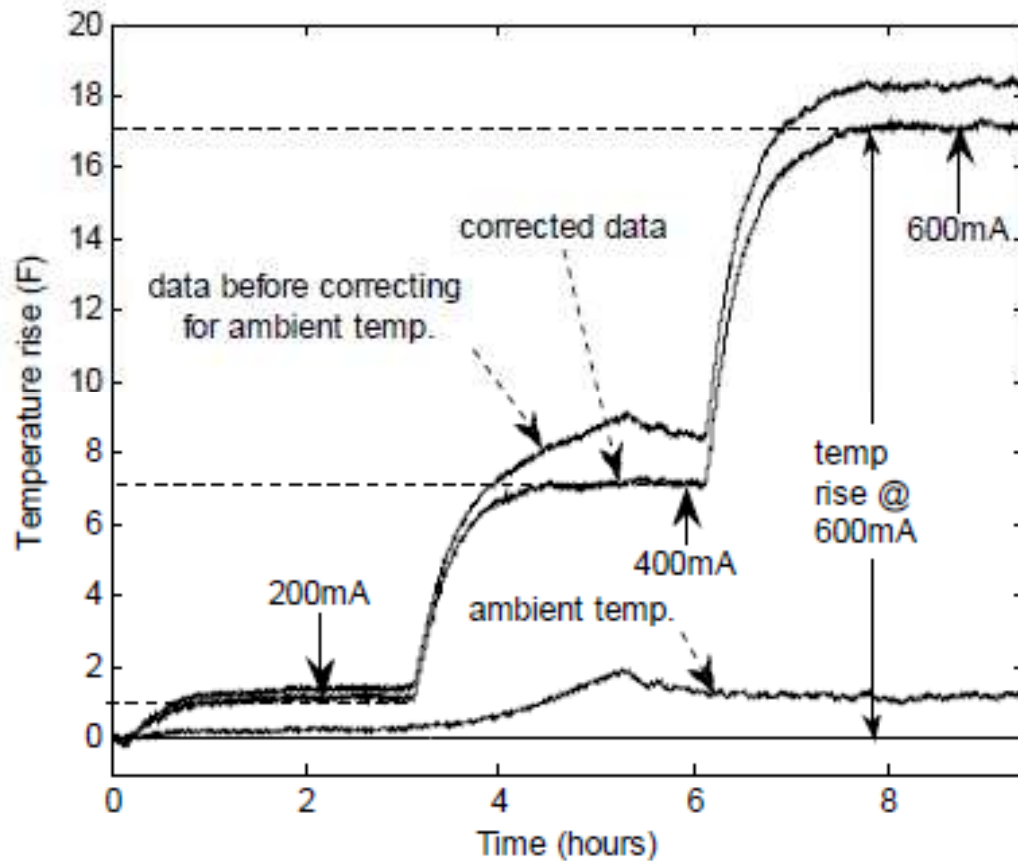
A single long cable was wound around a mandrel at both ends, and layered over itself, to produce a 61 cable bundle.

Procedure



Current was applied through all 8 conductors in alternating directions so that all conductors were energized with the same current.

Getting data



Thermocouples were placed on the center cable, and in the room nearby but outside the bundle. The bundle was allowed to stabilize in temperature at each current level. The rise in temperature was corrected for the change in ambient temperature.

Data

| Current | N = 7 | N = 19 | N = 37 | N = 61 |
|---------|-------|--------|--------|--------|
| 0.2 | 1.3 | 2.34 | 3.29 | 3.95 |
| 0.4 | 3.72 | 7.08 | 11.1 | 15.64 |
| 0.6 | 7.75 | 14.97 | 23.55 | 33.77 |

Table 1. Temperature rise for differently sized Cat 5e bundles

| Current | N = 7 | N = 19 | N = 37 | N = 61 |
|---------|-------|--------|--------|--------|
| 0.2 | 0.586 | 1.2 | 1.19 | 3.13 |
| 0.4 | 2.37 | 5.18 | 7.34 | 12.45 |
| 0.6 | 5.48 | 11.45 | 17.3 | 27.6 |

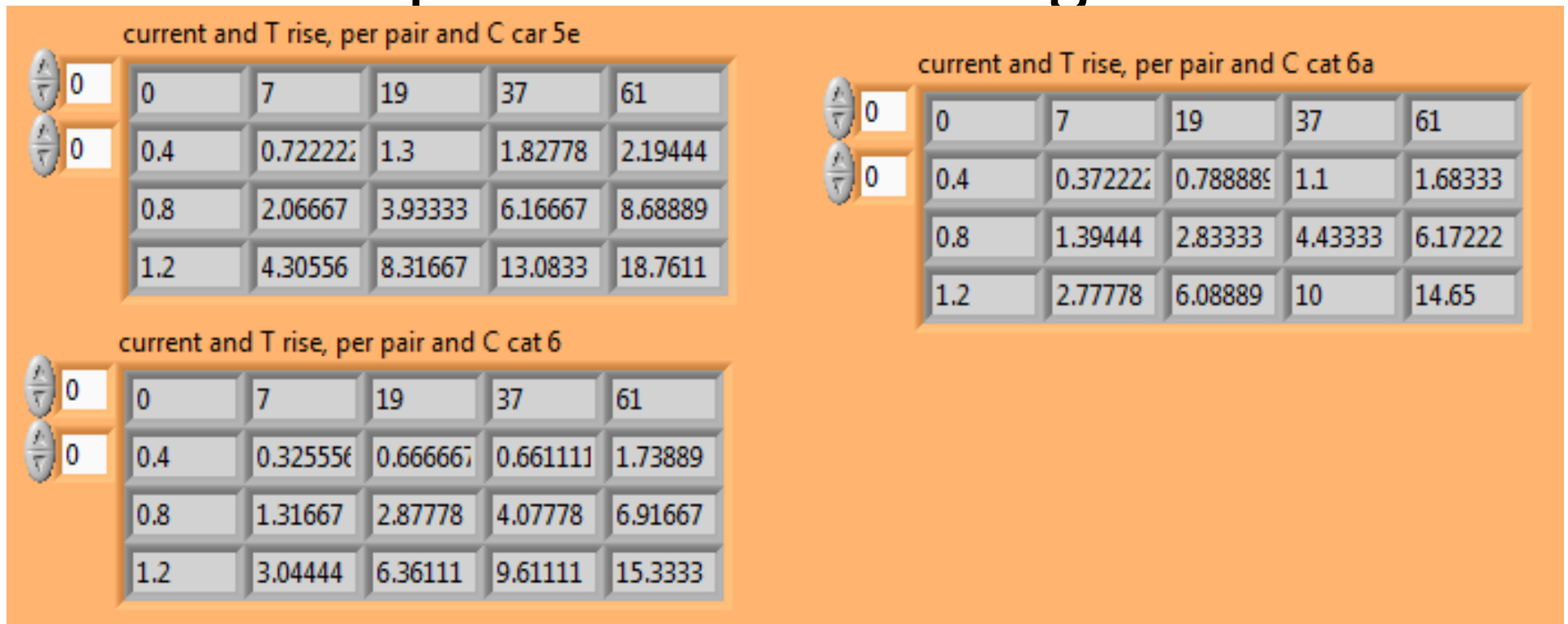
Table 2. Temperature rise for differently sized Cat 6 bundles

| Current | N = 7 | N = 19 | N = 37 | N = 61 |
|---------|-------|--------|--------|--------|
| 0.2 | 0.67 | 1.42 | 1.98 | 3.03 |
| 0.4 | 2.51 | 5.1 | 7.98 | 11.11 |
| 0.6 | 5 | 10.96 | 18.06 | 26.37 |

Table 3. Temperature rise for differently sized Cat 6A bundles

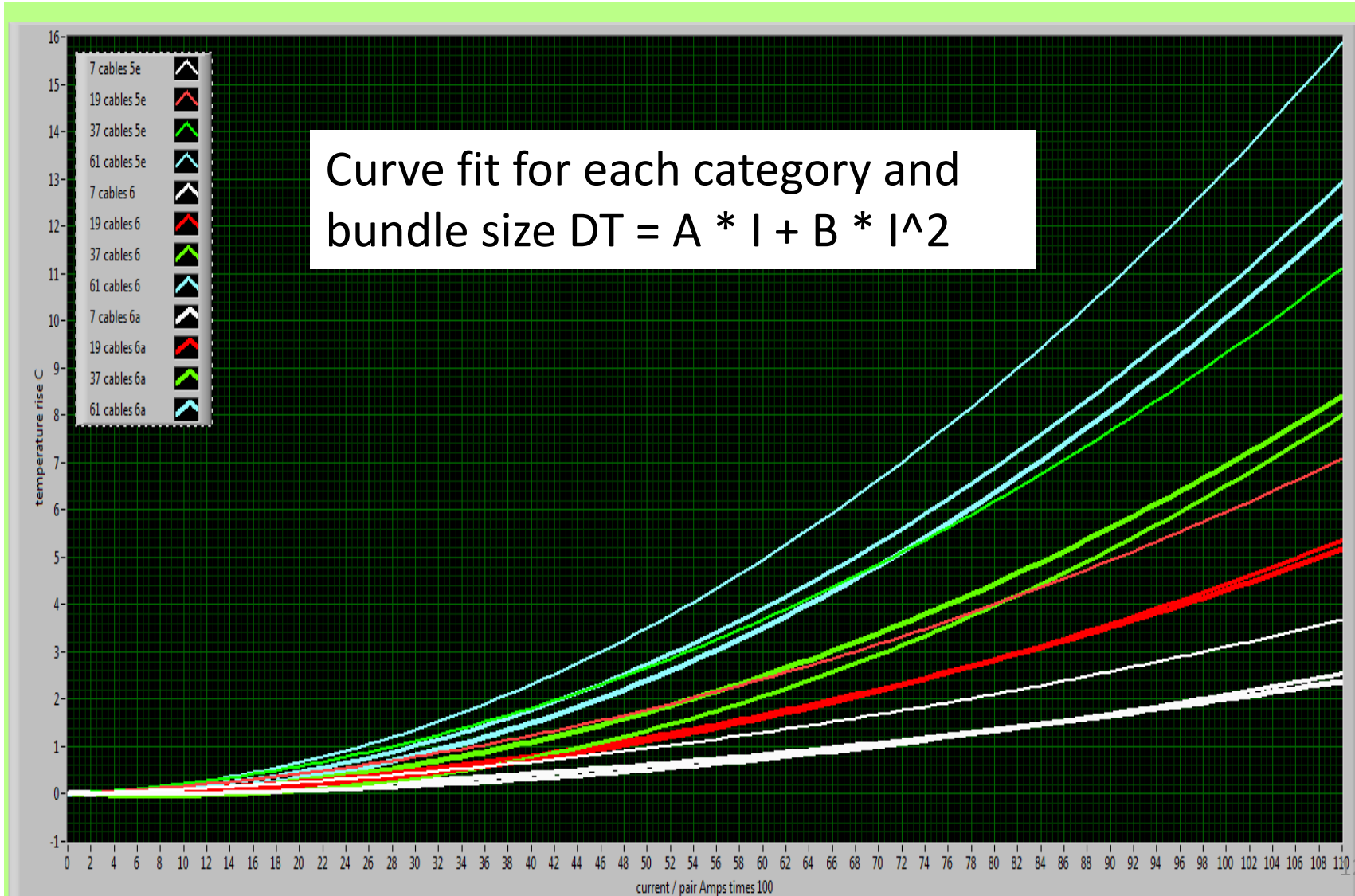
Data as reported by experimenter – current per conductor, and degrees F

Data – current per pair and temperature rise in degrees C

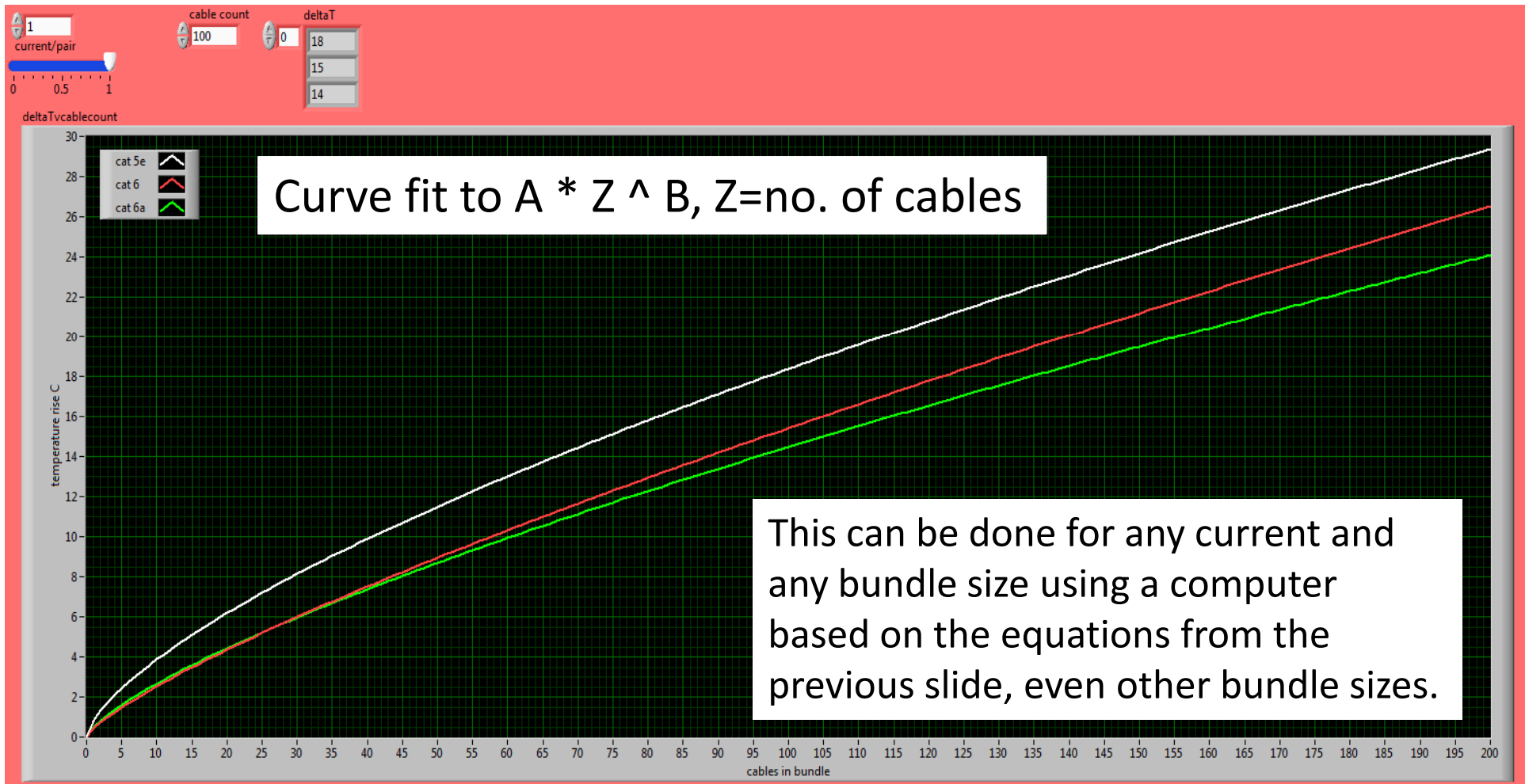


Note that a large conclusion is being drawn from 3 current levels, 4 bundle sizes, and one design (with one particular conductor diameter) for each of the three categories.

Empirical curve fit current



Empirical curve fit bundle size



Sample size and variability considerations

- The data represents a study of a limited number of samples.
- Bundle size depends on the particular conductor diameters selected for each Category, which is an item requiring further study if recommendations varying by category are to be adopted.
- Consequently, any future study should include varying cable diameter and conductor diameter since both affect temperature rise in a bundle

Conclusion

- A maximum bundle size of 40 cables will support 1 Amp per pair on all four pairs with no more than 10 degrees C temperature rise
- While higher category cables could potentially support larger bundles, a better idea is to unify the requirement to a common number for all categories
- If necessary, other current levels and temperature rise allowances can be studied

Questions?