Data transfer at the speed of light, but is it reliable?

Data transfer have almost exclusively been done through electrical cables, but the use of fibre optic cables is increasing. But how does the reliability of fibre optic cables compare to that of electrical cables? As it turns out the fibre optic cable might be the better choice.

Sometimes the communication between devices is taken for granted. Take an ordinary light switch for example. When you flip the switch the light comes on, this is due to electricity being transported along a cable to the light bulb. Much the same happens when we control more advanced equipment that carry out actions such as closing a valve instead of bringing light to your kitchen. Sometimes there are situations at which this action is absolutely critical to the safety of humans, for example in a nuclear power plant or nuclear research facility.

In these types of facilities, the actions need to be carried out from a distance and that is where the cables come in. In case of an emergency the reliability of the cables is important. This can be shown through a real example, the Browns Ferry Nuclear Power Plant accident in March 1975. A fire damaged 1600 cables, where 600 of these were cables that monitored or controlled safety features of the plant. The damages to the cables caused several faults to occur; some safety features could no longer be operated from a distance, some safety features were put into motion by themselves, and some instruments on the control panel showed misleading indications.

The misleading and erroneous signals in the Browns Ferry accident was probably due to the use of electrical cables for control equipment. In other words, there was a possibility for the signal to go the wrong way if the cables came in contact with each other. Signals that are interpreted by computers has mainly been sent using electricity, but it is also possible to use light to send the same signals through fibre optic cables. The fibre optic cables offer higher speed as well as an inherent electrical isolation. Therefore, the problem with signals going the wrong way becomes impossible with fibre optic cables as they themselves are electrically insulated. Instead, the problem with a fibre optic cable subjected to fire is how the light being transmitted is disturbed, and thus how the actual data is affected. In this work, fibre optical cables are put to the test when it comes to effects of fire. In the tests, measurements of temperature and data loss was key in order to understand if the data became corrupted or even lost at some point.

In a laboratory environment we subjected the cables to the radiation and heat that correlate to an intense fire. From the experiments in the lab, we could show that fibre optic cables have at least, if not even a better, resistance to fire than its electrical cable counterpart. The cables were shown to transfer data without loss until the cable broke clean off, which happened at temperatures exceeding 300 ºC and in combination with narrow bends. This could be compared to an electrical cable that usually break at temperatures around 200 ºC. Through this work we can better understand under what conditions the fibre optical cables fail. The result of the work can then be used in future risk analysis when reliability is key.