## 'The Right Stuff', breaking the 40Gb/s TB3 Barrier (Ver. 1.0)

If you have ever seen the movie 'The Right Stuff' then you will know for many years there was a devil believed to exist at 767mph for test pilots, the point at which many died trying to break through the sound barrier. For Thunderbolt 3 there is a devil at 40Gb/s and to most Thunderbolt 3 is simply a peak performance computer interface, to provide for example a single connection from an ultra thin notebook to a docking station carrying both high speed 10Gb/s to 40Gb/s data, including driving multiple 4K or a single 8K resolution display. However these applications merely scratch the surface of what is possible. This brief intends to highlight what is possible with a little imagination and persistence.

We started out by pushing the boundaries of peer-to-peer Thunderbolt 3 networking, which uncovered some surprising and very welcome results, exceeding 9.2Gb/s and transferring a 20GB video file in approximately 18 seconds! But then we got to thinking how can we hit Thunderbolt 3's theoretical maximum throughput of 40Gb/s. Since Thunderbolt 3 peer-to-peer bidirectional networking tops out around 10Gb/s, the obvious solution is to convert Thunderbolt 3's maximum i/o speed 40Gb/s (in non peer-to-peer mode) into another well known and industry proven interface, 10Gb/s to 40Gb/s Ethernet. In fact the product for that already exists in the ATTO 'ThunderLink' NQ3402. Any Thunderbolt 3 enabled computer with a single Thunderbolt 3 USB-C Type 40Gb/s port, can plug into a state of the art 40Gb/s fibre optic Ethernet network, via 'Port 1' and 'Port 2' in the following generic diagram:
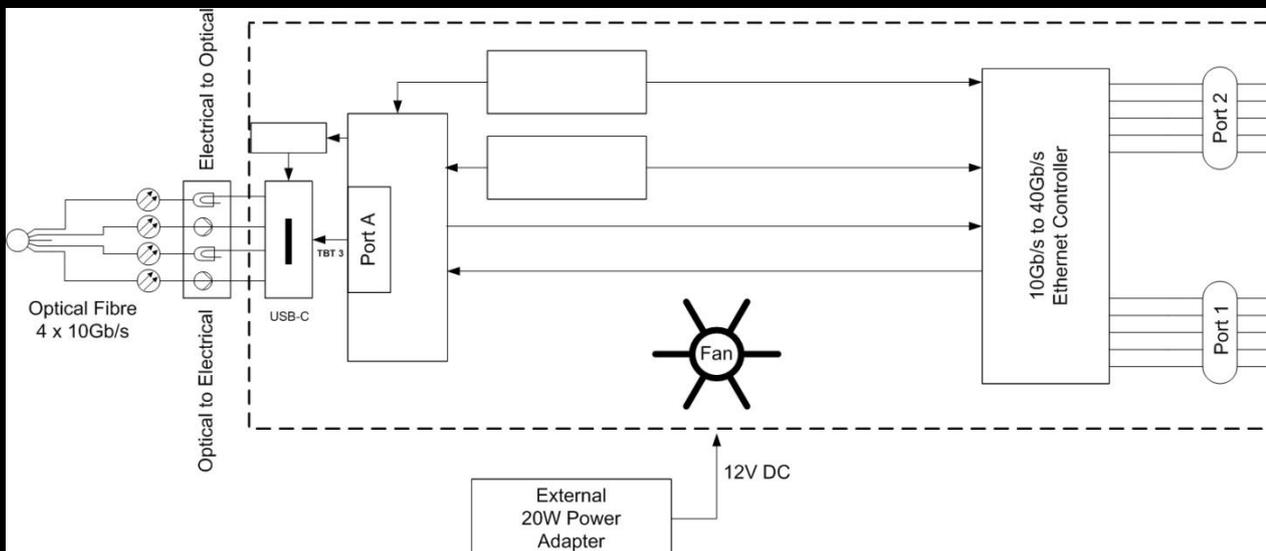
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In some of our previous briefs we discussed various applications that demand this level of data throughput from SMART Cities 'big-data' analytics for the Crown Commercial Service (CCS) and the Department for Environment Food and Rural Affairs (DEFRA), remote virtual / augmented reality medical diagnosis and surgery - particularly useful to the NHS for highly contagious viruses like COVID-19, remote operations centres (ROC) for offshore oil and gas platforms including BHP Billiton, Exxon Mobil and mining companies such as Rio Tinto. Computer AI, game and film production (assisted by the Government Department: Office for Artificial Intelligence) can also hugely benefit from this technology. Industry sectors that our engineers and data scientists have been working with for the last 30 years.

Today's main stream 1Gb/s Ethernet equates to 125MB/s, which is the speed of a traditional mechanical hard disk drive. 10Gb/s (1.25GB/s) is around the speed of high density quad layer NVME PCIe 3.0 x 4 SSDs (developed by Intel Corp. at 1.8GB/s). However for computer networks to take full advantage of the data throughput of high speed SSD technology, such as the now main stream NVME PCIe 3.0 x 4 Multi-layer Cell (MLC) or Triple Layer Cell (TLC) with typical Serial Read speeds of 3.4GB/s and NVME PCIe 4.0 x 4 at 4.95GB/s, then 40Gb/s (5GB/s) Thunderbolt 3 (along with the upcoming Thunderbolt 4) is the future proof solution that we should be implementing as far as possible today.

The move from 1Gb/s to 10Gb/s Ethernet provided increased application performance in 77% of cases according to a survey of IT managers by Intel Corporation, who has over 30 years experience in Ethernet development, with 67% also reporting that their infrastructures are simplified and easier to manage.

Thunderbolt 3 brings peak 40Gb/s performance at a relatively low cost and ease of implementation, with connectivity to the robust industry standard 10Gb/s to 40Gb/s Ethernet. The metrics for: increases in application performance, simplifying computer networks and making them easier to manage, will therefore similarly increase as a result of the network upgrade to 40Gb/s.

In Part 2 of this brief we will conduct detailed evaluations of ATTO's 'ThunderLink' TB3 to 40Gb/s Ethernet Adapters, suggest ways to increase the data throughput on the TB3 USB-C side, and select the optimum overall solution.

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