Alcatel-Lucent 1830 PSS and 1626 LM®
Real-world 8 Tbit/s Throughput Test Report

Introduction

It is not every day that we are asked to support a major telecommunications operator in verifying that their brand-new transport system delivers the capacity they require. In June 2013 we received exactly such a request by Alcatel-Lucent Teletas. As the supplier to Türk Telekom, the incumbent operator in Turkey, they requested that we measure the throughput capacity of their DWDM systems built for the Turkish operator between Istanbul and Ankara - a 540 km cable run.

Turkey, being a major link between Europe and Asia, is an ideal location for an east-west exchange point. In addition to this trans-continental passage capability, Turkey's two major cities boost a total population of 18 Million. With this population density, one can assume that the broadband penetration, reported to be 20.3 million at the end of Q1 2013 (reference: Türk Telekom Investor Relations), is also centered there. Capacity is therefore required.

Tested Devices

The transport system constructed by Alcatel-Lucent for Türk Telekom consisted of two products: the 1830 Photonic Service Switch (PSS) and the 1626 Light Manager (LM). The client, connected to the 1830 PSS (the device that also connected to our testers) included two types of interfaces: 10x10GbE mux coherent transponder (model: 112SCX10) and 100GbE add drop coherent transponder (model: 112SCA1).

For the actual tests all customer traffic was re-routed to other links and the transponders were connected to an array of testers. One Alcatel-Lucent 1626 Light Manager terminal was installed in each location, in addition to six 1626 LM in-line Erbium Doped Fiber Amplifier (EDFAs), as well as three Optical Add-Drop Multiplexers. 32 Alcatel-Lucent 1830 Photonic Service Switchs hosted a total of 160 transponders (divided equally between the two locations). Half of the transponders were used to carry the 100 Gbit/s Ethernet signal mapped into Optical Transport Unit 4 (OTU-4) payload and the other half were dedicated for the 10 Gbit/s line rate.

Alcatel-Lucent engineers configured 80 wavelengths between Ankara and Istanbul. 39 of these wavelengths carried 10 x 10 Gbit/s and another 41 wavelengths carried 100 Gbit/s. In essence the carrier has fine granularity on the wavelengths they wish to use and is able to activate specific channels as needed. For our tests, all 80 channels were active.

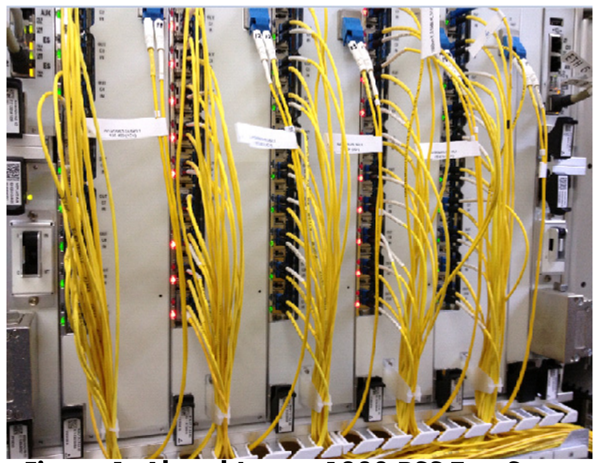


Figure 1: Alcatel-Lucent 1830 PSS Test Setup

Test Methodology

Our interface to the Alcatel-Lucent 1830 Photonic Service Switches was an array of JDSU testers which the carrier supplied. In preparation for the test we agreed to use a methodology, used by EANTC in previous tests, to minimize the requirement on the number of tester ports. We connected the tester ports in such a way that each was responsible for generating traffic to a number of transponders. This method is commonly called *Snake* or *Back-to-Back*. The principle requires careful planning: the first transmitter port connects to the first receiver port on the device under test. The rest of the connections are looped through the device, until the last transmits from the device under test connects to the receive port.

An additional challenge was the fact that we wanted to verify that the link really terminated in Ankara and was not a lab experiment. This meant that we had to loop the test traffic in Ankara and verify that it is really heading from Istanbul to Ankara in the first place. Since the distance between the two locations is well-known we calculated the latency and compared our measurements to our expectations. Our calculations proved to be within 20 microseconds of the results, and since we did not account for the local fiber connections in both ends we were convinced that the link terminated in Ankara.

When designing the tester-to-channel mapping we specifically made sure that two neighboring channels received distinct bit patterns. The idea behind this was to ensure that there is no crosstalk between the channels. We also evaluated that the configuration was correct by disconnecting each channel separately and verifying that the signal only disappears from every other interface. This can also be seen in Figure 1 - the red LEDs indicate the channel fed by one tester while the green LEDs still cary traffic for the adjacent channel.

As the last step in our verification tests we sent traffic for all channels. We then disconnected the single fiber connection that was leaving the building (see Figure 2 of the optical fiber distribution frame). This was a common ITU-T G.652 Single Mode fiber that disappeared from the building in a fiber duct and continued its way through nine amplification points before reaching Ankara. Once we disconnected the fiber, all traffic disappeared as expected. It proved that indeed all our 80 channels were using this one link. With this indication we were ready for the formal test.

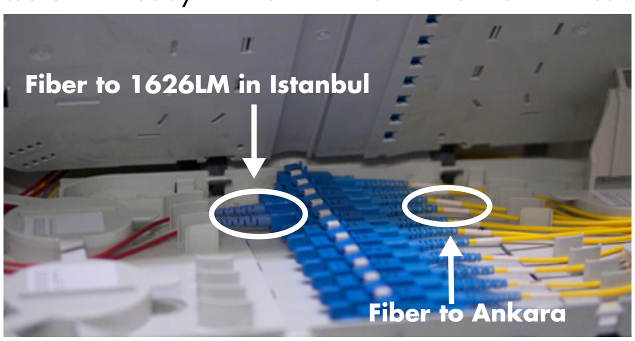


Figure 2: Single Fiber Connection between Istanbul and Ankara

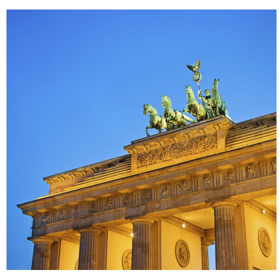
Test Results

After verifying that the configuration was correct and that all cables were indeed connected in the right order we started an overnight Bit Error Rate (BER) test. 8 hours later we returned to find out that one of the testers recorded frame loss, however, the devices under test did not indicate that any errors where present. We connected the tester to another fiber that showed no errors and ran traffic again only to record that the errors moved with the tester. We replaced the faulty tester and repeated the test three times, each run at 30 minutes without recording any frame loss. Every tester was sending traffic at line rate for its respective interface which meant that we were successfully generating 8 Tbit/s of traffic on the link to Ankara and back.

Conclusion

We verified that the Alcatel-Lucent-provided DWDM transport between Türk Telekom sites in Istanbul and Ankara indeed carried 8 Tbit/s using a single fiber pair. With the way that the transport infrastructure is setup, Türk Telekom has indeed ample growth possibilities both for residential broadband services and transit connections between Europe and Asia.

About EANTC



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