METRO-HAUL Newsletter Year 2 – A Year in Blogs

October 2019

THE METRO-HAUL BLOG

Distributing information about progress and developments is an essential factor of the METRO-HAUL project. With such a large project (21 partner organisations) we have to put significant effort into internal communications to make sure that everyone knows what is going on and to ensure synchronisation across the project.

A key goal of METRO-HAUL is broad and vibrant communication. We need to make sure that people beyond our partner organisations (companies and research institutions) are aware of what we are working on and notable successes. We are excited really want to have an impact on the wider technical community which we cannot do unless we let them know what we are doing.

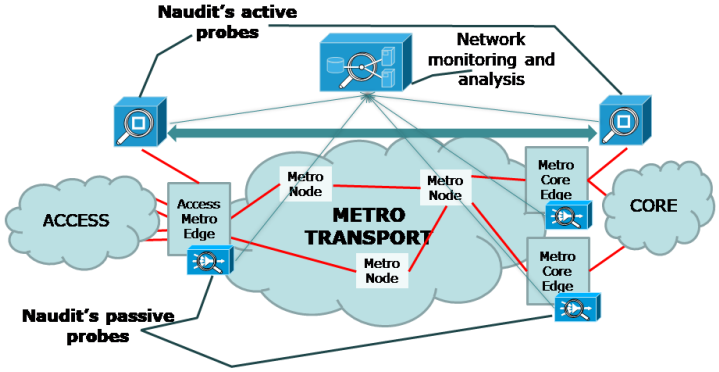
The METRO-HAUL blog is available through the project web site via https://metro-haul.eu/media-corner/blog/. It provides somewhere for individuals participating in the project to report on the work they have been doing, interim success, important participation events. It also gives them a venue to express their thoughts on any of the issues raised by the project.

During the second year of the project, we considerably increased the amount of blogging. The bulk of this newsletter is made up of edited highlights from some of these posts. If you find them interesting, why not go to the web site and read more widely?

Packet-Level Network Measurements in METRO-HAUL by Jorge Lopez de Vergara

One of the main challenges of the METRO-HAUL project is to implement tools to monitor future 5G metro networks. Such data can be obtained by telemetry from the different network elements, such as optical transponders or SDN controllers. Moreover, packet-level measurements can also be taken from network probes, to contrast their results with optical-layer measurements, providing information that is closer to the users' experience. However, in order to obtain both accurate and precise measurements at the packet level, it is necessary to develop high-performance equipment that can reach 100 Gbit/s and beyond.

In the context of the METRO-HAUL project, Naudit HPCN is developing highly accurate and precise high-performance network probes that are both active and passive and that work at 100 Gbit/s. At 100 Gbit/s in an Ethernet network, in the most stringent situations, a new packet can arrive every 6.72 ns, which is shorter than current SDRAM technology memory access time. Thus, it is necessary to combine inventive solutions with state-of-the-art high-performance computing technology to deal with this data rate.



Naudit probes developed in METRO-HAUL are planned to be used in one of the low-latency ultra-reliable use cases, to be deployed for demonstration purposes, conveniently located in the metro edge nodes, as shown in the figure. The network probes will be useful to feed the network monitoring and analysis

system with packet-level data, combining both active and passive measurements.

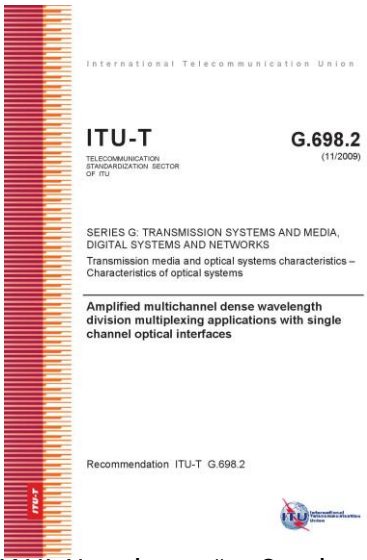
METRO-HAULers Win Best Student Paper Award at CNSM 2018

The prestigious International Conference on Network and Service Management (CNSM) is held annually. In 2018, the 14th event was held in Rome, Italy.

Well done to Daniel Perdices and his co-authors: David Muelas, Luis de Pedro, Jorge E. Lopez de Vergara for their award-winning paper "Network Performance Monitoring with Flexible Models of Multi-Point Passive Measurements". This paper was published in the conference proceedings at http://cnsm-conf.org/2018/.

Standardization of 100-Gbit/S Coherent Interfaces By ITU-T SG15 by Michael Eiselt

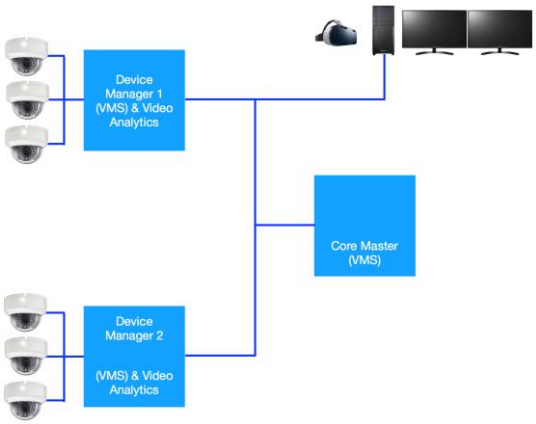
ADVA, Coriant, Ericsson, Nokia, and Telecom Italia, all partners in the METRO-HAUL project and have participated in developing the latest revision of G.698.2, the ITU-T's specification of coherent optical interfaces.



Safe Cities
A METRO-HAUL Use Case by Stephan Rasp

The Metro-Haul project depends heavily on a number of use cases to establish realistic requirements to underpin the research and drive the development. One of those use cases concerns the collection and coordination of data streams from a large number of video cameras.

Over the last decade *Smart City* and *Safe City* have become widely discussed concepts. Video is a key element in these initiatives giving a view of traffic, of litter, and very importantly of crime. Video has shown itself to be a good deterrent to planned crime and is invaluable in criminal and anti-terror investigations.



Prior to 5G and metro networks, cities have either deployed recording servers on poles close to a small number of cameras managed by that server, or they have resorted to laying their own fibre and limiting coverage to spots close to the fibre. Both solutions have maintenance, reliability, and coverage drawbacks.

In the METRO-HAUL project we are focusing on the enhanced capabilities of metro networks to provide low latency data delivery. Low latency in video is required whenever a camera is remote controlled.

A typical scenario would be to secure a parking lot with a thermal camera using a wide field of view. The video analytics on this camera are programmed to detect human movement and track the person. This tracking data is then transmitted to a second camera that has pan, zoom and tilt (PTZ) capabilities. The second camera is able to zoom in on the person and follow them

around. For this setup to work, the latency needs to be below 5ms.

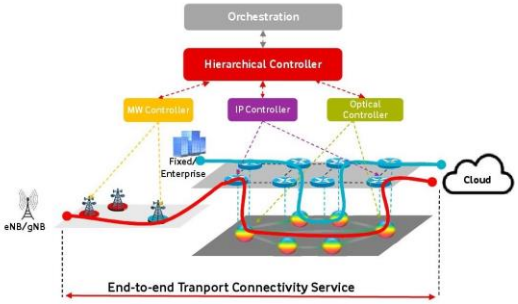
Pre-Conference Workshop at NGON and DCI World 2019 in Nice by Adrian Farrel

As part of its outreach beyond the current partners in the METRO-HAUL project, we organised a successful pre-conference workshop at NGON and DCI World 2019 in Nice. Titled "Evolving Approaches to the Control of 5G Support Networks Using IETF Technologies" it formed part of NGON's Optical Masterclass Series.

The workshop, which was chaired by Sterling Perrin, Principal Analyst from Heavy Reading, deliberately reached beyond the METRO-HAUL project to bring in speakers who are experts in the subject material, but do not all work for partners in the consortium. Thus, in addition to Adrian Farrel and Jorge E. López de Vergara Méndez who participate in Metro-Haul, the workshop was also addressed by Julien Meuric of Orange, Italo Busi of Huawei, and Jeff Bouquier of Vodafone.

The topic of Julien Meuric's talk was "The Role of GMPLS/PCE and ACTN in Network Operations". He gave some history of the protocols and components, but then expanded on the ACTN architecture, the applicability of PCE within that architecture, and the scope of use of ACTN. He concluded with his vision of the future: a form of "distributed SDN" that includes centralised controllers supported by distributed control planes. ACTN is a key component of the METRO-HAUL solution.

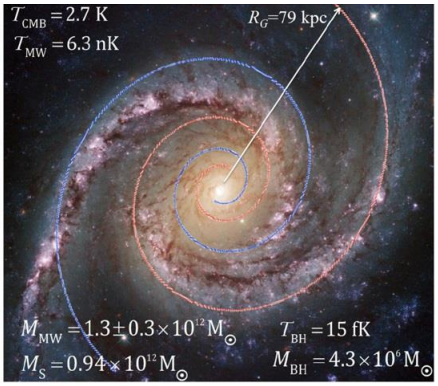
Vodafone SDN Single Transport target architecture



The final speaker in the workshop for Jeff Bouquier. He introduced "Vodafone SDN for Single Transport & IETF Pre-Deployment Experience" and presented Vodafone's target architecture for their transport networks and explained how SDN control is intended to provide coherent oversight for multi-layer and multi-domain networks.

Dark Matters about Metro-Haul by Mike Parker

One of the delightful aspects about European research in H2020 is the chance to interact and work with a fantastic set of engineers, scientists, and technologists on interesting and highly worthwhile projects. In justifying the work we do in these research projects, however, there is still always the need to report on the positive impact of the research outcomes.



A key research topic of photonic networking in METRO-HAUL relates to the efficient use of the optical spectrum; that is, optimising what is known as routing and spectrum assignment (RSA) to avoid fragmenting the available capacity of an optical fibre. And the best metric for understanding the fragmentation of a resource is to study its *entropy*. Working together with Andrew Lord (*Metro-Haul's* Coordinator) and Paul Wright at BT we found that by employing *Maximum Entropy (MaxEnt)* techniques we could significantly improve the efficiency of an optical network and greatly expand its throughput.

The power of Maximum Entropy set me thinking about whether tool could also be applied to a more '*natural scientific*' matter: I was interested in investigating whether *MaxEnt* could be applied to the shapes and geometries seen every day in Nature. I wondered whether Maximum Entropy theory could be applied to these structures and used to prove that these shapes are indeed the 'most likely'.

This set me on a path lasting a few years while I investigated and unravelled the equations underpinning the application of Maximum Entropy to the natural world. The result was very surprising

– I had discovered an entirely parallel universe to the one that science has hitherto explored.

The METRO-HAUL 2nd Year Annual Review: A Personal Perspective From the Project Manager by Andrew Lord

It's a respectable 10am and my trusty Technical Manager for Metro-Haul (Albert) arrives on my drive, and we duly set off to catch the Eurostar from Ebbsfleet on our journey to Brussels to lead the end of 2nd year project review. The rest of the day, whilst driving, on the train, dining in Brussels, but mainly sitting in a hotel room, is spent preparing slides. The most frequent question in my mind today: "So what did we actually achieve this past year, with all that EU money?". And the second question, about which I seem to worry a lot (and more than the rest of the team – but I guess that's my job): "What difference will it make to the world?".

We met at the BT Office in central Brussels for the "PRACTICE DAY". If this sounds extreme, it is literally the opposite. A whole day to practise for an annual review, is essential. When you appreciate that the project has three committed reviewers who have spent a good part of the last few weeks reading every deliverable and all the other documentation from the project, there is no excuse – so we knuckled down and worked very hard for a solid day. We worked our way through the work packages, checking presentations, harmonising messages, prioritising conclusions… or at least that was the plan. But somehow my troublesome second question "What difference will Metro-Haul make?" was still the main topic of debate as it got to lunch time.

I think this is a good thing and I think project reviews are good things because they force the project to dispassionately analyse why we are doing the work and what we have learnt. Most of the time we are buried deep into the technical aspects of the project, and reviews like this make us take a step back and honestly assess the situation – potentially highlighting future directions that will make us even more successful.

Metro-Haul is an extremely successful project, with a vast number of impressive results from physical layer, control plane, end-to-end (or should I say edge-to-edge) demos, and techno-economics. Nevertheless, a review on this scale was well timed: a year seems about right for sufficient work to merit something on this scale. The practice day highlighted again what I knew already: the project is outperforming on all measures. And yet still this nagging, existential doubt about overall purpose.

So our plans were largely complete (apart from Work Package 5 sent off to drink Belgian beer somewhere and complete their slides). After a pleasant meal with my trusty Albert, I spent the final hours of the day sending our completed slide sets to the Project Officer (PO).

Review day started early. Everyone arrived including the PO and reviewers, and unlike the previous year, we now have got to know each other better and so friendly exchanges are in order. We even started the review five minutes early. And I was first up, presenting my honest assessment of the project, which I did by taking a step back and looking at the bigger network picture, reviewing the take-off of 5G and FTTP in the access and the enormous multi Tb/s core network capacities.

I tried to paint a stark picture of a 'world without Metro-Haul' with scary skull and cross bones emblems, and this hit the right note. Encouraged, I talked in more depth about the need for edge caching, and the inevitable dynamic control requirements, including the transport as well as DC functions. One reviewer question took me back – "Would business and consumer applications be able to use the same edge DC resources – surely they are in physically different locations?" Well, although agility will mean being able to spin up functions where required, there are added questions of sufficient connectivity and impact on latency. Yes – we really have more work to do!

The team worked valiantly through the project and were only 14 minutes late ending the day. The reviewers retired to consider their verdict…. which was almost entirely first class. They even said they had run out of adjectives to describe our dissemination. We will get a detailed report later, and there will be things to attend to, but overall this project

is doing extremely well. I admit a moment of pride in this distributed team of people, who I have known in some cases for many years. They work incredibly hard and they deserve a result like this.