

CHALLENGES AND LESSONS LEARNED DURING THE TWO PHASED DEVELOPMENT OF THE LOW INDIAN OCEAN NETWORK SUBMARINE CABLE

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Abstract: LION/LION2 is a regional cable system connecting Low Indian Ocean islands to East Africa. The cable was deployed in two successive phases (LION was deployed first, and LION2 two years later) using the stubbed BU method. During the second phase, special care was needed to minimise the risk created to the LION commercial traffic. Special attention was also paid to marine diversity, in order to choose diverse landing points in Mauritius and La Réunion, away from the SAFE landings, and to avoid the congested landing zone in Mombasa.

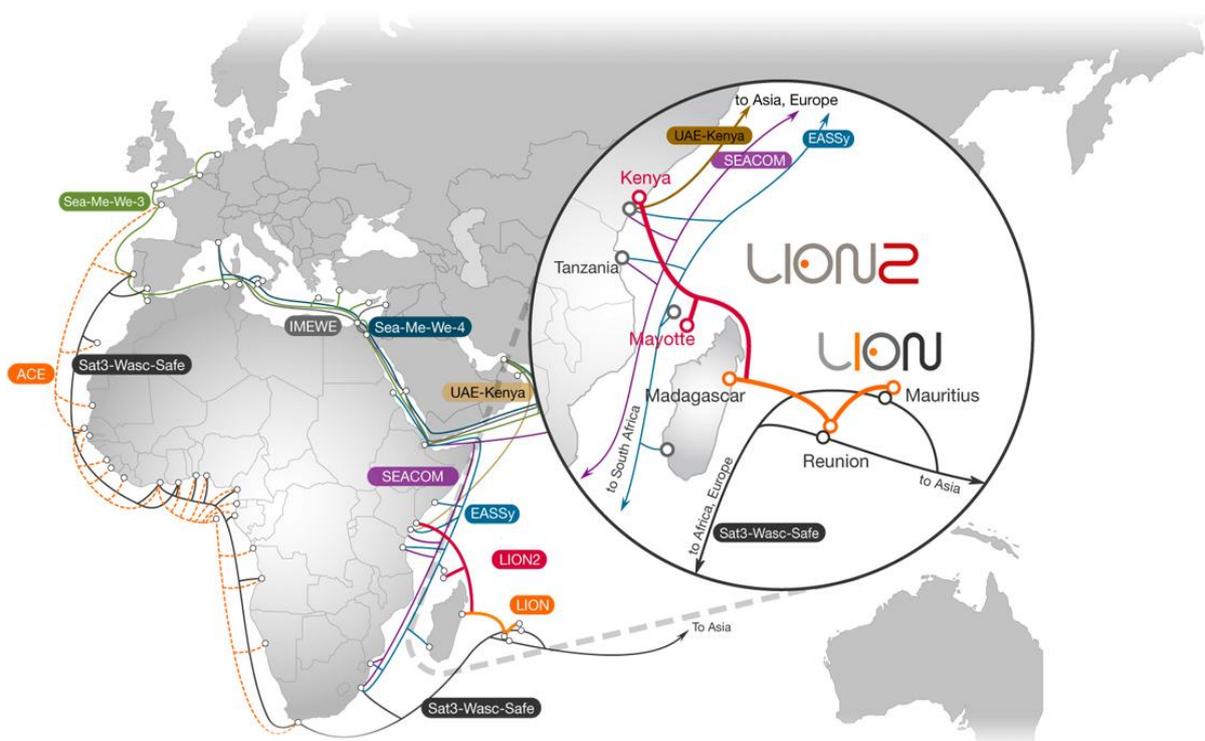


Fig.1 The LION/LION2 cable system

1. THE LION/LION2 REGIONAL SUBMARINE CABLE SYSTEM

The Low Indian Ocean Network (LION/LION2) submarine cable system is a regional cable network linking the four Indian Ocean islands: Mauritius, La Réunion, Madagascar and Mayotte to the African continent via Mombasa in Kenya.

The LION/LION2 system also serves as a transit cable link between the SAFE cable stations in Mauritius and La Réunion, and the Mombasa cables stations for three East African cables: EASSy [1], UAE-KENYA (a.k.a. TEAMS) [2] and SEACOM [3,4].

The cable is made of two segments:

- A 280 km unrepeated segment between Mauritius and La Réunion;
- A 3500 km repeated segment, between Kenya and la Réunion, including two branches in Madagascar and in Mayotte.

Because the system was built in two successive phases, the repeated segment was actually divided in two subsystems, as can be seen in Fig.2:

- The LION subsystem, 800 km long, made of the portion of the express cable located between La Réunion and the Madagascar branching unit (BU), and the Madagascar branch itself. This subsystem was built first by the LION consortium;
- The LION2 subsystem, 2700 km long, made of the portion of the express cable located between Kenya and the Madagascar BU, and the Mayotte branch itself. This subsystem was built in a second phase by the LION2 consortium.

As for the unrepeated part, it was built initially by the LION consortium.

The LION2 consortium is in fact an extension of the original LION consortium, initially composed of France Telecom, Mauritius Telecom and Orange Madagascar, in order to include three new investors, Société Réunionnaise de Radiotéléphone (SRR), EMTEL Ltd. and Telkom Kenya.

The system is managed by a single Network Operations Centre (NOC), located in Mauritius.

Both LION and LION2 subsystems are managed by their own consortium-type committees but with close interaction to ensure coherence in the decisions taken.

Technically speaking, the cable is made of a classical two fiber pairs cable, offering a maximum capacity of 640Gb/s if equipped with 10Gb/s wavelengths using OOK modulation, and this capacity can be raised to 2.6 Tb/s using new 40Gb/s coherent technology.

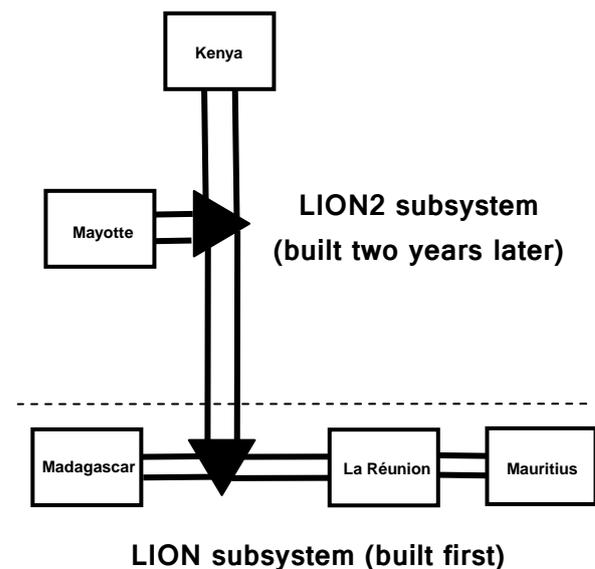


Fig.2 LION and LION2 cable subsystems

2. A TWO-PHASED DEPLOYMENT

The objective of the global LION/LION2 system as it stands today was known at the beginning and was taken into account in the design of the wetplant. From the beginning it was anticipated that the longest link would be the Mombasa to La Réunion 3100 km express fiber pair, and the repeater spacing was defined accordingly. However, because of initial limited financing, the deployment started in 2008 and was restricted to the LION part, with a beginning of service in November 2009.

The LION subsystem was deployed with a ready to use branching unit (BU) located between Madagascar and La Réunion. The stubbed leg of the BU had fiber pairs looped back to establish the optical continuity between Madagascar and La Réunion allowing the LION subsystem to be operated during nearly two years using both fiber pairs in a MSP 1+1 protection mode.

The deployment of LION2 started when the extended consortium signed its Construction and Maintenance Agreement (C&MA) in September 2010.

Since LION2 was being deployed with LION already in service, special attention was needed to minimise the risk created to the LION commercial traffic.

Therefore it was decided to lay the LION2 cable entirely, separately from LION, and to end the operations with the final splice between LION2 and LION at the stubbed leg of the Madagascar BU. So, when establishing this connexion, the entire LION2 had already been properly deployed and partially tested.

The final splice operation was programmed at night time, during low traffic hours to reduce the risk of impacting the commercial traffic, under the supervision of the NOC.

Once the final splice was completed, there still remained a period of commissioning of the LION2 subsystem that also required

care to avoid any other risk of impacting the commercial traffic. In particular the nominal state of the Madagascar BU was not the same for the LION subsystem when it was operating on its own (at that time, the temporary express link was between La Réunion and Madagascar) than for the integrated LION/LION2 system (the final express link now being between La Réunion and Mombasa). The switching of the BU to its final state was also carried out at low traffic hours under the supervision of the NOC.

3. CHANGING THE PROTECTION SCHEME

LION, with its very simple initial topology made up of two point to point links, was configured with MSP 1+1 protection using the two fiber pairs between Madagascar and La Réunion. Before the LION/LION2 final splice, since the fiber pair passing through the BU stub had to be cut in order to be spliced with LION2 fiber pairs, the live traffic between Madagascar and La Réunion was moved to the other fiber pair, using different wavelengths. The protection scheme was maintained as a MSP 1+1 scheme to protect the transponders of the remaining active fiber pair. This lasted few months until the network commissioning of the LION/LION2 system was complete.

The new protection scheme for LION/LION2 had been defined as mesh restoration (a.k.a. GMPLS or G-ASON) because it provided increased flexibility to manage the protection of individual VC4 circuits. The migration to mesh restoration was carried out as the last step, during network commissioning.

4. DIVERSITY OF LANDINGS AND CABLE STATIONS

Diversity of routes was a key criterion to select the landing points of LION and LION2.

The diversity criterion was first applied to the LION part, both for the Mauritius and La Réunion landings, so as to have all LION landings and cable stations distinct from the SAFE landings and cable stations also present on the islands.

The diversity criterion was also applied to LION2 for the Mombasa landing. This was a difficult exercise because three cables (EASSy, UAE-KENYA, and SEACOM) already landed in Mombasa city, in a congested landing zone, with their routes crossing or near the entrance channel to the harbour. The Mombasa coast is barred naturally by a coral reef and beside the access to the ports, very few passages exist North and South of the city. However, with the agreement of the authorities, a diverse landing point could be found in the North of Mombasa city, away from the crowded shipping routes. A new cable station was selected near the landing point, away from the existing cable stations. There still remained the problem to interconnect the LION2 station to the other cable stations, as Mombasa city is an island with only narrow paths to the main land. In the end, the challenge could be overcome, and a ring network was built with two diverse interconnection routes between the LION2 cable station and the other cable stations.

5. THE MAYOTTE LAGOON

Mayotte has a beautiful lagoon which is one of the largest in the world. It is well protected by environmental laws. We had to make sure the laying of the cable was done in the best way possible.

The difficulty for the laying operation came from many coral outcrops (pinnacles) sometimes several meters high scattered across an area of the lagoon, before reaching the passage to the open sea. Indeed the main lay left the cable hanging on some of the pinnacles. But a post lay inspection was carried out and after careful analysis of the situation, the significant suspensions were removed with the help of divers.

6. MANAGEMENT OF DELAYS

The LION2 consortium had to face some challenges with permitting delays. Obtaining the landing permits in protected areas such as Mayotte or Mombasa takes a lot of time. While the permits arrived on time for Mayotte, for Mombasa, after an initial phase of overconfidence, unexpected delay and complexity popped up. On the other hand, the supplier was trying to speed up the plan of work for his own convenience and was ignoring the warnings sent by the consortium. A high level of uncertainty prevailed until the very month of the landing operations, but happily enough, things sorted out all fine. Luckily, we had avoided the nightmare of seeing a cables ship arrive to the limit of the territorial waters, while the permits have not yet been delivered, preventing the completion of the cable lay all the way to the beach manhole. Such a situation would have raised the cost of the project seriously and certainly nobody wanted to pay for that!

Looking back and trying to draw improved guidelines for future projects, one of the constraints is that expenses can start only once the C&MA is signed, and for some activities, like permitting, is desirable to start earlier.

There were also delays in delivering the energy supply to one of the cable stations and this required some ad hoc methods such as using an existing temporary energy supply for the installation and testing of the equipment, and for the segment commissioning. The change over to the final station energy supply was carried out at a final stage, just before the network commissioning. Here again things sorted out just on time.

7. CONCLUSION

The LION/LION2 cable system is a regional cable system of the Indian Ocean that was built and put to service in a two-phased approach, as two subsystems built one after the other, using the well known stubbed BU method. Doing that requires special care during the construction of the second subsystem, to avoid impacting the commercial service of the first subsystem. Moreover the deployment of LION2 implied important evolutions: contractually, an extension of the consortium in order to include new partners, and technically, an evolution of the protection scheme to mesh protection. LION/LION2 connects countries (Kenya, Mauritius, La Réunion) already well equipped with submarine cables, therefore diversity has been a main criterion to select landing points, but sometimes hard to achieve.

Looking back after the end of the project, we realised that we could have anticipated better some of the difficulties, such as the classical permitting difficulties, and established a better understanding between suppliers and purchasers to find flexible ways of handling such difficulties.

8. REFERENCES

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