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Improving RF connectivity for space application in Telecom satellites in production environment

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OUTLINE

With the ever-developing world of Telecom satellite payloads we see more requirements to meet a production-based scenario, in parallel to the traditional bespoke payloads the need for more repeat builds determines us to re-evaluate how we do things and why.

From an RF connectivity perspective, historically whereas the waveguide is a very determined category, we have designed, routed and attached each RF cable in turn following a path between multiple different equipment's.

If we are to encompass a production mentality, we need to challenge many aspects of design, production, assembly and test, aiming to standardise and simplify where ever possible, in my world this is RF connectivity. How can we therefore improve the RF connectivity?

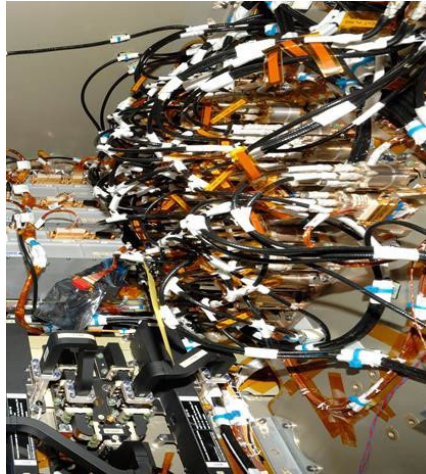
One solution is to route multiple RF path at the same time, which means moving from individual RF cable assemblies to multiple RF cables assemblies in the for more multiway RF connectors and harnesses.

The team assembled by Airbus Defence and Space included the equipment design, system architects, connector and cable designers and harness specialists. With the common goal to assess the productionisation of a Telecom payload design team requirements it actually meant a great deal of communication and co-engineering to ensure the final payload solution worked successfully and would do so for the lifetime of the payload.

To be clear each member of the team brings unique skills and experience, managing the team successfully ensures the payload application works. The specification created by the team addresses harness requirements, and must address the real life scenario the payload team deals with, the Airbus equipment specialist, brings expertise supporting the connector and cable manufacturers to create products addressing multiple payload criteria.

PRESENT

Historically we have routed individual RF cables between various equipment, but in a production scenario the equipment are more standard, positions predetermined and regular and less need for unique RF cable routes.



Multiple RF cable routes between various equipment, very organic.

CONNECTORS

Looking at the market for RF connectors and particularly multiway RF connectors there are many options and variants available, each suppliers taking a slightly different view on the solution, based on their knowledge and current product portfolio.

One of the major tasks facing the Airbus Defence and Space team was to identify not just a suitable connector, cable, assembly and design solution but to ensure the solution was not single sourced, which could introduce additional commercial risk.

CABLE

The cable partner needed to understand both the system needs and the connector parameter in order to carefully select the cable type, construction and materials. Also how to use in harness in flight scenario. As with the connectors, the cable needs to match the connector characteristics to ensure best signal performance. The needs for manufacture, assembly, integration and routing are also addressed.

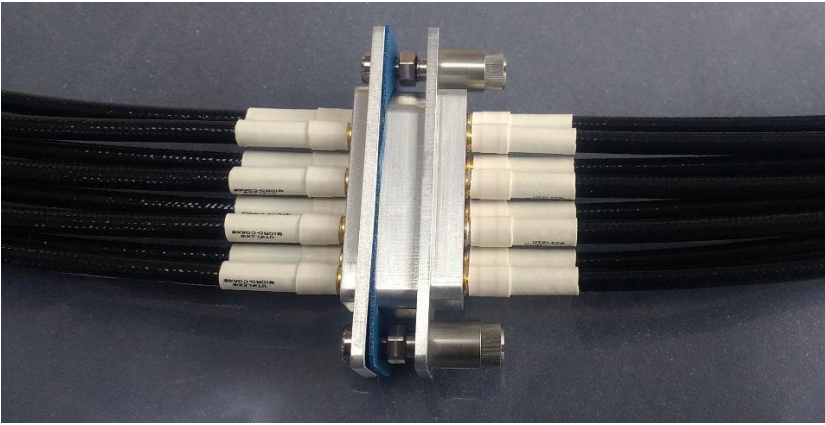
CABLE ASSEMBLY

Every cable assembly is more than a sum of its parts, the process of attaching the connectors to the bulk cable is critical to the final result, only by working with both the cable and connector suppliers can the best performance be extracted from the bags of bits. Every connector is designed with ideal mating and matching characteristics.

HARNESS ASSEMBLY

Each cable assembly provides the RF path, payload's are made up of multiple units and many RF signal paths, so when the cable assemblies can't be bundled together and routed to meet the payload accommodation requirements and without affecting the signal integrity there is significant advantages to production.

The supplier has to have both connector and cable expertise in order to make sure the cable assemblies work efficiently, and further experience in harnessing has proved critical.



Multiway RF connector – Mated Male and Female

CO-ENGINEERING

It was clear to the Airbus Defence and Space team that despite the wide variety of RF connector available nothing quite met the system, production or commercial needs.

Here we undertook to work with suppliers to provide a suitable solution by working with the supplier in a Co-Engineering approach. Each area of Airbus Defence and Space interprets this approach in a slightly different manner, for Telecom satellites we approached a number of suppliers, all of whom had similar products, and opened discussions regarding our needs and their solutions.

It must be said all the suppliers were very supportive, to make the process work all parties need to invest with trust and openness to make the Co-Engineering work, on both sides there is a lot of work to do to achieve this, and understanding boundaries, both technical and commercial can only progress with hard work from everyone.

Co-Engineering can come in many forms, in this case I have posed the problem, the environment, the production envelope and RF needs, the suppliers bring vast understanding and knowledge of RF connectors and cables. We have worked together with Airbus

Defence and Space creating the specification for the program needs and the suppliers develop suitable products, at this point it is important to describe some of the rules under which this development takes place and makes success possible.

The ADS specification describes the environment, RF needs and fundamentally the RF interface, how the supplier realises this is their IP, as long it the product functions, can be fitted and interconnects with other products to the same spec that is the limit of technical disclosure, how the connector is attached, how the cable is constructed etc., is not documented or 'open source', so each supplier can also bring their own 'magic' to the team.

SUMMARY

Implementation of the multiway harness has also impacted the production time, historically each threaded RF connector would need installing, routing, torquing and re-torquing, the multiway RF connector also needs installing and routing but is 2/4/8 times more efficient since it is now a group of cables and RF connections.

Only by working together could we create a multiway RF harness for current and future telecom satellites requirements.

Understanding the overall requirements for Telecom payload applications could Airbus Defence and Space work with various different suppliers' to successfully develop a flight multiway RF harness.

Co-engineering is much talked about term but in the case of the multiway RF harnesses currently being developed by Airbus this is a real life, real time, real world scenario that has produced great results.

ACKNOWLEDGMENTS

I would like to extend my thanks to all the team members who worked together to make this project a success, without the support and cooperation from the suppliers design teams the connector designers and cable manufacturing teams and the experts within Airbus, we could not have created this multiway RF harness solution for production line commercial telecom satellites.