Arinc 793 Fiber Schematic

V23 – Maintenance slides added, Edits agreed in meetings

V24 - Combined Rx/Tx-Antenna (LEO), BI tradeoff studies

V25 - Updating FOS requirements

10.Sep.2024

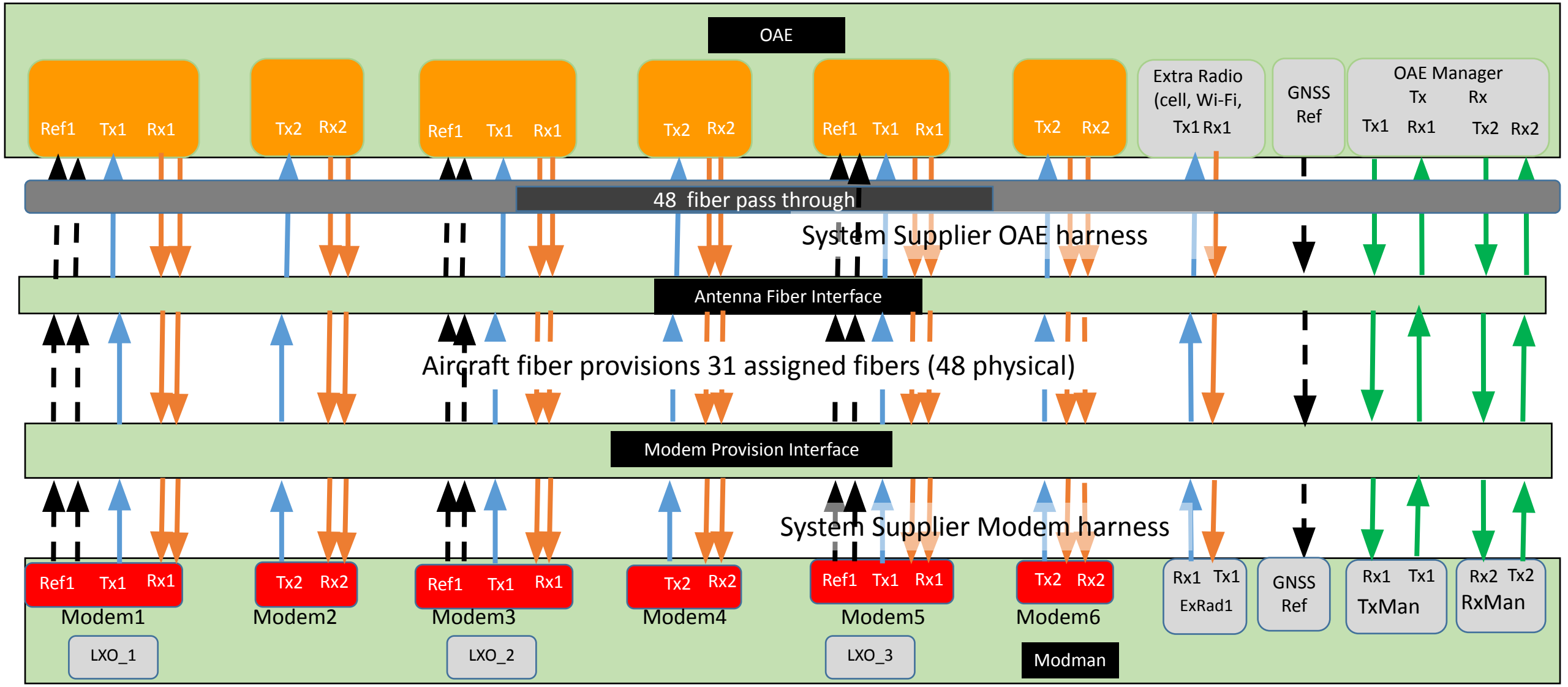
Origin presentation made in Google Presentation and converted to ppt.

793 v23 MiM

Functional full system

Tx and Rx: IF Analog or Digital Baseband over Ethernet

Tx and Rx: Ethernet



Eth control plane

Ref signal

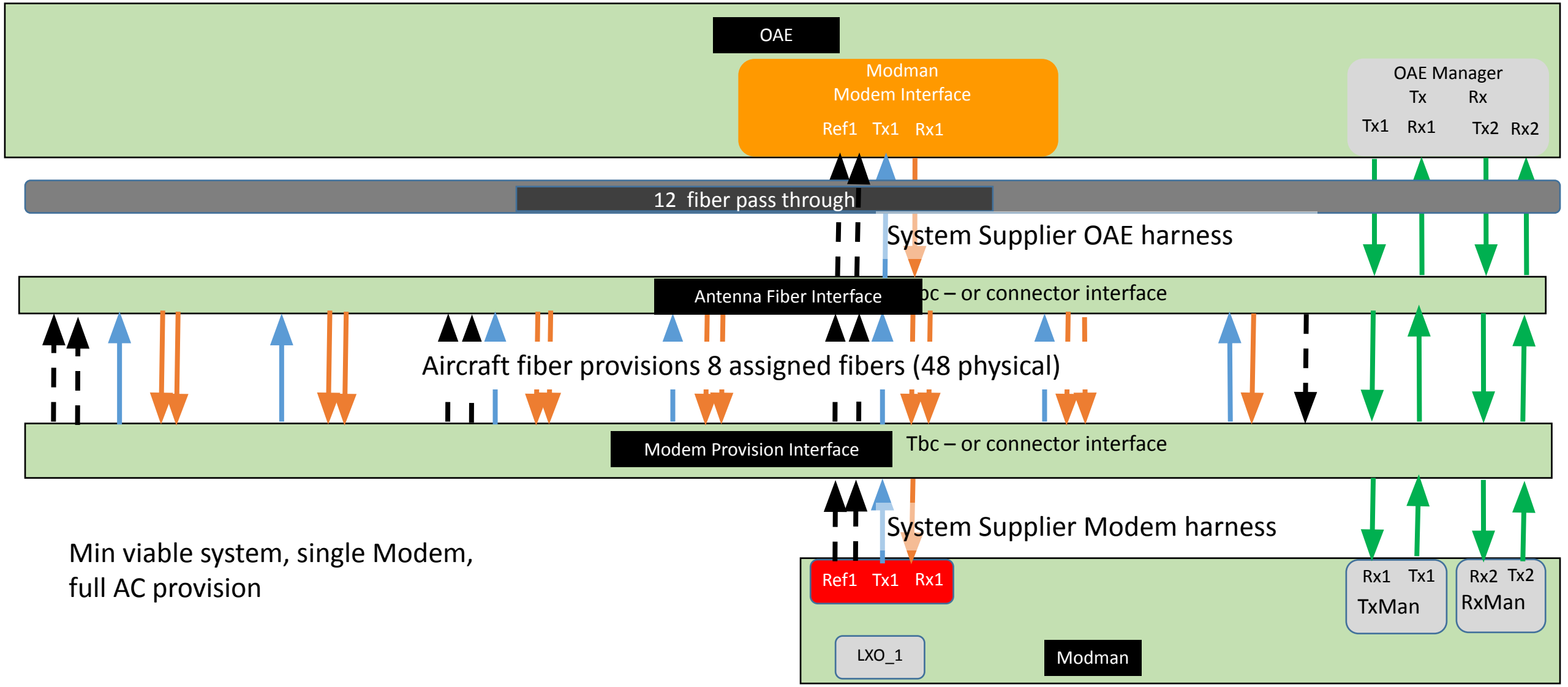
Rx - signal

Tx - signal

Note: There is no required assignment of LXO to Modems.

Functional min viable system

Tx and Rx: Ethernet



Min viable system, single Modem,
full AC provision

Eth control plane

Ref signal

Rx - signal

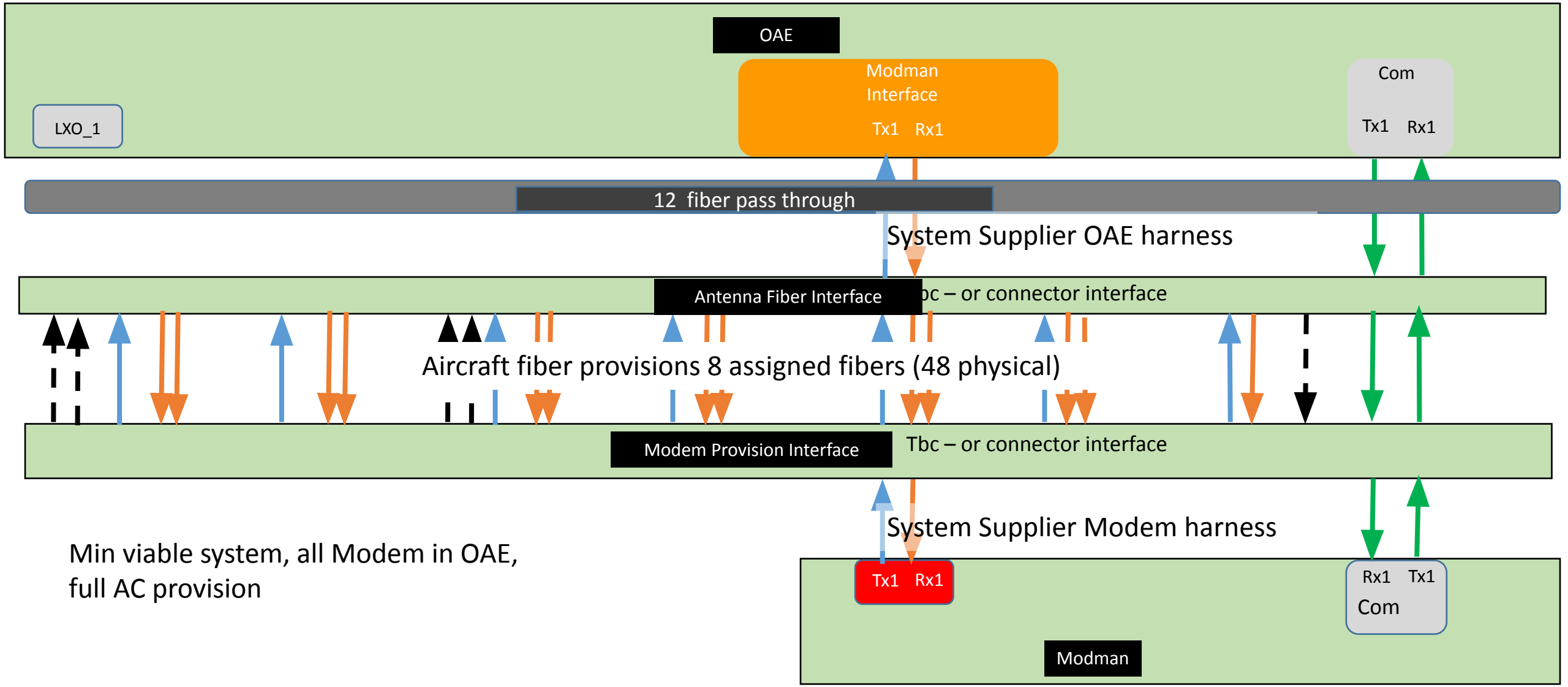
Tx - signal

793 v24

MiO

Functional min viable system (modem in OAE)

Tx and Rx: Ethernet



Min viable system, all Modem in OAE,
full AC provision

Eth control plane

Ref signal

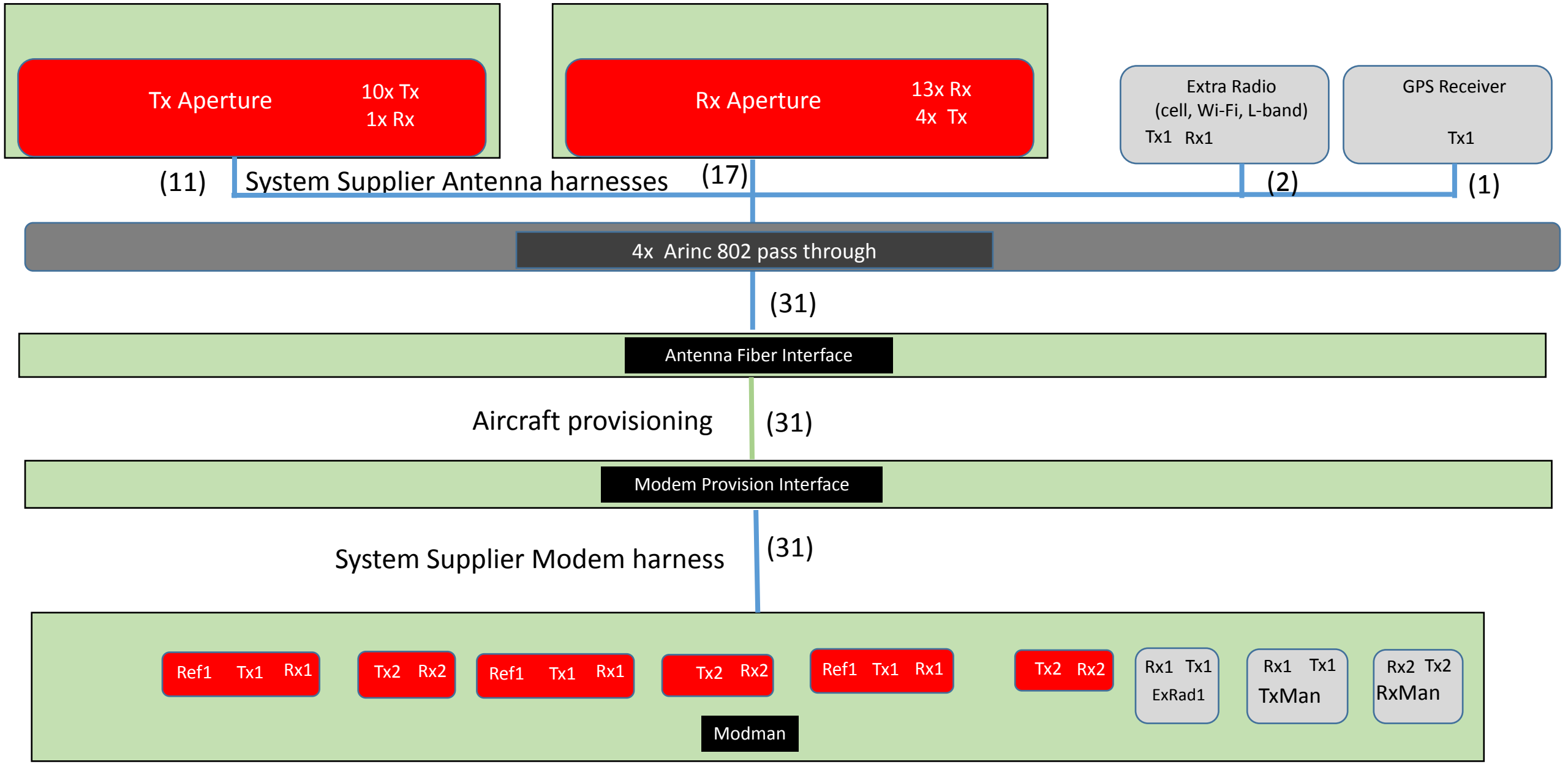
Rx - signal

Tx - signal

793 v23 MiM MiO

Physical FO Routing & harness layout

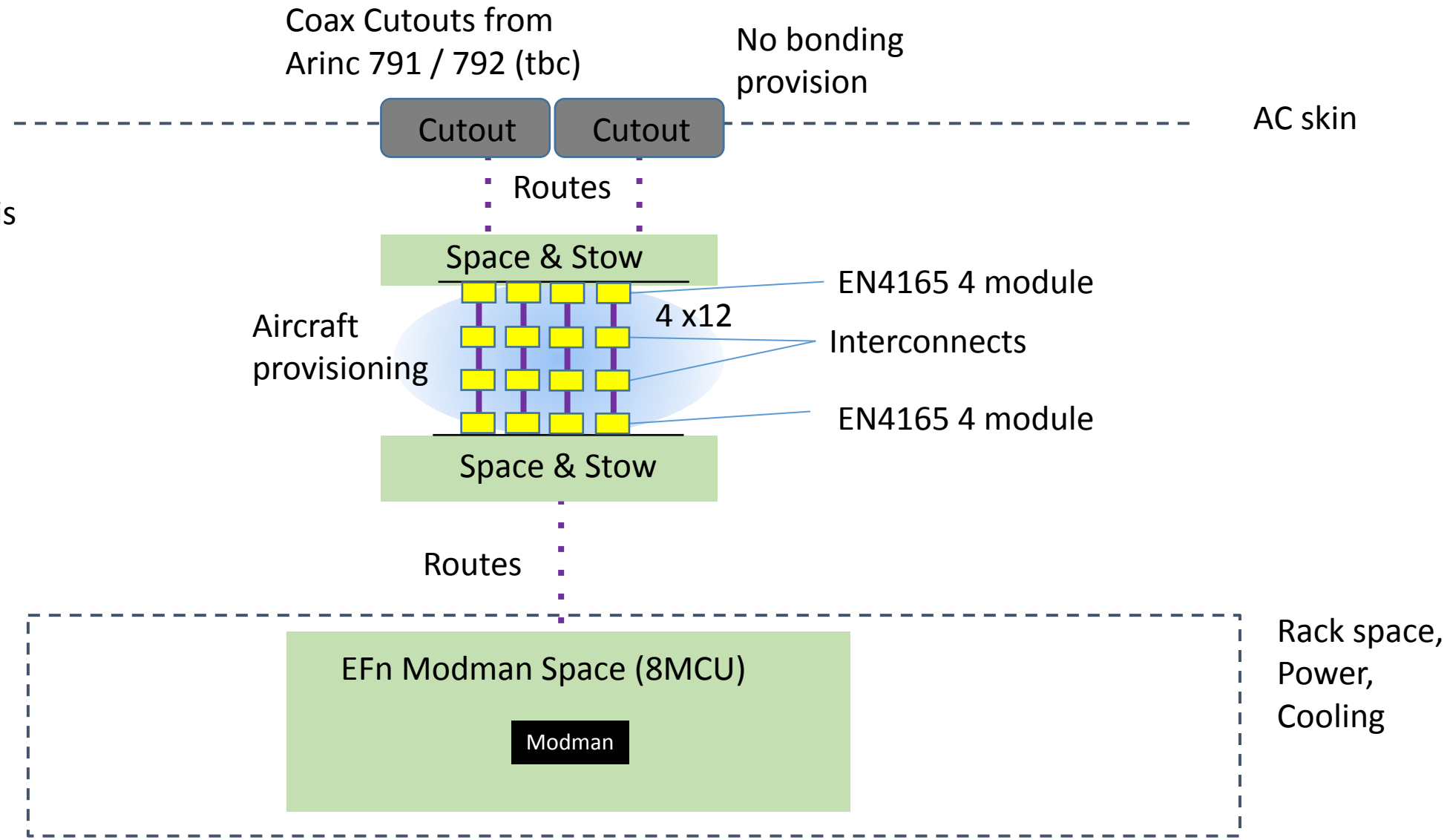
Tx and Rx: Ethernet



in brackets: active fiber count

Aircraft fiber & space related provisioning

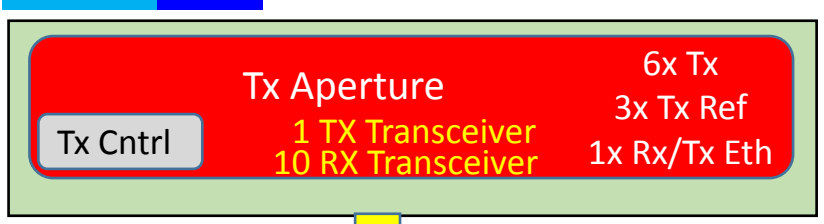
Interconnect design is the responsibility of provision designer, does not have to be EN4165

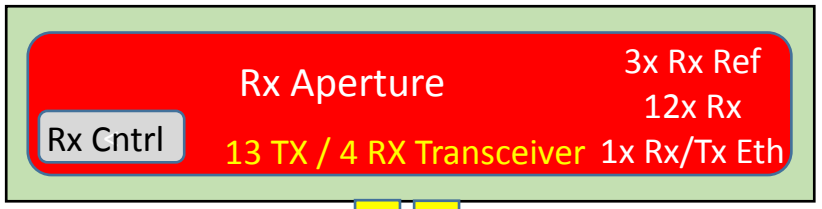


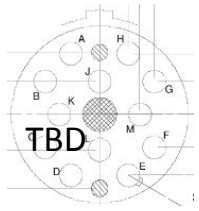
793 v25 MiM

48-Fiber EFn architecture

Tx and Rx: Ethernet







38999 19-12

11 e.g. (38999 19-12

System Supplier
Antenna harness

12 5 e.g. 38999 19-12

2 e.g. 38999 19-12 1

4x12 Fiber Provisions - FULL FEATURE

(MAX) 6-Beam Layout
6x 20Gbps Rx,
6x 10 Gbps Tx,
Ext Radio, GPS Ref.,
no Fan-Out cables

pass through

FIBER ONLY pass-through,
no bonding to AC

Bulkhead IF

Note: Power/control copper wires use BI according A792

EN4165

Aircraft provisioning

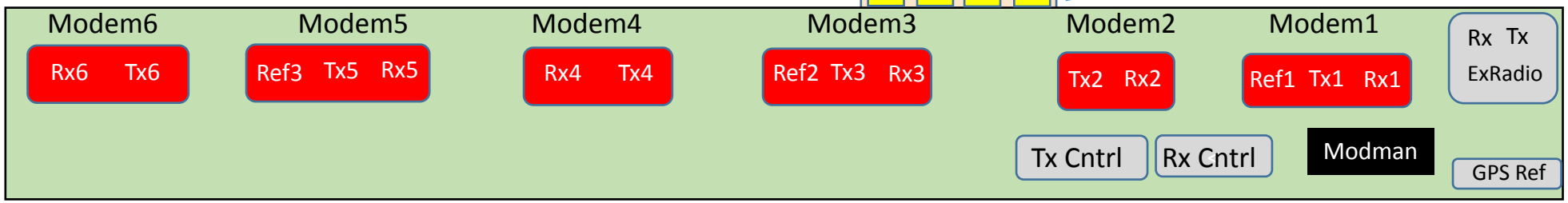
EN4165

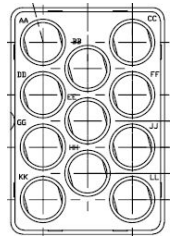
EN4165

System Supplier
Modem harness

11 12 5 3

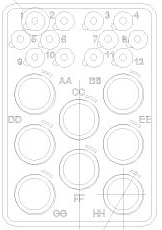
Q11 or 20F12Q8





TBD

ARINC 600
Q11 Insert

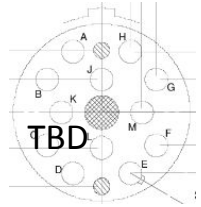


ARINC 600
20F12Q8 Insert

793 v25 MiM

48-Fiber EFn architecture

Tx and Rx: Ethernet



38999 19-12

Tx Aperture
Tx Cntrl
1 TX Transceiver
3 RX Transceiver
1x Tx
1x Tx Ref
1x Rx/Tx Eth

Rx Aperture
Rx Cntrl
2 TX / 2 RX Transceiver
1x Rx Ref
1x Rx/Tx Eth

4 e.g. (38999 19-12

System Supplier
Antenna harness

4 e.g. 38999 19-12

pass through

FIBER ONLY pass-through,
no bonding to AC

EN4165

Aircraft
provisioning

EN4165

EN4165

System Supplier
Modem harness

4 4

Q11 or 20F12Q8

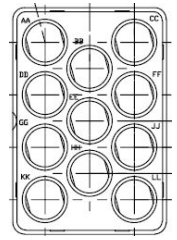
Modem1
Ref1 Tx1 Rx1
Tx Cntrl
Rx Cntrl
Modman

Bulkhead IF

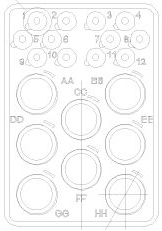
Note: Power/control copper wires
use BI according A792

4x12 Fiber Provisions - Min Viable system

(MIN) 1-Beam Layout
1x 10Gbps Rx,
1x 10 Gbps Tx,



TBD



ARINC 600
Q11 Insert

ARINC 600
20F12Q8 Insert

793 v25

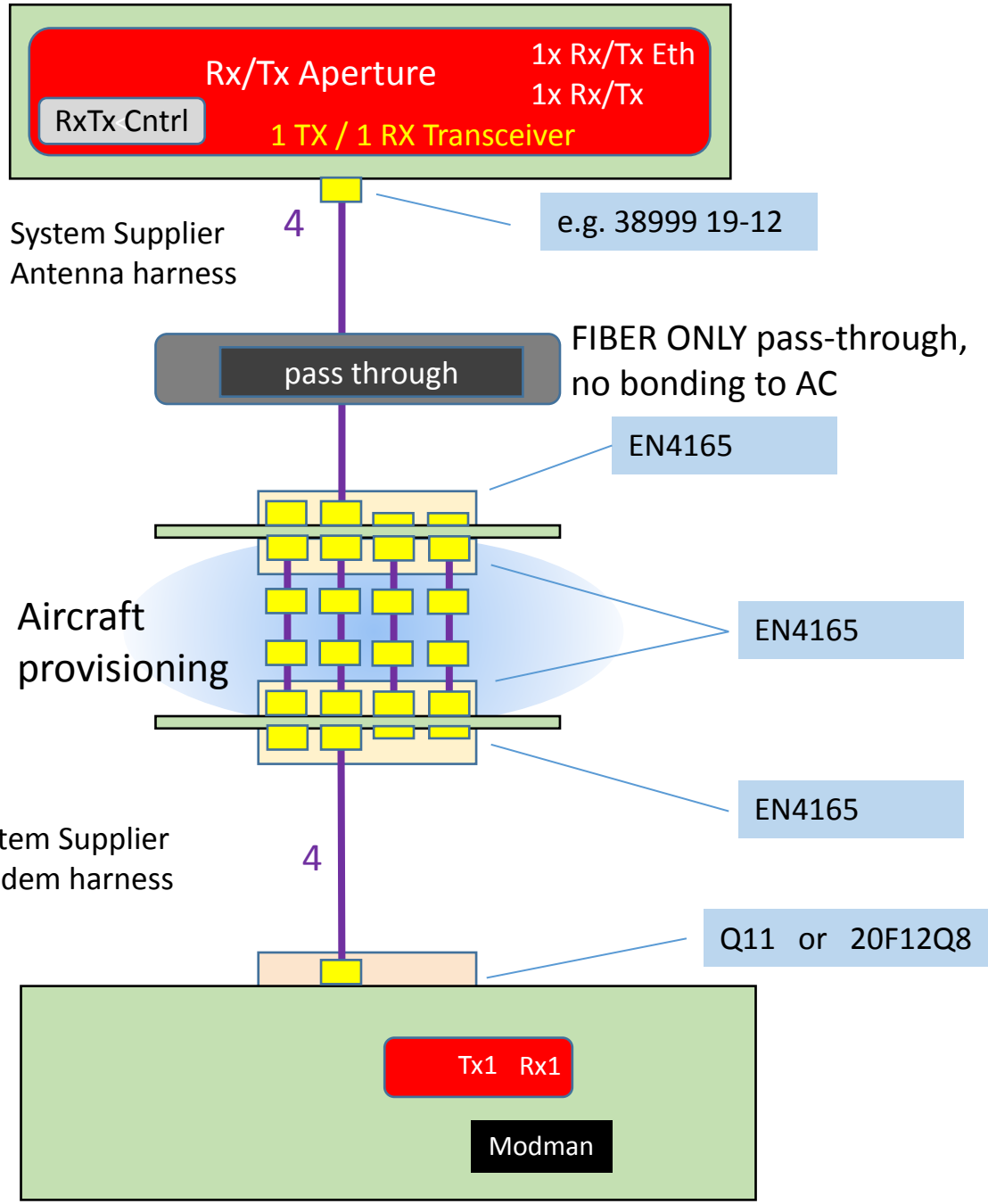
MiO

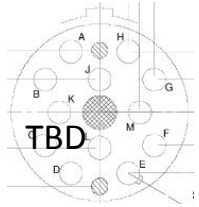
48-Fiber EFn architecture

Tx and Rx: Ethernet

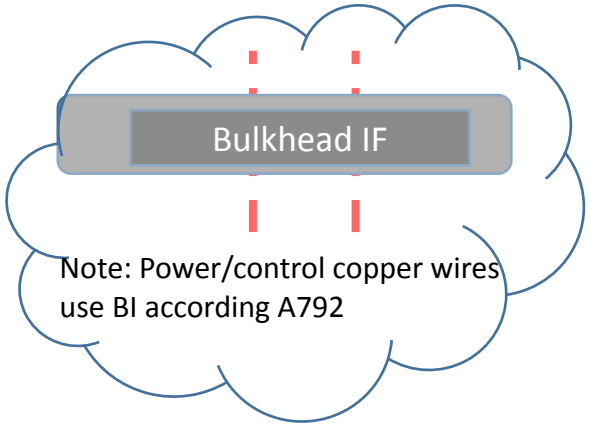
4x12 Fiber Provisions - Modem in OAE

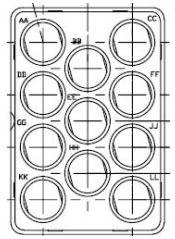
(MIN) Modem in OAE
1x 10Gbps Rx,
1x 10 Gbps Tx,



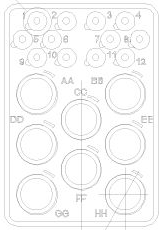


38999 19-12





TBD

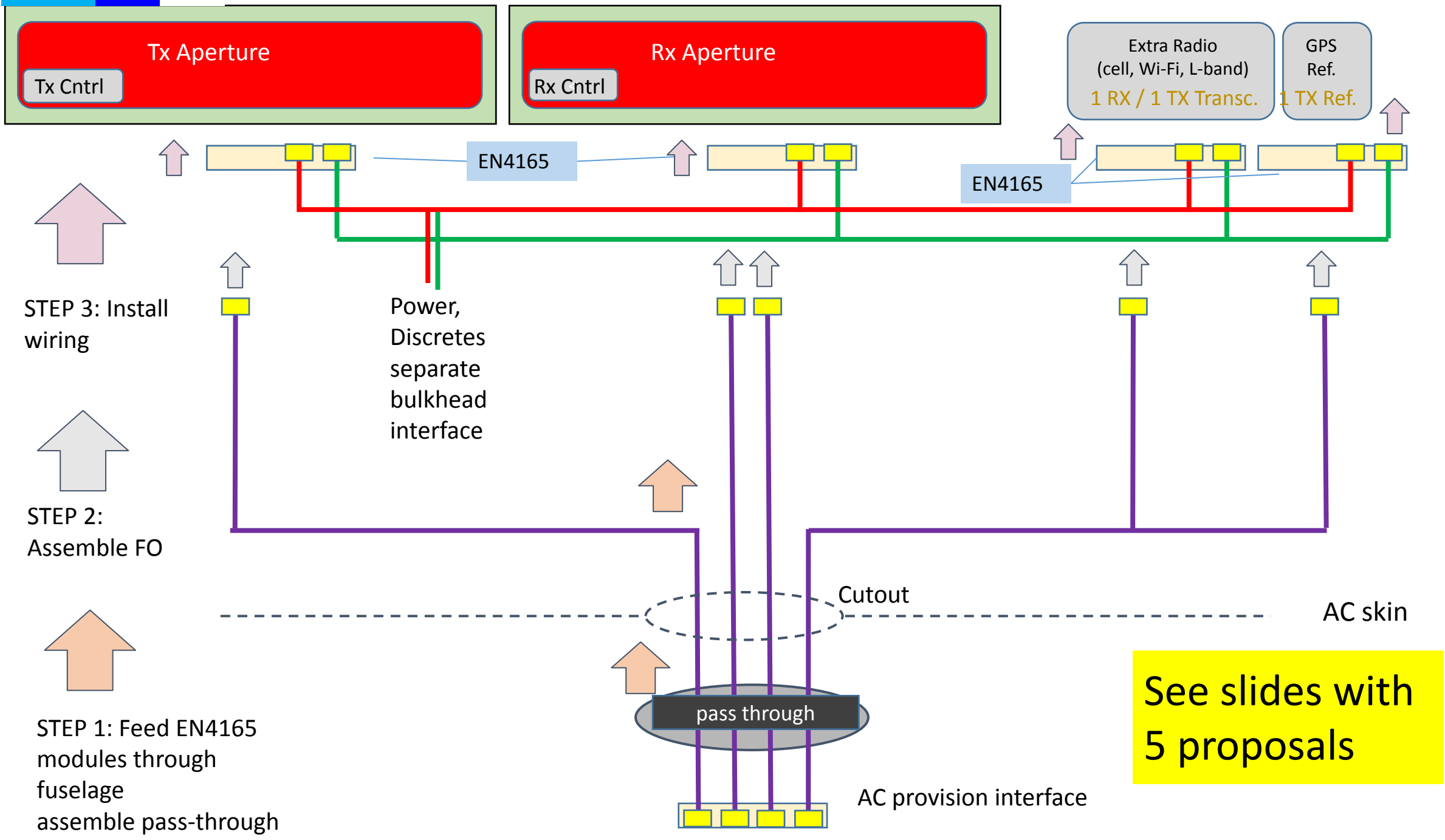


ARINC 600
Q11 Insert

ARINC 600
20F12Q8 Insert

793 v25 MiM

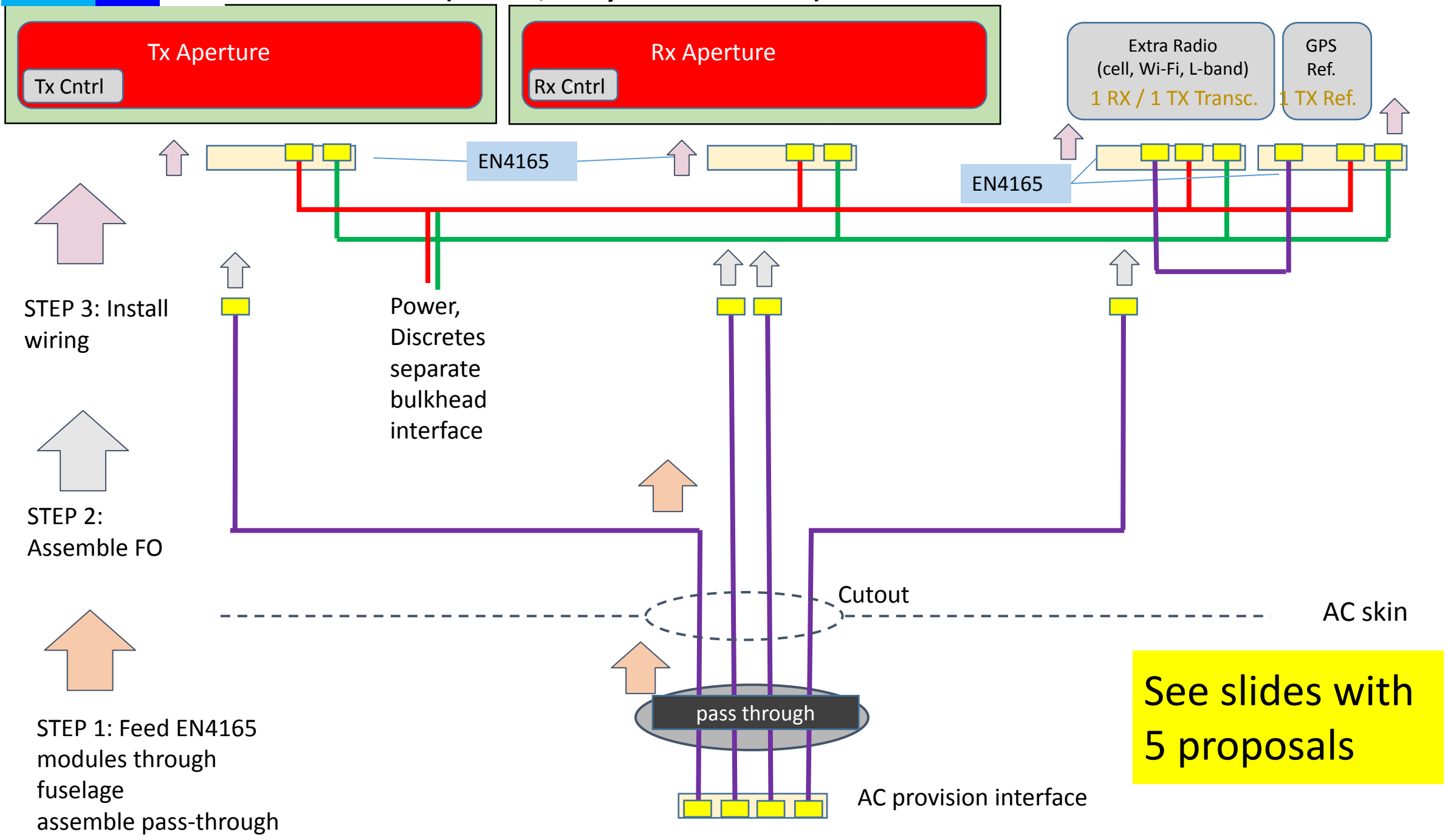
Antenna Harness



See slides with 5 proposals

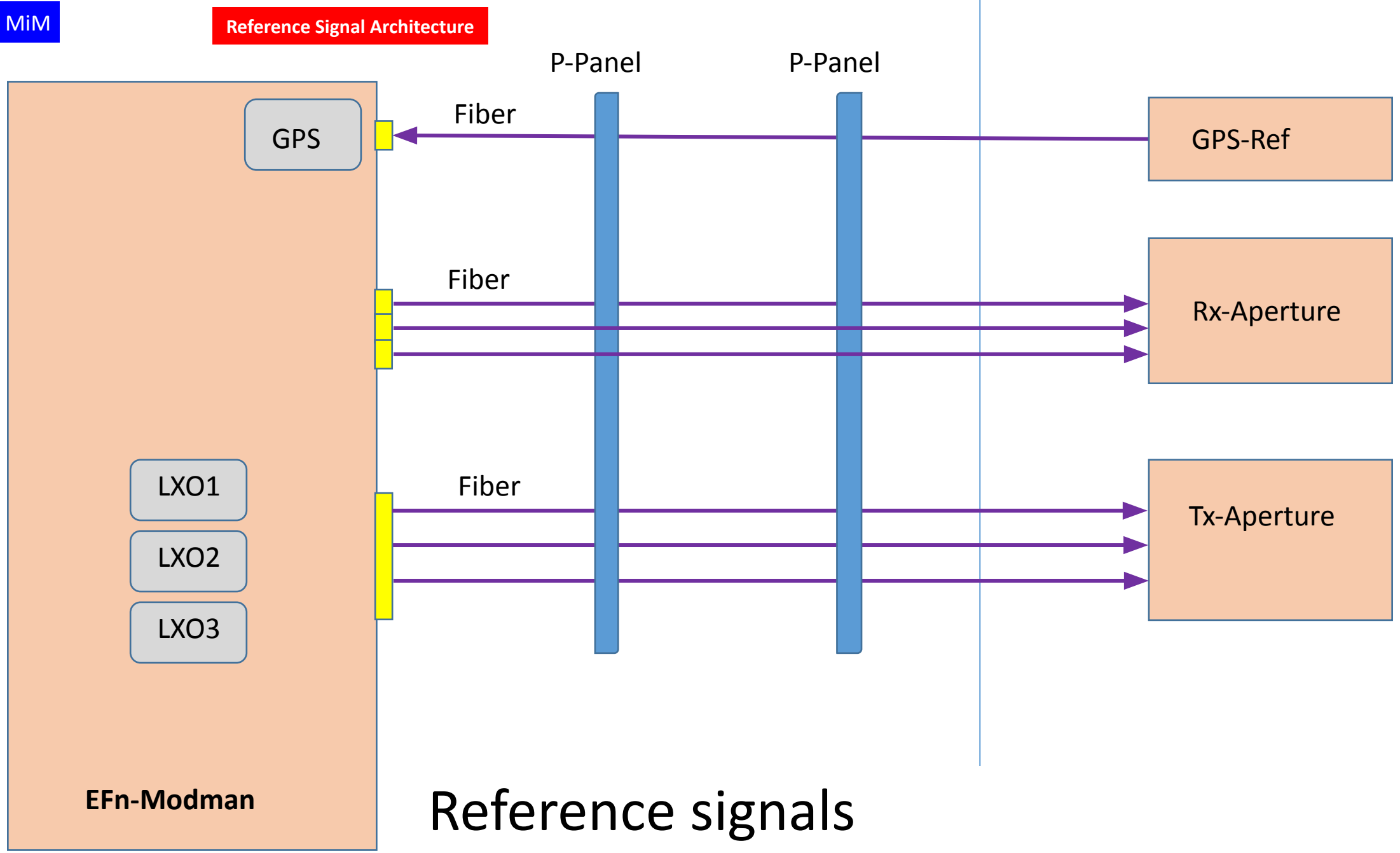
793 v21 MiM

Antenna Harness (Variant, Daisy Chain Ext Radio)



See slides with 5 proposals

Reference Signal Architecture



Reference signals (current EFn-MODMAN architecture)

Rationales:

Rx datarate is calculated to require max 15Gbps, two parallel fibers with 10GBps each selected for component and transceiver simplicity.

Reference signals:

One Ref signal distributed from Modman to the antenna, analog RF-over-fiber, range 10 to 100MHz. Ref. DIFI discussion.

ASSUMPTIONS:

- EN4644 10Q2 Insert can be used to either connect to equipment or between harnesses, tbd FOS
- Transceivers can be fully utilized (12x per MT), any combination of Rx and Tx
- EN4165 can host at least 1x new FOS MT ferrule

Cables:

Multi-fiber cable for MT terminus termination = ARINC 802 Cable, Appendix K, 12 fiber cable (50/125)
Single channel fiber cable = ARINC 802, Appendix I, but need to consider a double jacketed version (50/125)

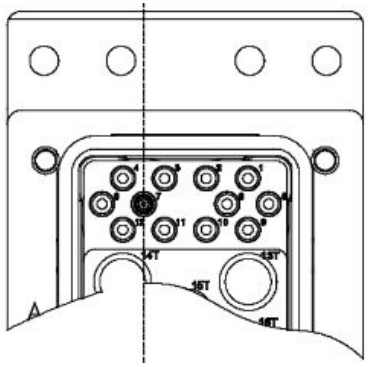
ARINC 802 Cable, Appendix K,
12 Fibers, for MT

ARINC 802 Cable, Appendix I,
Single Fiber, for ARINC 801

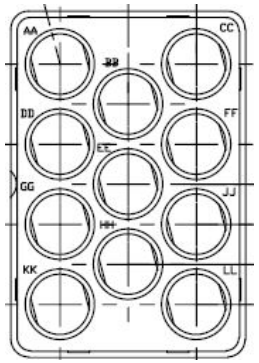
slide obsolete?

Connectors:

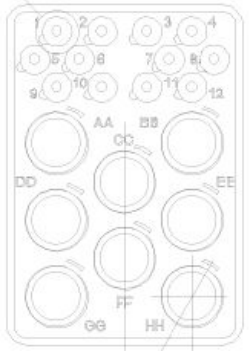
Rack mounted equipment = ARINC 600 type according new FOS APIM
Disconnects between rack mounted equipment and antennas ARINC 801 single insert rectanguar shell (EN4644) w[illegible]Q2 insert shown, but should be according new FOS APIM



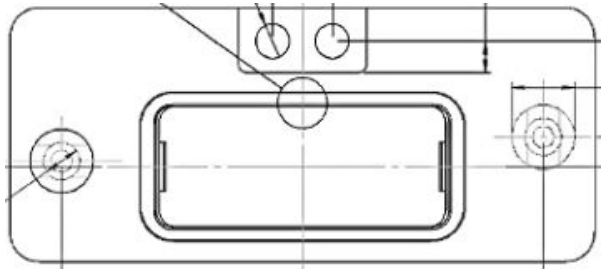
ARINC 600
Connector



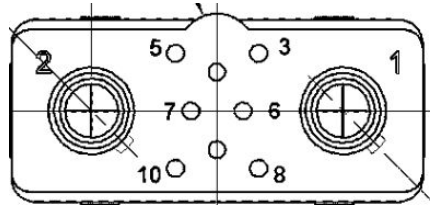
ARINC 600
Q11 Insert



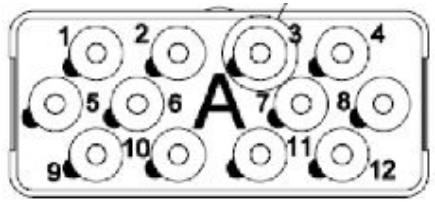
ARINC 600
20F12Q8 Insert



ARINC 801 (EN4644)
Single Insert Connector

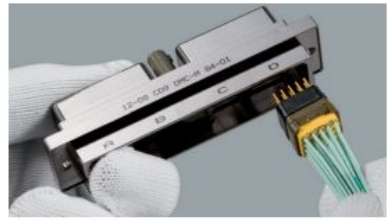


EN4644 10Q2 Insert



ARINC 801 12F12 Insert

EN 4165 4-module connector



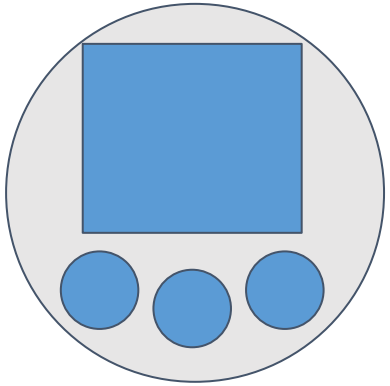
STEP 1: The module must be inserted from the rear side of the housing. The module polarization key must be visible from the marked side of the housing.

STEP 2: Push manually the module (wired or not) until butting. For sealed modules use the insertion tool part number 057-0699-00 A or B. Make sure that the module is well inserted either by pulling back the wires (if wired) or by pushing the module from the front of the housing

Pictures from the TE / Deutsch website

Fuselage Cutout design

This is a 50mm cutout with 3 fibers of 10mm (including protection)



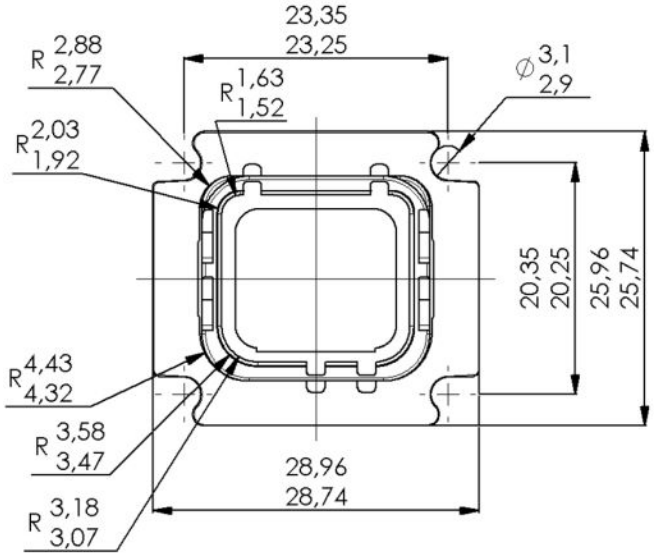


Figure 8

prEN 4165-025:2010 (E)

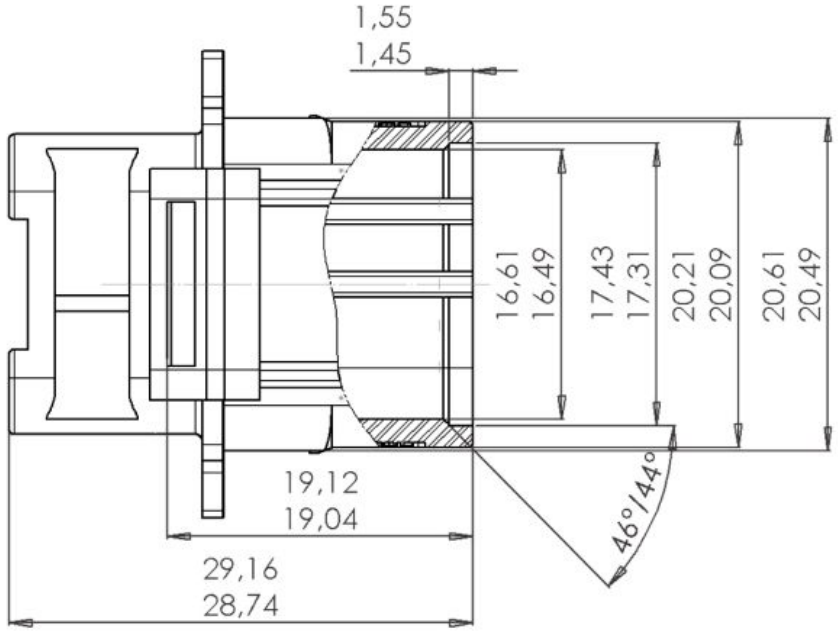
4.2 Single module jack receptacle (extender) design (long receptacle) Type 7

Dimensions and positions of keying polarizations, see Clause 5.

See Figures 5, 6, 7, 8 and 9.

Dimensions are in millimetres.

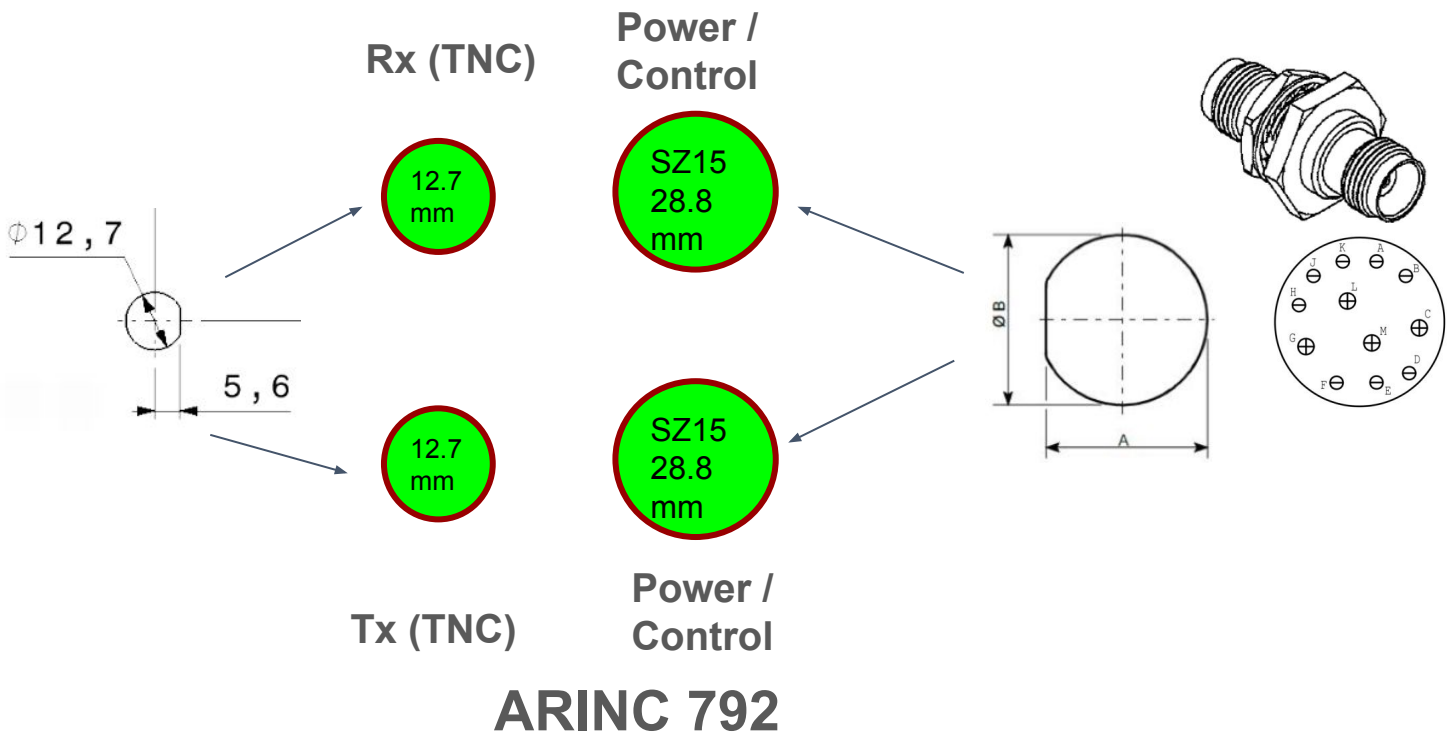
Mass = 7,5 g max.



The cutout has to pass the electrical connectors (e.g. EN4165 modules)

Fuselage Cutout design - increasing the existing and Arinc 792 coax cutouts

source: Radiall



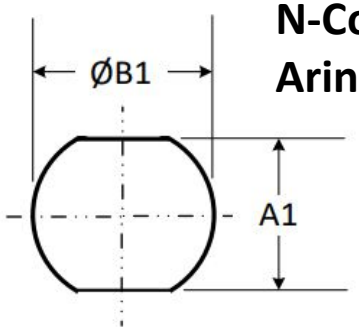
Arinc 792 uses the same Coax and Power/Control cutouts and connectors for the Rx and Tx antenna interface. They are on the LH and RH side of the antenna and can't be mis-assembled.

793 v24 MiM MiO

Fuselage Cutout design - using the existing and abandoned Arinc 791 / 792 coax cutouts

ATTACHMENT 4
CONNECTORS AND PIN ARRANGEMENTS

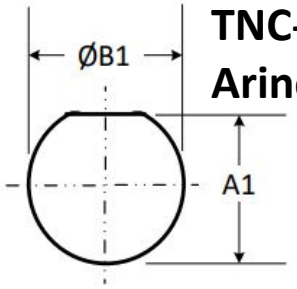
N-Connector cutout
Arinc 791 (1x) / 792 (N/A)



A1, in [mm]	ØB1, in [mm]
0.535 +0.004/-0 [13.6 +0.1/-0]	0.630 +0.008/-0 [16.0 +0.2/-0]

Figure 4-14b – Example 2 – N-type for Tx-IF (Coax)

TNC-Connector cutout
Arinc 791 (1x) / 792 (2x)



Note: The flat face of the cutout should face forward.

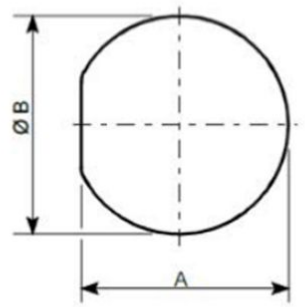
A1, in [mm]	ØB1, in [mm]
0.473 +0.004/-0 [12.0 +0.1/-0]	0.505 +0.008/-0 [12.8 +0.2/-0]

Figure 4-14c – Example 3 – TNC for Rx-IF (Coax)

All receptacles should be installed with an o-ring seal located internal to the aircraft skin. A typical installation, illustrated for a coaxial interface, is shown in Figure 4-15. For the larger penetration, a separate adapter plate may be needed to interface a coaxial connector to the penetration.

ATTACHMENT 4
CONNECTORS AND PIN ARRANGEMENTS

TNC-Connector details in Arinc 792



B, in (mm)	A, in (mm)
0.500 +0.012/-0 (12.7 +0.3/-0)	0.479 +0.012/-0 (11.9 +0.3/-0)

Figure 4-14 – IF TNC Bulkhead Penetration Cutout

A typical installation, illustrated for a TNC coaxial interface, is shown in Figure 4-15.

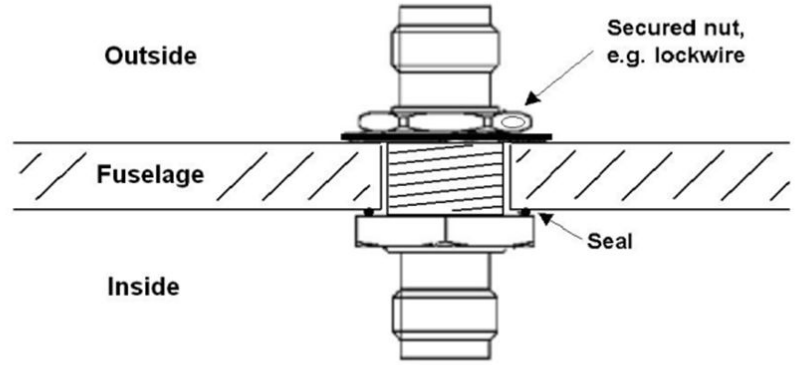
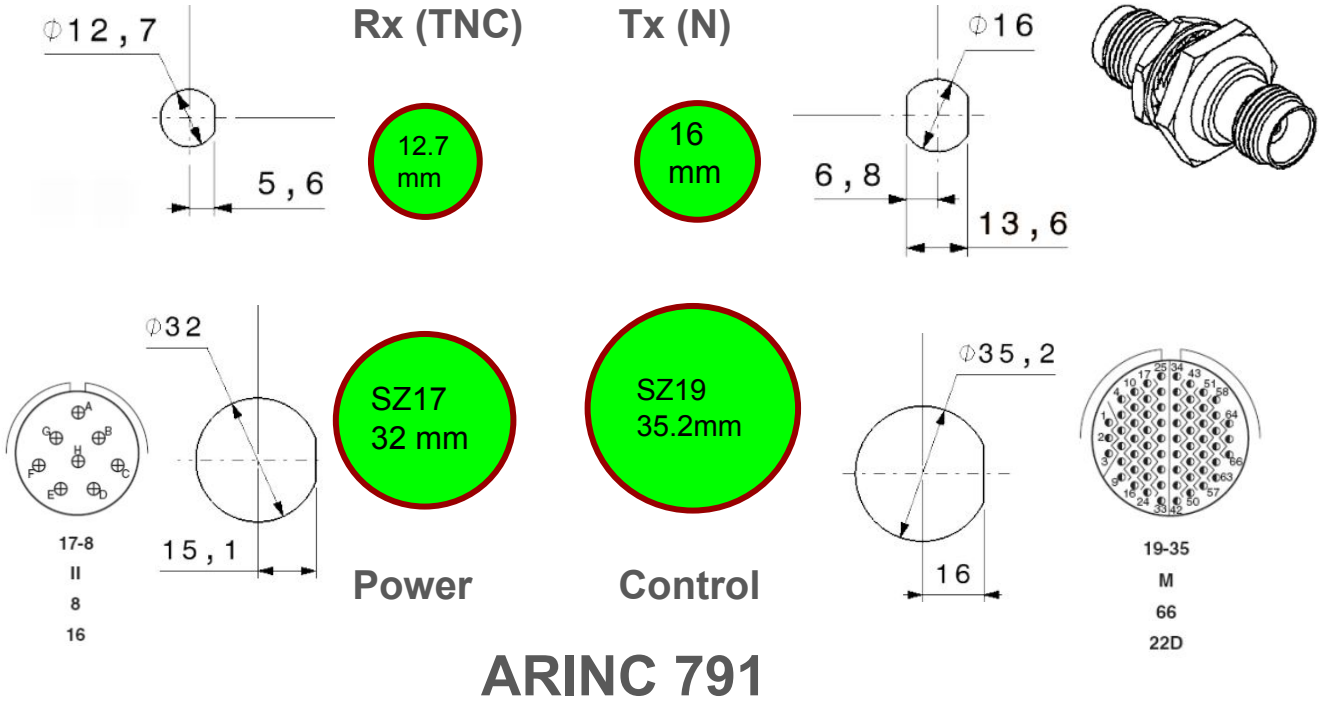
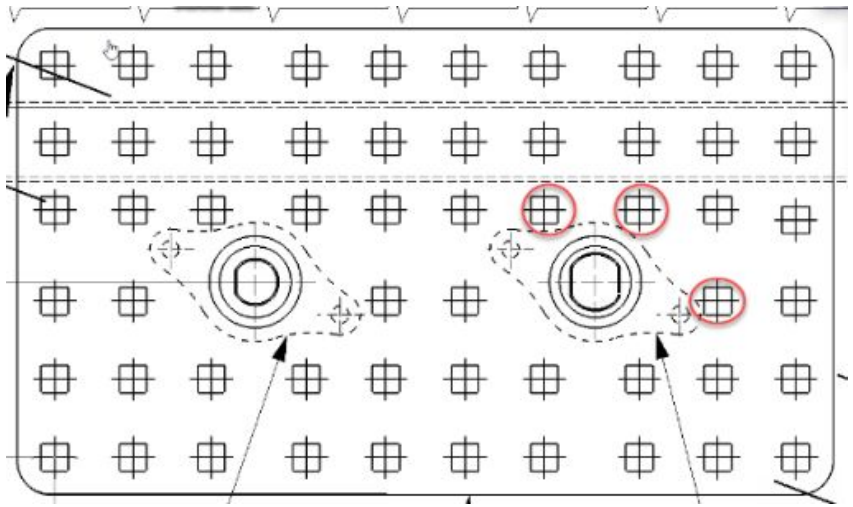


Figure 4-15 – Typical Bulkhead IF Connector Assembly

The assembled IF interface should not protrude more than 4 inches (101.6 mm) below the fuselage.

Fuselage Cutout design - increasing the existing and Arinc 791 coax cutouts





Example of a doubler / backplate

The ARINC 791 cutouts for Power, Control, Rx- and Tx-Coax are available in service. The cutout shape incl the anti-rotation feature and bonding provisions may only exist in the doubler / backplate.

Increasing the cutout is difficult in retrofit and linefit as the doubler / backplate may not have the clearance to skin rivets.

Arinc 793 Requirements for FOS APIM 24-0XX:

Planned scope:

- Create new ARINC 8XX series standard for unmodified Mechanical Transfer (MT) ferrules used in **ARINC 600 connectors**, **circular connectors**, and **rectangular connectors**

- Update ARINC 800 series specifications as needed in support of new ARINC 8XX series standard

- Identify preferred **solution for pressure bulkhead penetration** solution (whether a passthrough or a bulkhead connector)

Is ***"KSAT Optical Requirements _ 22June2022.xlsx"*** still valid? Or obsolete?

Questions for FOS:

- Interchangeability or Intermateability (this will affect the A600 layout design)
- What A600 connector layout can we agree on? Definitely a new layout?
- Is there a means to connect to the Modman from the front side? Pursue idea?
- Can Linefit FAL install EN4165 - assembling the modules when building the OAE? Is there a risk of damaging the fiber components?
- Is MT qualified for outside fuselage use? What does it take?

Arinc 793 Requirements for FOS APIM 24-0XX:

Pressure bulkhead penetration solution (whether a passthrough or a bulkhead connector):

should be qualified for a maximum of 14.5 psi (1000 hPa) overpressure inside cabin to meet cabin pressure testing requirements.

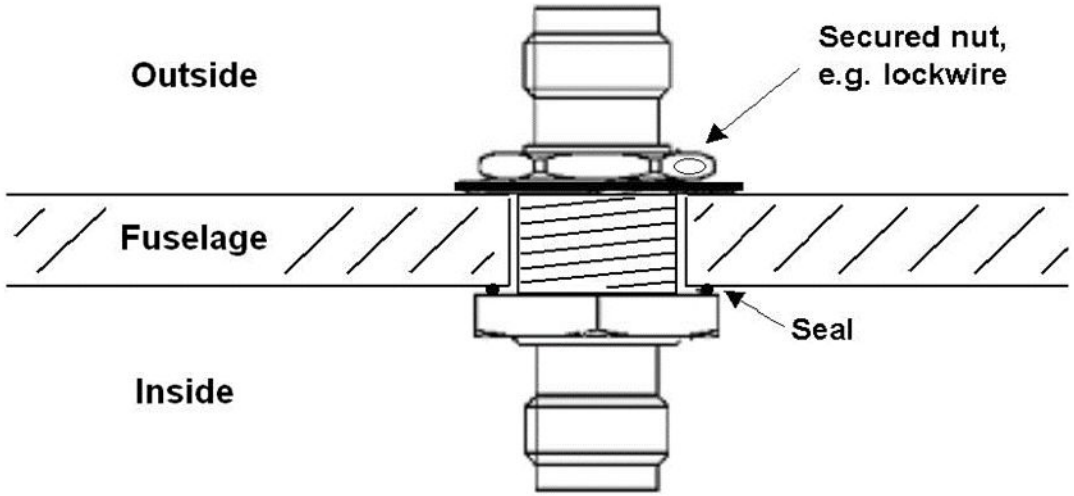
The fuselage section through which the bulkhead interface connectors fasten is inherently curved. The variation in the bulkhead interface mounting surface depends on the underlying local radius of curvature and the span of the connector fixture. Bulkhead interface sealing methods should accommodate curvature in the mounting surface (fuselage).

The flat face of the cutout should be oriented forward (the flange should be inside, pressure direction).

Bulkhead grip length (panel thickness) schuld be min 0.25 inches (6.35 mm) or more to work on all installations.

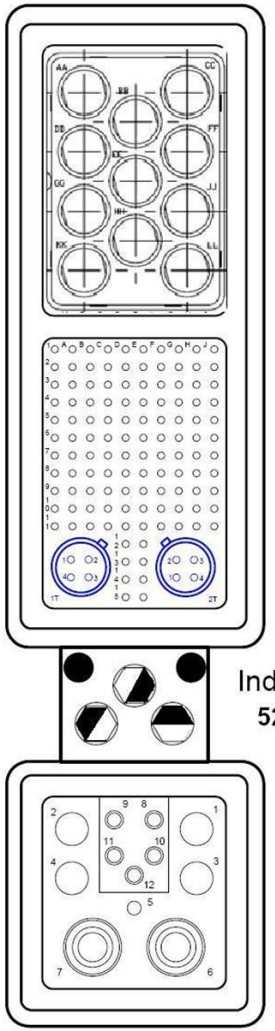
A washer may be necessary to avoid jam-nut damaging the fuselage finish.

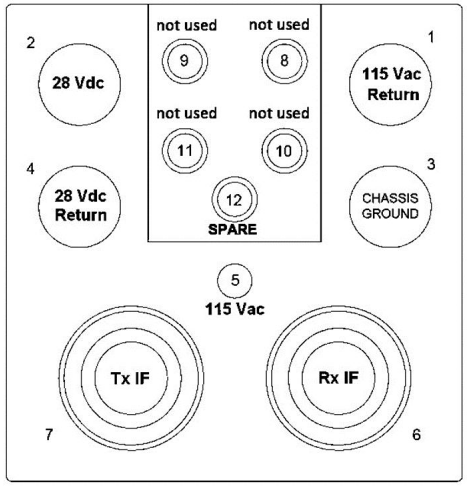
A jam-nut should be secured by lock wire.



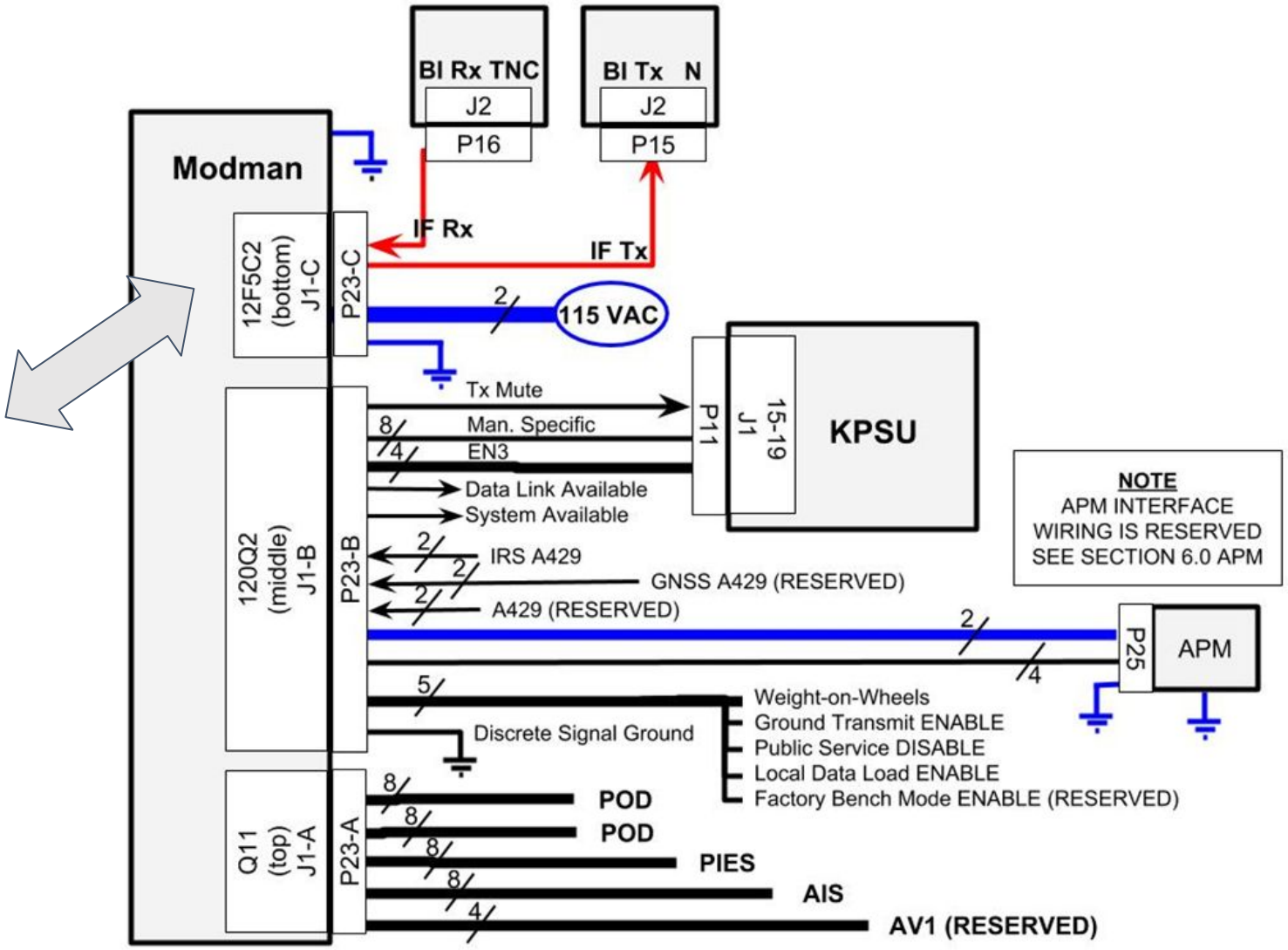
Arinc 793 Requirements for FOS APIM 24-0XX:

Arinc 791/792 Modman : Arinc 600 Connector





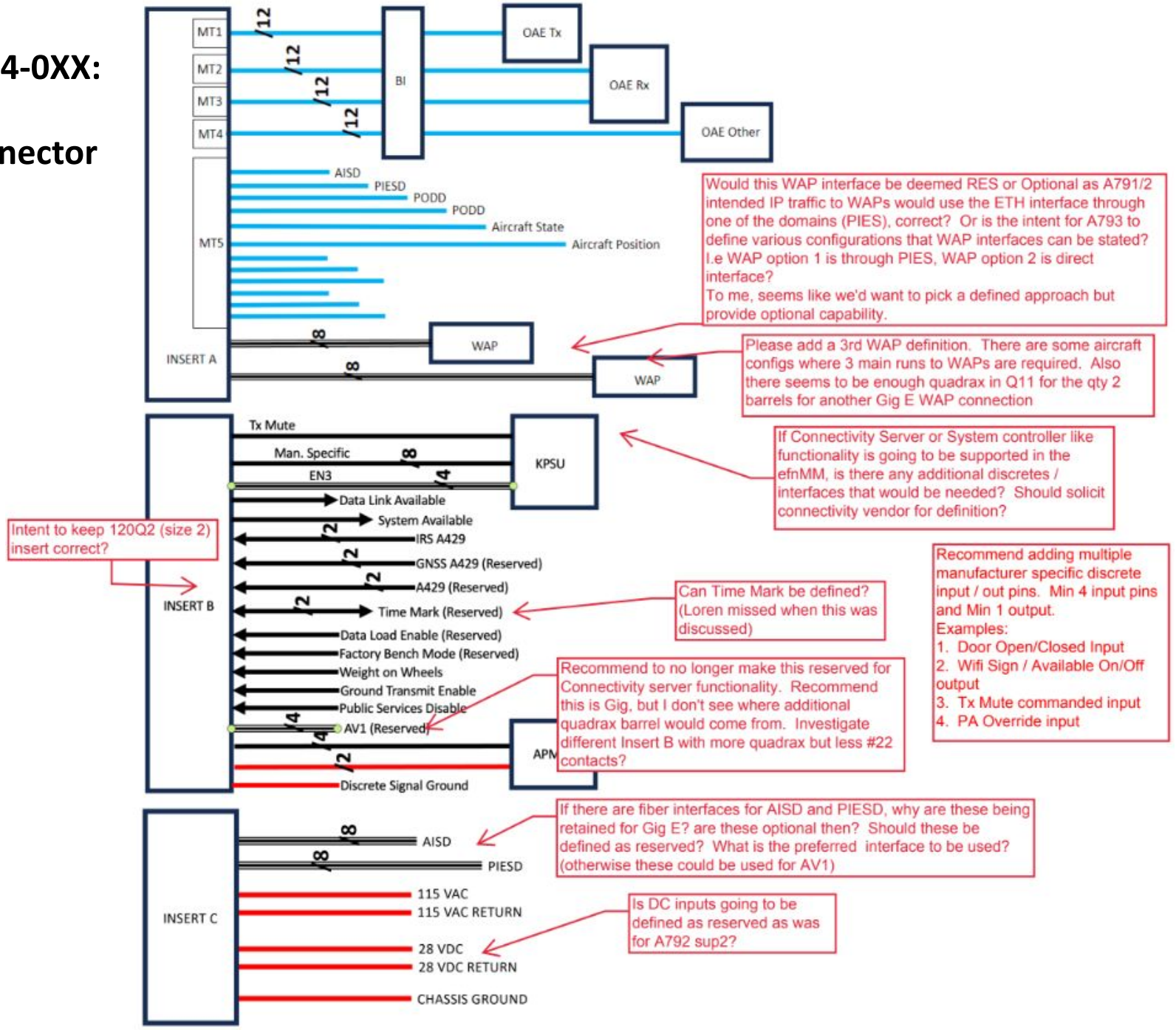
Insert C hosts coax and power supply pins.



Arinc 793 Requirements for FOS APIM 24-0XX:

Arinc 791/792 Modman : Arinc 600 Connector

Need to re-allocate the pins



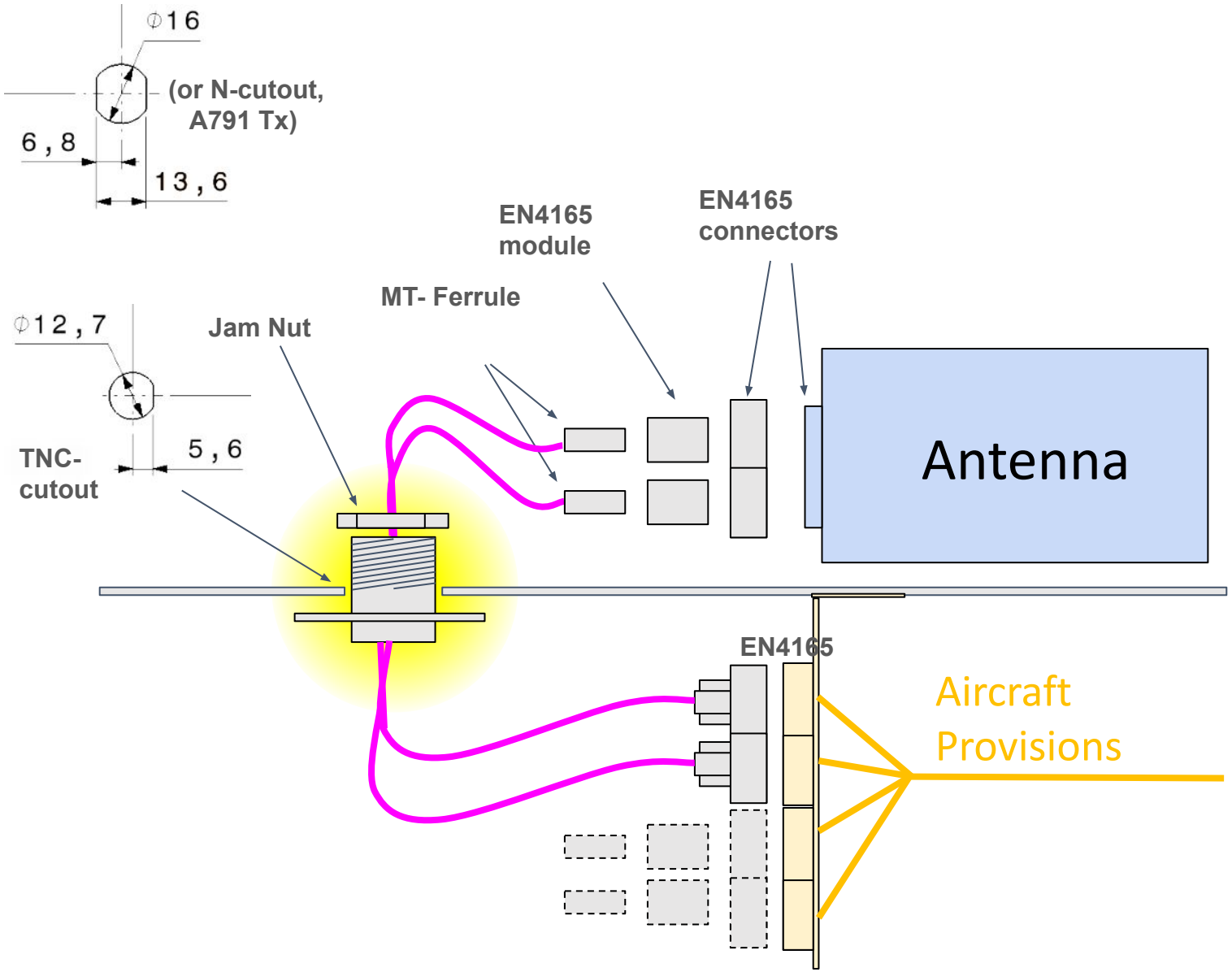
Fuselage Cutout design - using the existing and abandoned Arinc 791 / 792 coax cutouts

Trade-off studies for cutouts:

1.)	Using the existing TNC and N Type cutouts, new pass through components needed	Arinc 791 / 792 (TNC)
2.)	New RF cutout size, to accommodate a SZ15 4x MT connector, keeping P and C cutout	Arinc 791 only
3.)	Re-purpose A792 SZ15 to 4xMT connector and reconsider the other connector (15-97) to accommodate the entire copper lines - or add something using the coax cutouts.	Arinc 792 only
4.)	Minimize the KPSU manufacturer specific wires so that the A791 size cutouts could be used for combined power and discretes allowing the other cutout to be used for the 4xMT. Coax cutouts are both capped.	Arinc 792 system on Arinc 791 Provisions
5.)	Different than the D38999 insert patterns for the SZ17 and SZ19 - for example size 16 or 18.	Arinc 791 only

Fuselage Cutout design - using the existing and abandoned Arinc 791 / 792 coax cutouts

1.) Using the existing TNC and N Type cutouts, new pass through components needed



STEP 1: The module must be inserted from the rear side of the housing. The module polarization key must be visible from the marked side of the housing.

STEP 2: Push manually the module (wired or not) until butting. For sealed modules use the insertion tool part number 057-0699-00 A or B. Make sure that the module is well inserted either by pulling back the wires (if wired) or by pushing the module from the front of the housing

source: TE Connectivity Deutsch

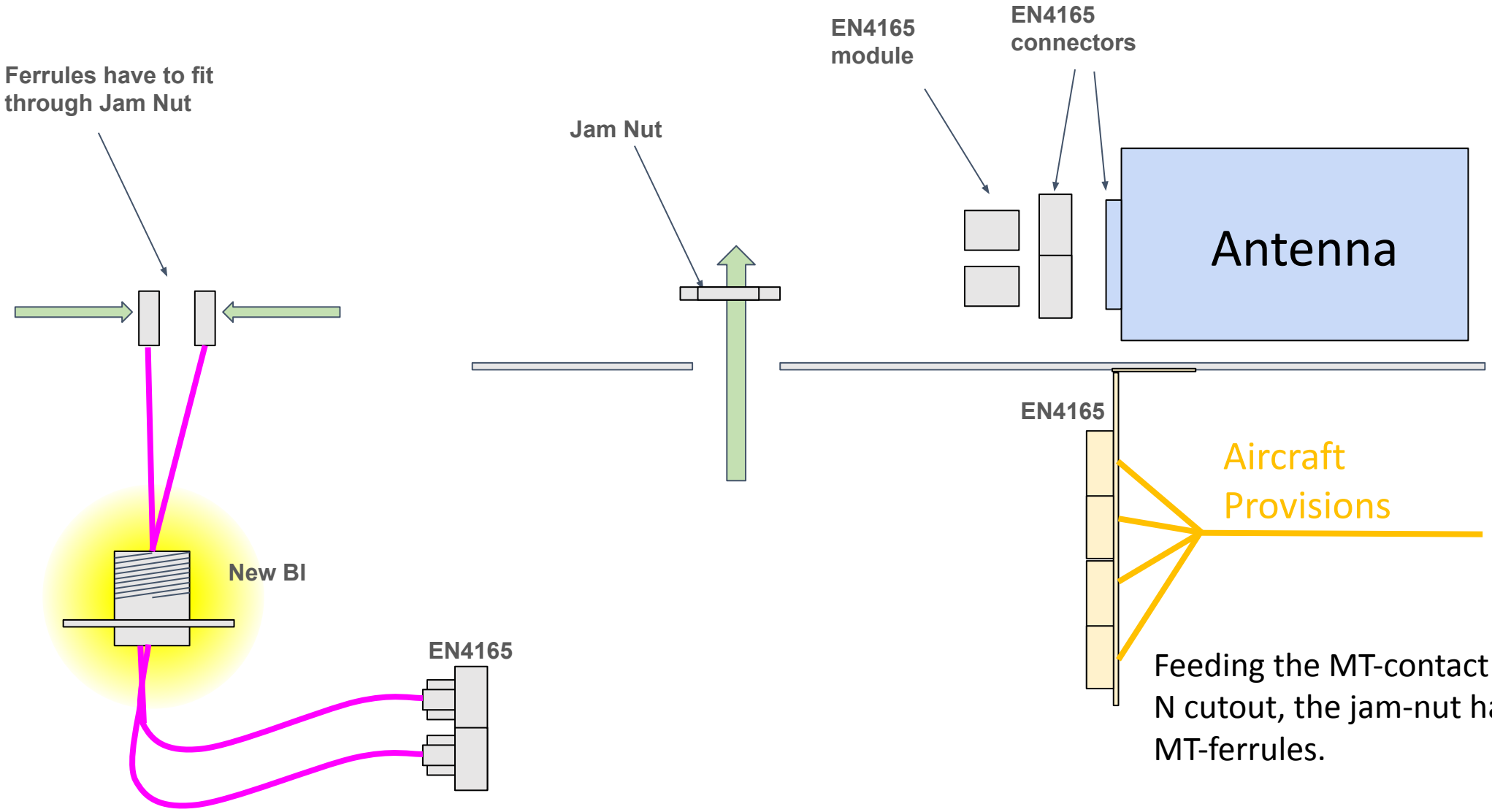
Feeding the MT-contact through the TNC cutout, the jam-nut has to fit over the MT-ferrules.
N-Type (Arinc 791 Tx) is not required when all four MT ferrules can be passed through a single TNC cutout.
Note: Arinc 792 has only TNC, no N-Type cutout.

The EN4165 is a proposal, not mandatory.

NEW: TNC bulkhead interface

Fuselage Cutout design - using the existing and abandoned Arinc 791 / 792 coax cutouts

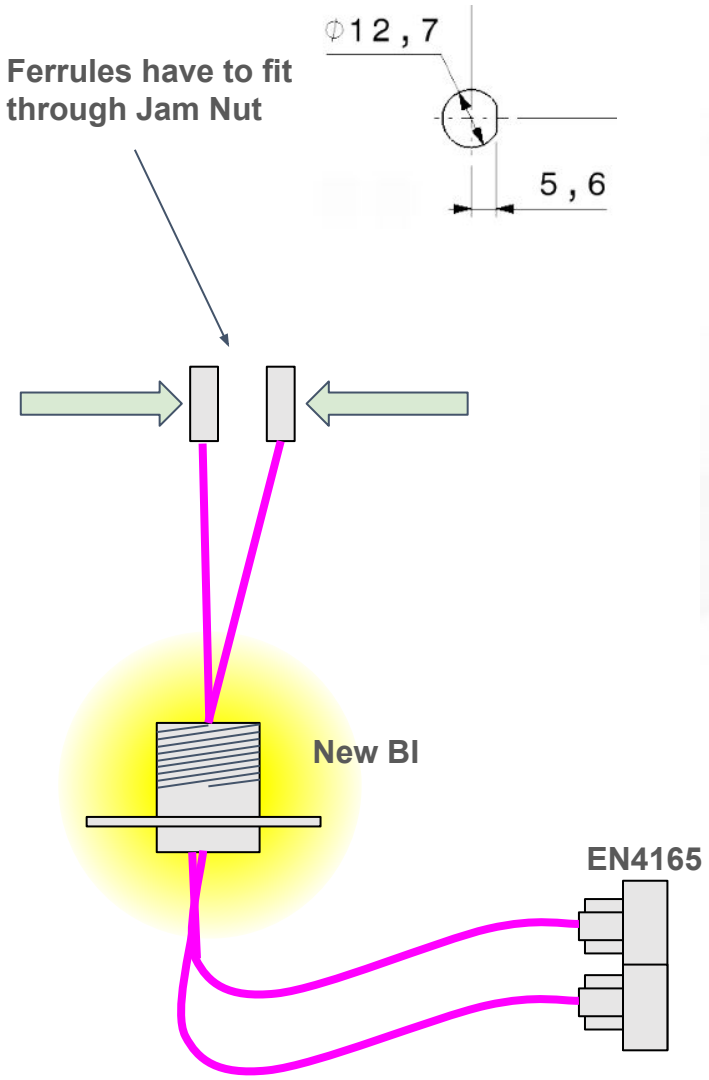
1.) Using the existing TNC and N Type cutouts, new pass through components needed

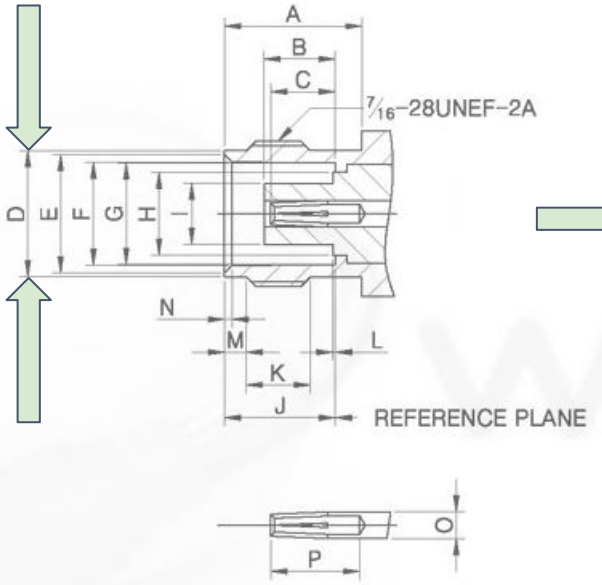


Feeding the MT-contact through the TNC / N cutout, the jam-nut has to fit over the MT-ferrules.

Fuselage Cutout design - using the existing and abandoned Arinc 791 / 792 coax cutouts

1.) Using the existing TNC and N Type cutouts, new pass through components needed





Letter	Millimeters		Inches	
	Minimum	Maximum	Minimum	Maximum
A	10.52	–	0.4140	–
B	4.78	5.28	0.1880	0.2080
C	4.72	5.23	0.1860	0.2060
D	9.60	9.68	0.3780	0.3810
E	8.79	9.04	0.3460	0.3560
F	8.31	8.46	0.3270	0.3330
G	8.10	8.15	0.3190	0.3210
H	–	6.50	–	0.2560
I	–	4.72	–	0.1860
J	8.31	8.51	0.3270	0.3350
K	4.75	–	0.1870	–
L	–	0.15	–	0.0060
M	1.73	2.24	0.0680	0.0880
N	0.38	0.76	0.0150	0.0300
O	2.06	2.21	0.0810	0.0870
P	4.95	–	0.1950	–

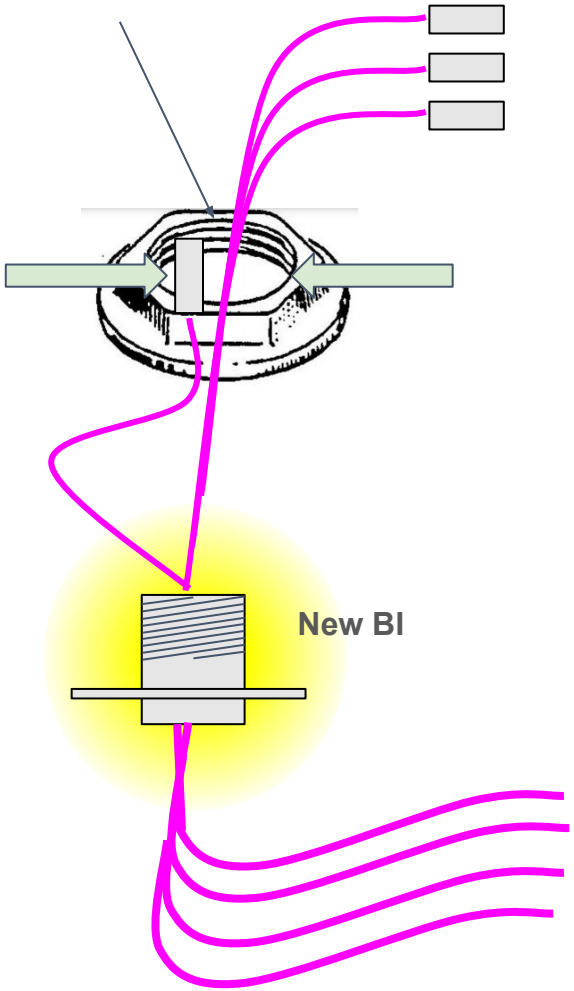
source: https://www.wellshow.com/products/rf-connectors/tnc-connectors/

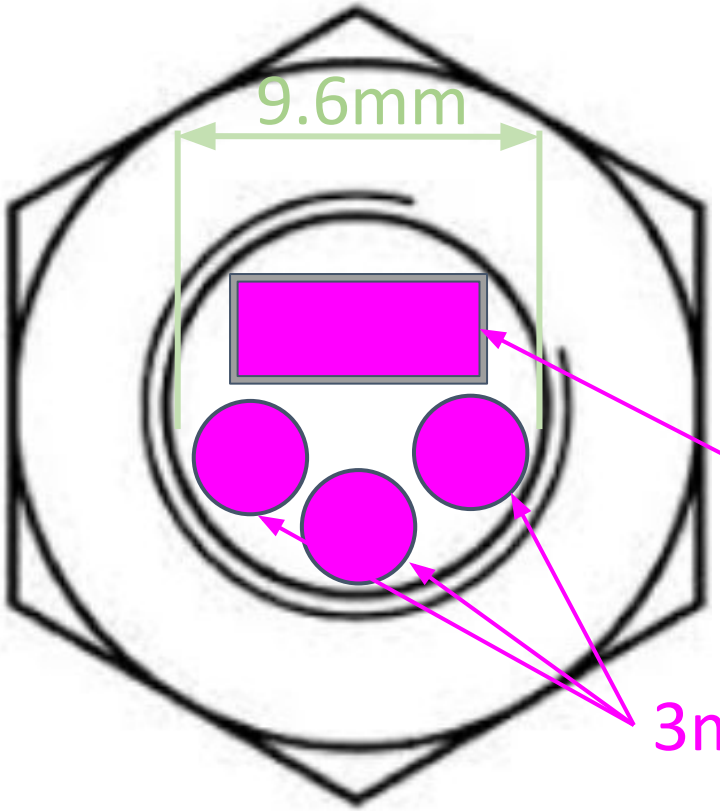
Feeding the MT-contact through the TNC / N cutout, the jam-nut has to fit over the MT-ferrules. The TNC connector features a 7/16"-28 thread.

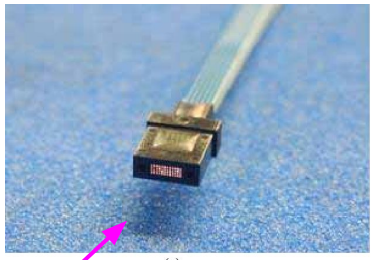
While the cutout is approx 12.7 x 12.0mm - the jam nut inner diameter is even smaller. In case of TNC 9.6mm

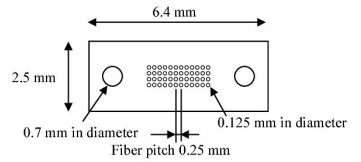
Fuselage Cutout design - using the existing and abandoned Arinc 791 / 792 coax cutouts

1.) Using the existing TNC and N Type cutouts, new pass through components needed









(a) (b)

Fig. 1. Newly developed 48-fiber thermoplastic MT ferrule
(a) Photograph, (b) Dimension of the end face

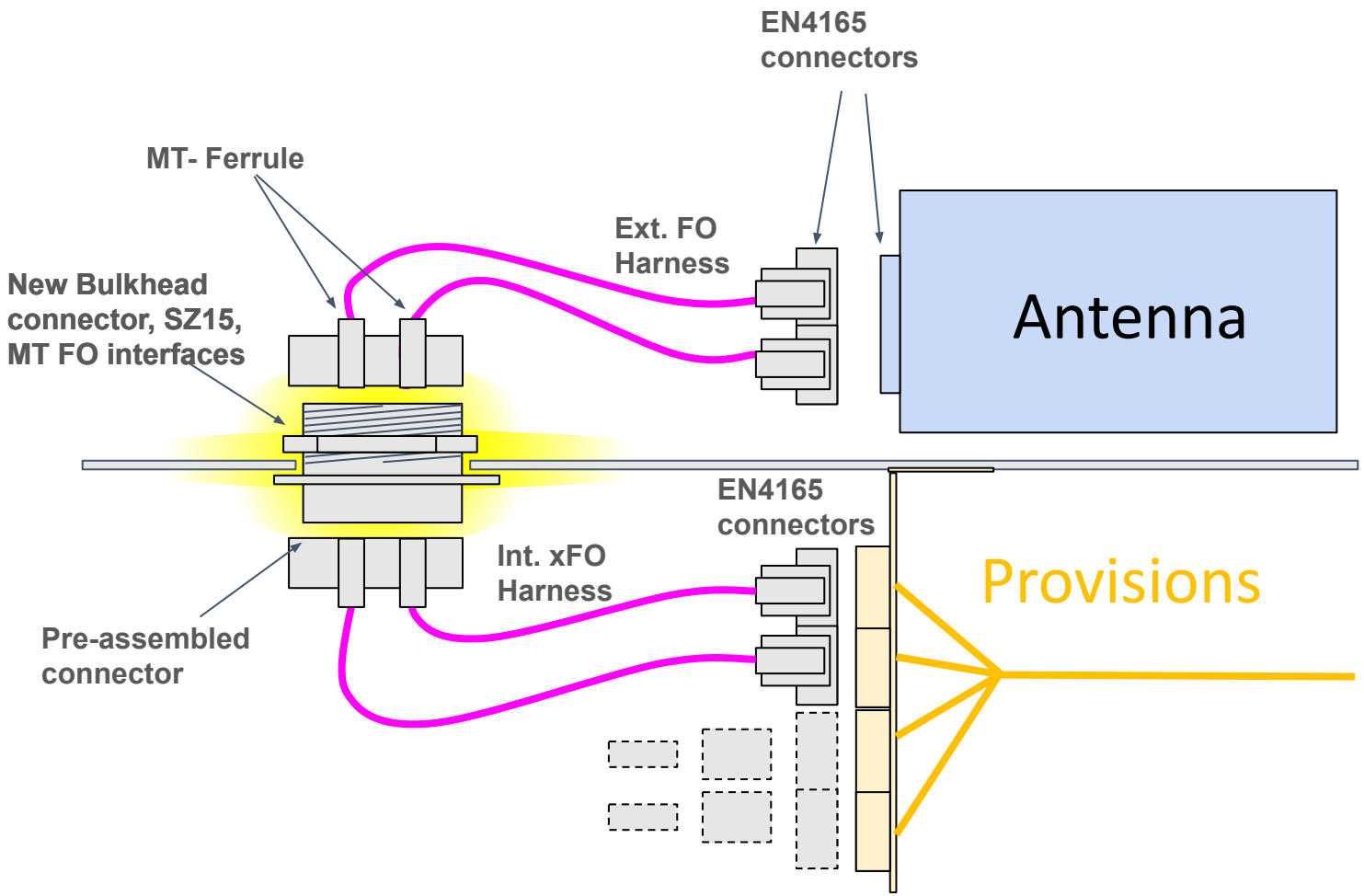
source: https://www.semanticscholar.org/

Can 3x cable jacket plus plus 1x MT-Ferrule fit through a standard TNC jam nut?

(If it fits through the jam nut it will easily fit through the cutout

Fuselage Cutout design - using the existing and abandoned Arinc 791 / 792 coax cutouts

2.) New RF cutout size, to accommodate a SZ15 4x MT connector, keeping P and C cutout



Increase Tx cutout to SZ15 (28.8mm) for a 4x MT- bulkhead interface. This proposal is for Arinc 791 only.

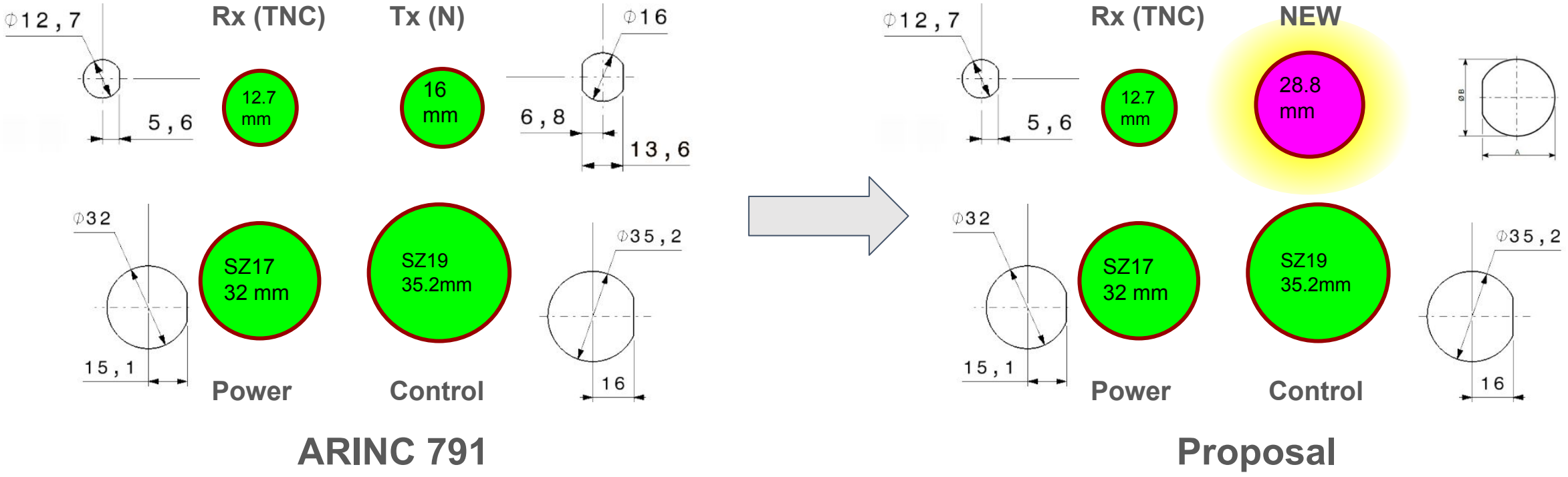
NEW: Modified fuselage cutout deviating from Arinc 791 provisions.
Cleaning / Inspection?

NEW: Bulkhead interface for 4x MT-ferrule

(see next slide)

Fuselage Cutout design - using the existing and abandoned Arinc 791 / 792 coax cutouts

2.) New RF cutout size, to accommodate a SZ15 4x MT connector, keeping P and C cutout

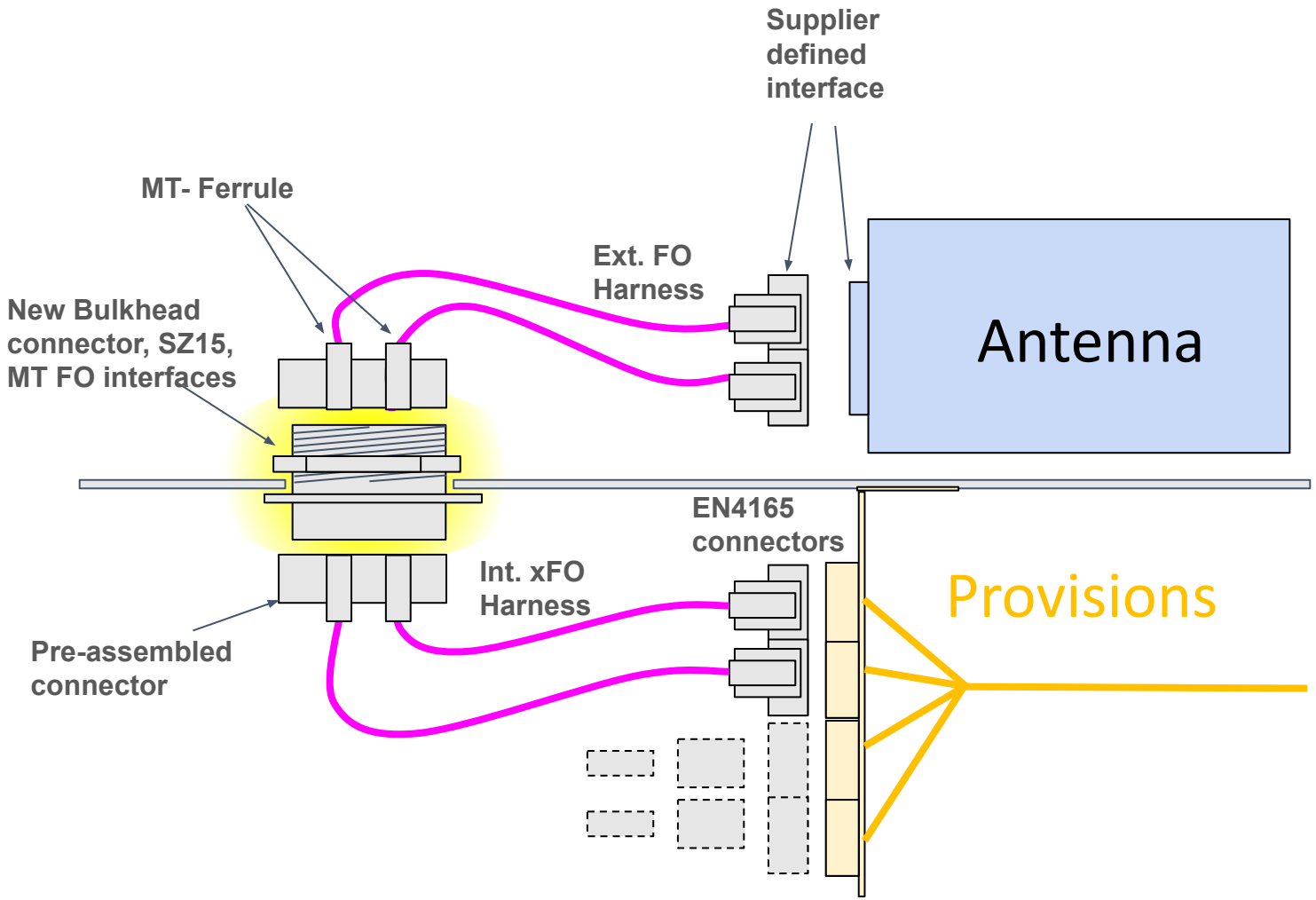


Problem to co-exist in production with A791, requires major structure re-design (local skin repair, new backplates, etc.

This describes only Arinc 791, Arinc 792 cutout problem is similar.

Fuselage Cutout design - using the existing and abandoned Arinc 791 / 792 coax cutouts

3.) Re-purpose A792 SZ15 to 4xMT connector and reconsider the other connector (15-97) to accommodate the entire copper lines - or utilizing the abandoned coax cutouts.



Increase Tx cutout to SZ15 (28.8mm) for a 4x MT- bulkhead interface. This proposal is for Arinc 791 only.

NEW: Re-purpose Arinc cutout

NEW: Bulkhead interface for 4x MT-ferrule

(see next slide)

Fuselage Cutout design - using the existing and abandoned Arinc 791 / 792 coax cutouts

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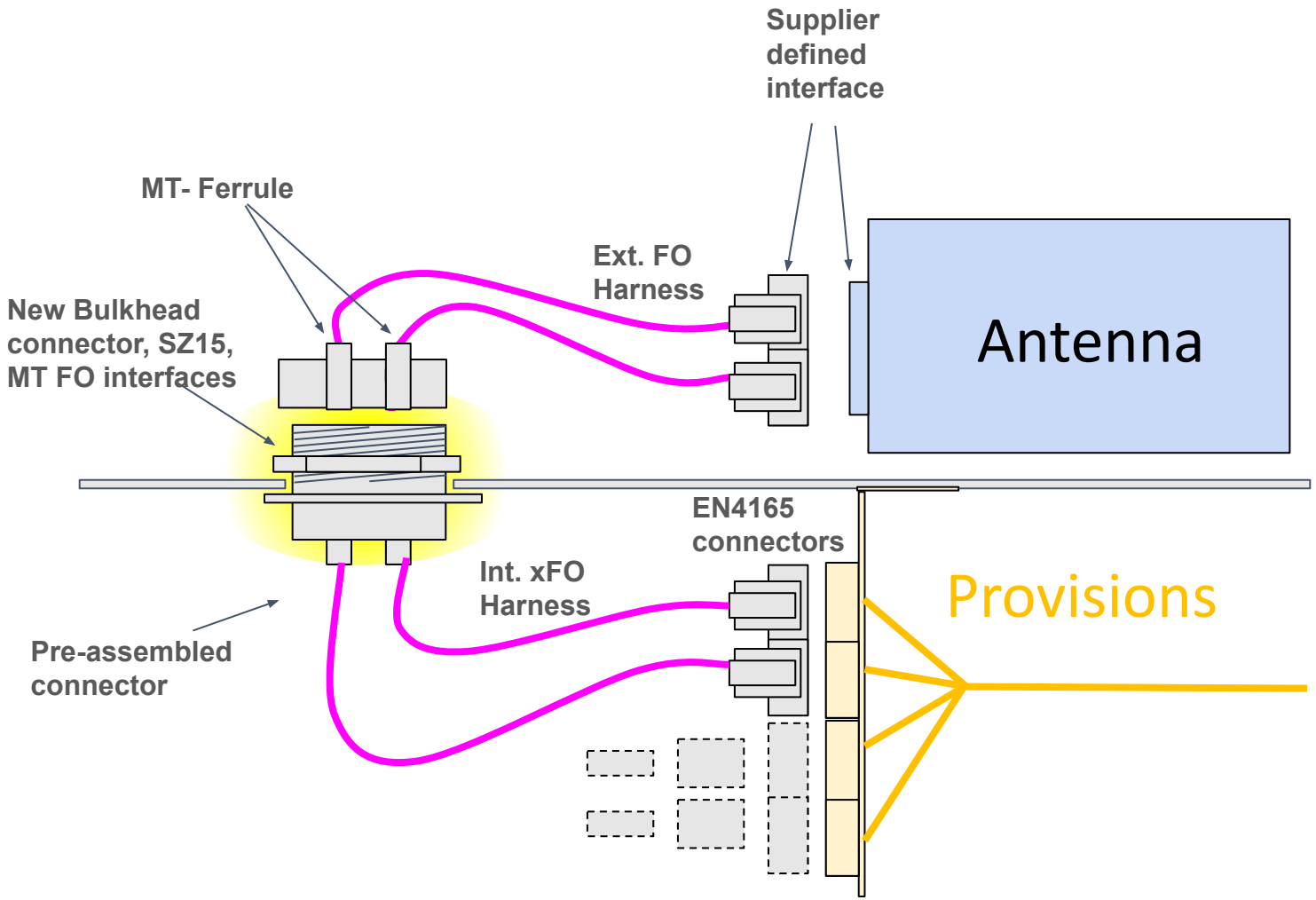
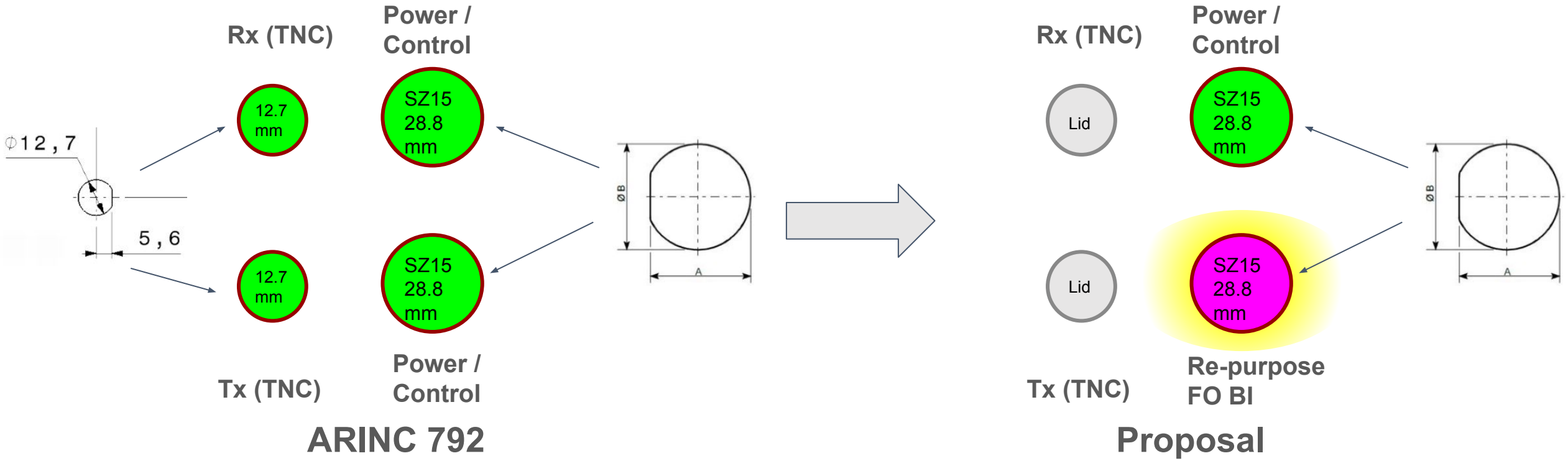


This is a variant of the above slide with a bulkhead connector.

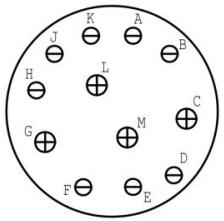
(see next slide)

Fuselage Cutout design - using the existing and abandoned Arinc 791 / 792 coax cutouts

3.) Re-purpose A792 SZ15 to 4xMT connector and reconsider the other connector (15-97) to accommodate the entire copper lines - or add something using the coax cutouts.



Contact	Function
A	Tx Manufacturer Specific 2 (STP2)
B	Tx Manufacturer Specific 3 (STP1)
C	Tx Power Supply 1 (UTP1)
D	Tx Manufacturer Specific 4 (STP1)
E	PIESD Ethernet EN2 Rx+ (STP3)
F	PIESD Ethernet EN2 Rx- (STP3)
G	Tx Power Supply 2 (UTP2)
H	PIESD Ethernet EN2 Tx- (STP4)
J	PIESD Ethernet EN2 Tx+ (STP4)
K	Tx Manufacturer Specific 1 (STP2)
L	Tx Power Return 2 (UTP2)
M	Tx Power Return 1 (UTP1)



All power AND control through a single SZ15 connector to open up the second one for FO BI. Cap the Rx / Tx coax interfaces
Layout 15-97 offers only 4x AWG#18 + 8x AWG#20, not enough for Arinc 792 power demand.

Fuselage Cutout design - using the existing and abandoned Arinc 791 / 792 coax cutouts

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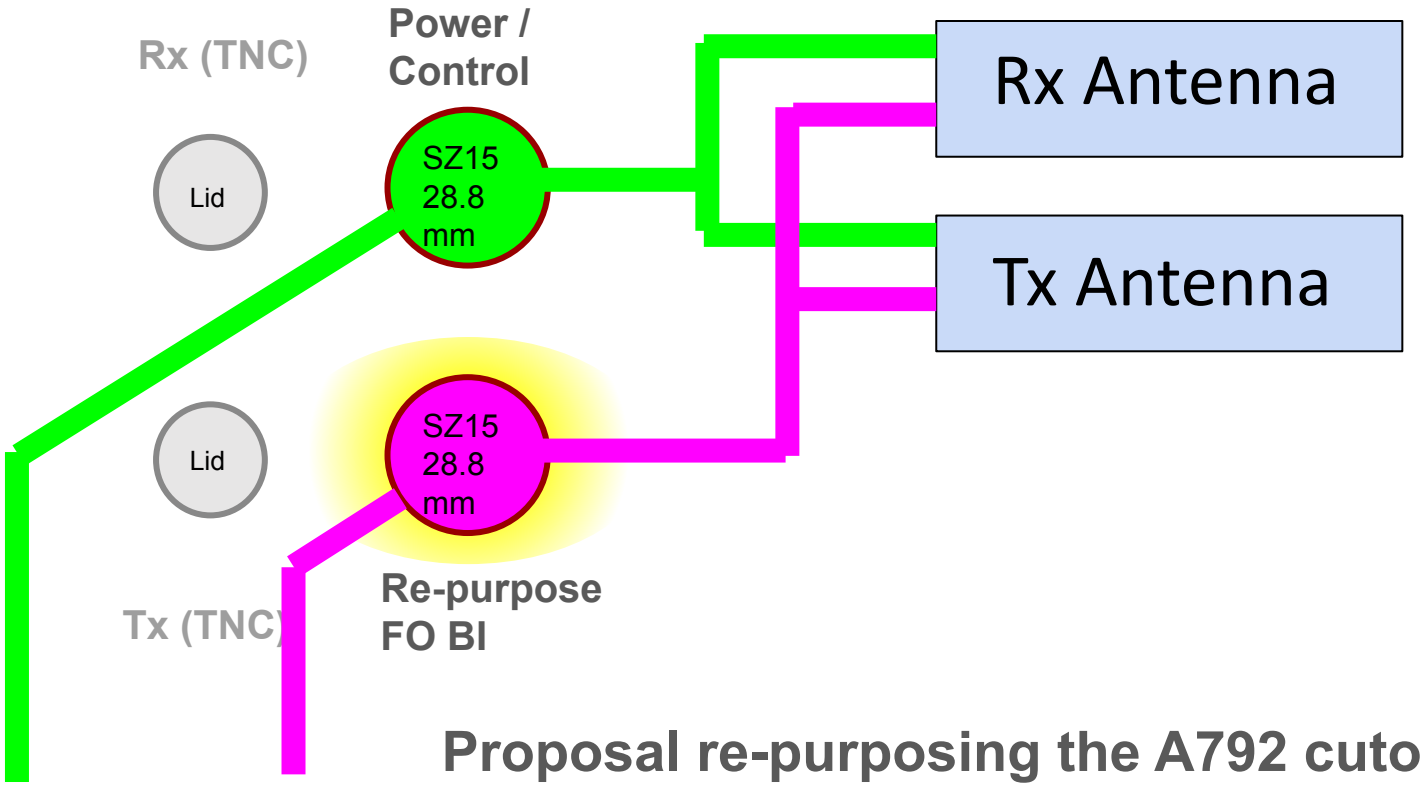


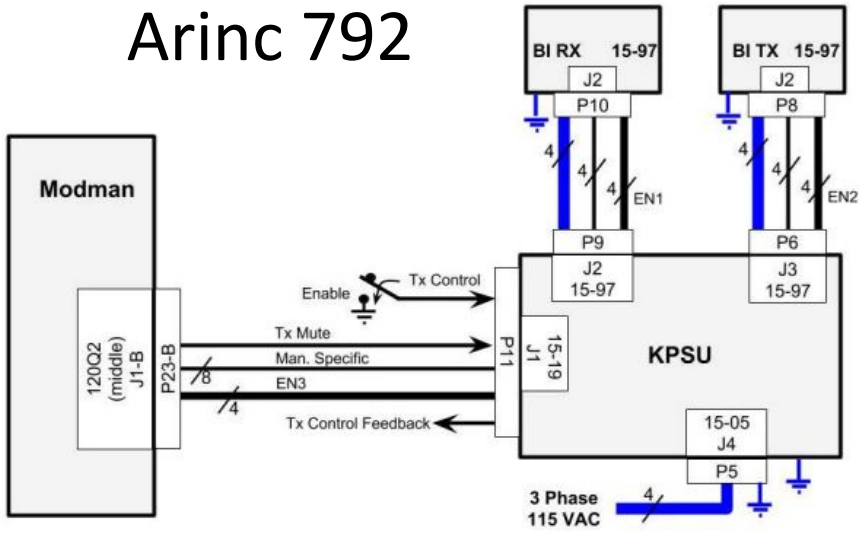
Proposal re-purposing the A792 cutouts

All power AND control through a single SZ15 connector to open up the second one for FO BI. Cap the Rx / Tx coax interfaces
Layout 15-97 offers only 4x AWG#18 + 8x AWG#20, not enough for Arinc 792 power demand.

Fuselage Cutout design - using the existing and abandoned Arinc 791 / 792 coax cutouts

4.) Minimize the KPSU manufacturer specific wires so that the A791 size cutouts could be used for combined power and discretes allowing the other cutout to be used for the 4xMT. Coax cutouts are both capped.

Arinc 792



Contact	Function
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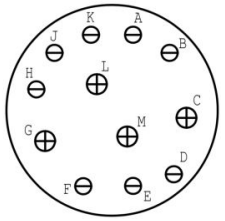
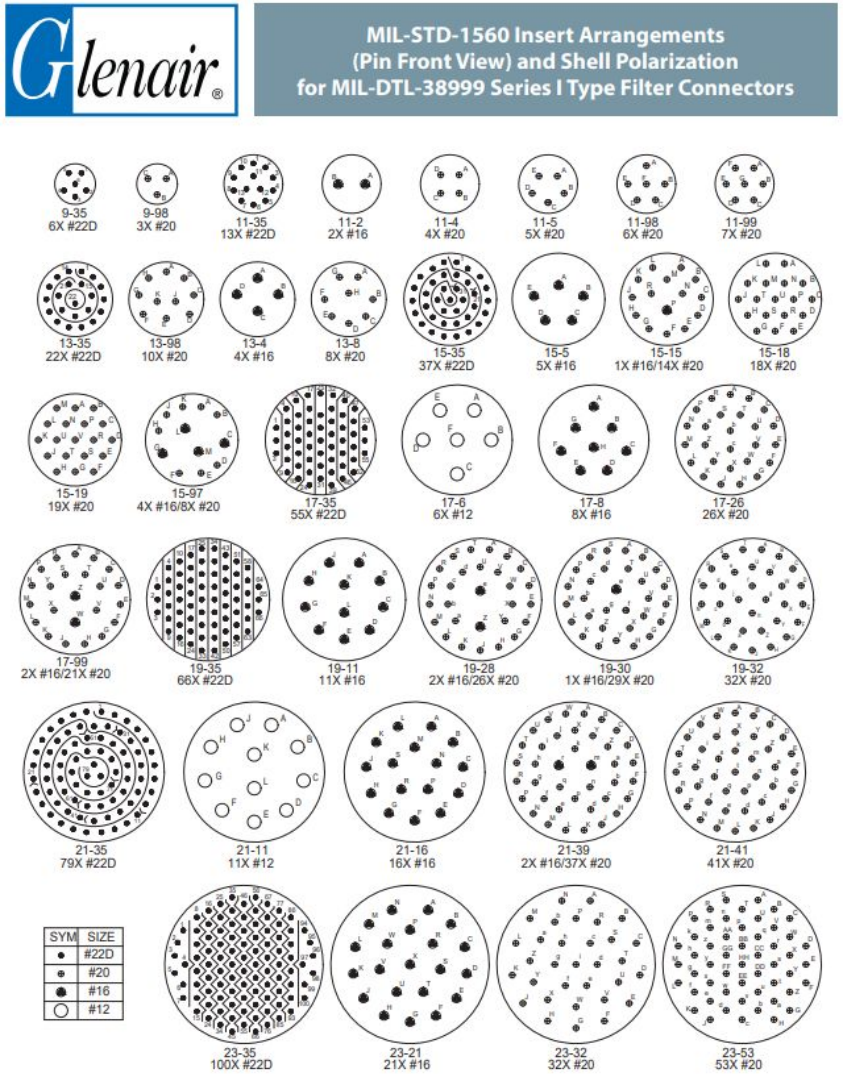
E	PIESD Ethernet EN2 Rx+ (STP3)
F	PIESD Ethernet EN2 Rx- (STP3)
G	Tx Power Supply 2 (UTP2)
H	PIESD Ethernet EN2 Tx- (STP4)
J	PIESD Ethernet EN2 Tx+ (STP4)
K	Tx Manufacturer Specific 1 (STP2)
L	Tx Power Return 2 (UTP2)
M	Tx Power Return 1 (UTP1)



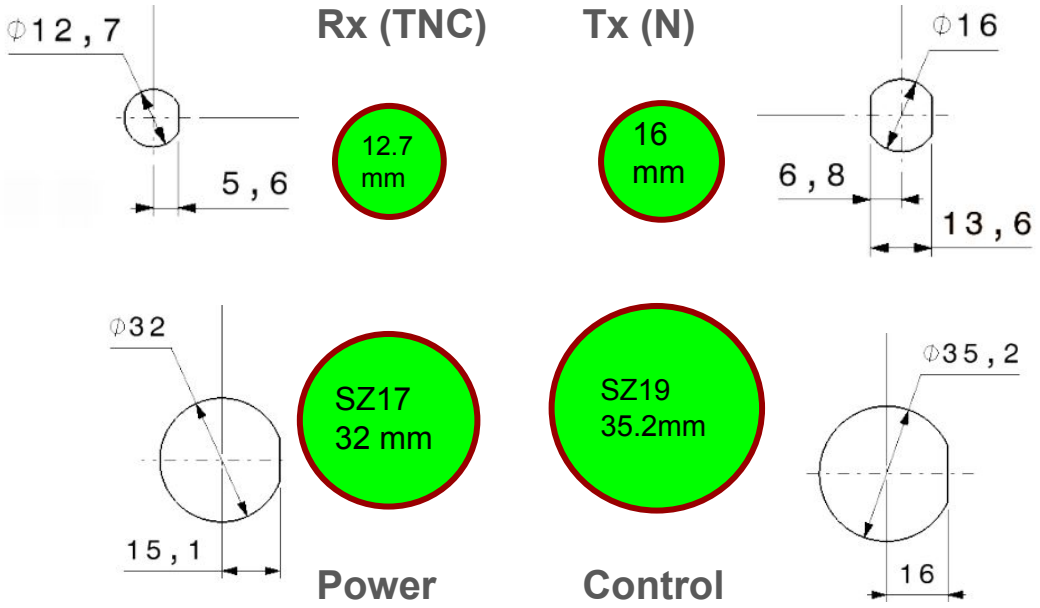
No mfg specific, total of
8x #16
8x #22

No obvious MIL STD 1560 layout



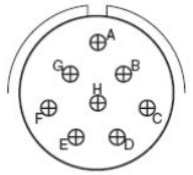
Fuselage Cutout design - using the existing and abandoned Arinc 791 / 792 coax cutouts

5.) Different than the D38999 insert patterns for the SZ17 and SZ19 - for example size 16 or 18.



ARINC 791

Connector	Mates with	Function	Interface Wiring	Insert	Contacts
P1	BI-Power-J1	Power	16 AWG	17-8	Pins
P2	BI-Control-J1	Control	22 AWG	19-35	Pins



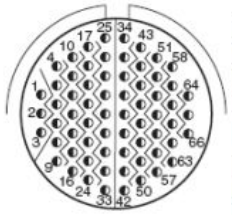
17-8

II

8

16

A	Power #1
B	Power Return #1
C	Chassis Ground #1
D	Reserved Power #3
E	Power #2
F	Power Return #2
G	SPARE
H	Reserved Power Return #3



19-35

M

66

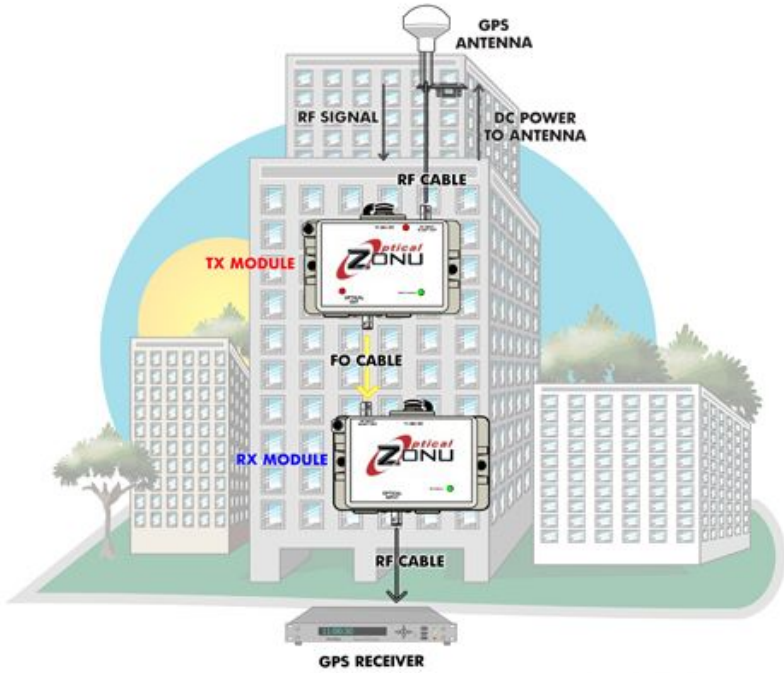
22D

1	UTT1-1	12	UTP2-1	23	UTP5-1	34	Tx Lo	45	STP1-1	56	UTT5-1
2	UTT4-1	13	UTP2-2	24	UTP5-2	35	Rx Lo	46	STP1-2	57	UTT5-2
3	UTT4-2	14	UTP1-2	25	Rx Hi	36	NC	47	STT3-1	58	STT1-3
4	UTT2-3	15	UTT3-2	26	Tx Hi	37	STP9-1	48	SPARE	59	STT2-1
5	UTT1-2	16	UTT3-3	27	NC	38	STP9-2	49	SPARE	60	STT2-2
6	UTT1-3	17	NC	28	UTP6-1	39	STP10-1	50	SPARE	61	UTT6-1
7	UTT4-3	18	NC	29	UTP6-2	40	STP10-2	51	STT1-1	62	UTT6-2
8	UTP1-1	19	UTP3-1	30	UTP7-1	41	STP11-1	52	STT1-2	63	UTT5-3
9	UTT3-1	20	UTP3-2	31	UTP7-2	42	STP11-2	53	STT2-3	64	STP12-1
10	UTT2-1	21	UTP4-1	32	STP8-1	43	NC	54	STT3-2	65	STP12-2
11	UTT2-2	22	UTP4-2	33	STP8-2	44	NC	55	STT3-3	66	UTT6-3

6x not connected

Need Series II proposal

COTS GPS over Fiber links

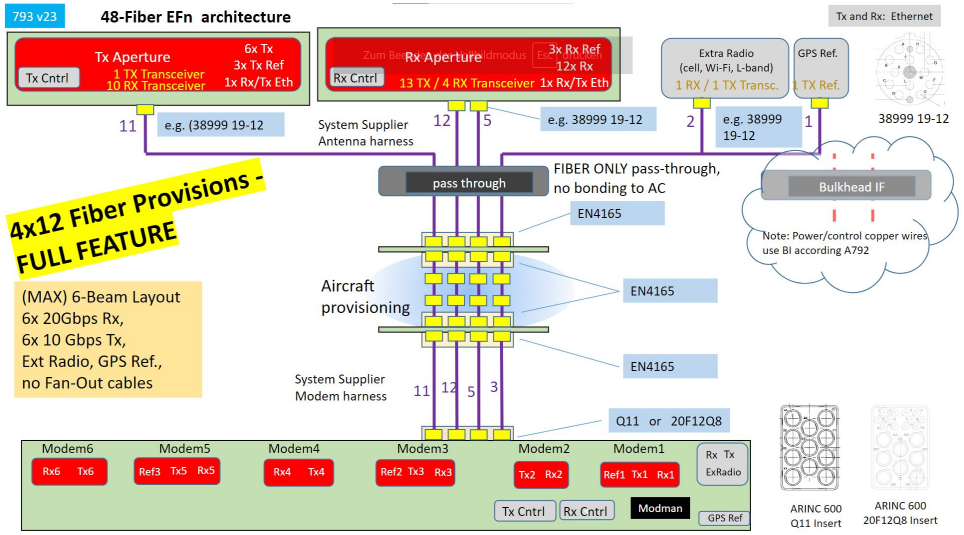


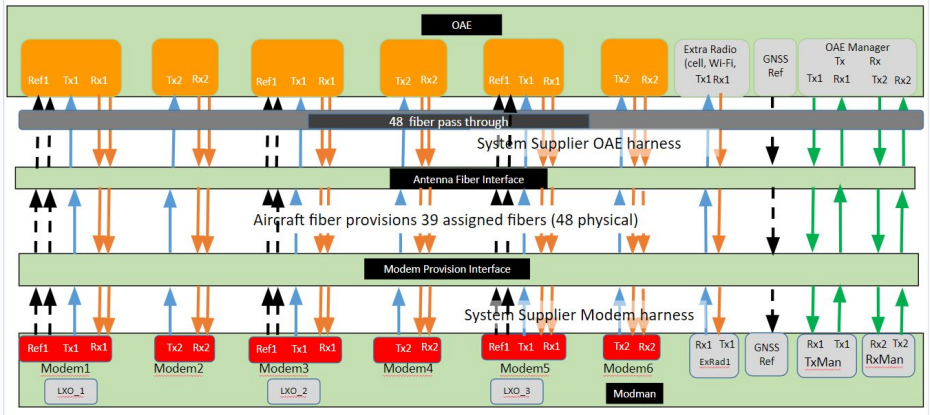
Shared in WS 11. Oct 23 Franklin WI

https://rfoptic.com/Downloads/low-frequency/RFoF-2.5GHz-for-GPS.pdf

https://www.opticalzonu.com/solutions/link/

Maintenance and Installation





Should the standard describe maintenance functions, e.g. is Link-Status, Signal-Quality or Transceiver-Temp commonly available?
What maintenance data from transceivers is useful?

If the control plane is established (separate control planes to Rx and Tx OAE) - an overall status for the fiber infrastructure can be obtained by BIST. Possibly excluding external radios.

System maintenance data should be available to support troubleshooting (e.g. identifying transceiver or fiber issues, identifying the affected fiber, logging intermittent faults)

Is it permitted to mitigate faults e.g. by re-allocating transceivers to recover max useful service?

To Do:

- Can the wiring to the Modman become provision? What A600 connector layout can we agree on? Pros and cons for SFE direct rack wiring.
- Is there a means to connect to the Modman from the front side?
- Reference signals - should we use 3x ref Modman->OAE Rx?
- Cutout for EN4165 modules, min space needed to feed modules through
- Can Linefit FAL install EN4165 - assembling the modules when building the OAE?
- Do we standardize the OAE EN4165 or leave it to the system supplier, pros and cons.
- Can we do RF control as a fiber discrete? Has to go from Modman to Tx-ESA (no longer KPSU or KRFU in the crown). Check DAL requirements.
- Is MT qualified for outside fuselage use?
- Maintenance and information from transceivers