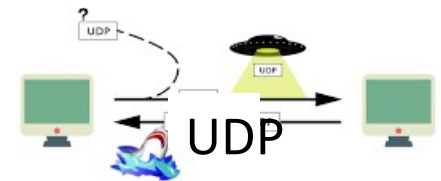
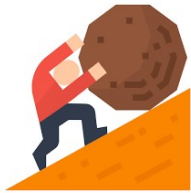


# AGATA Project

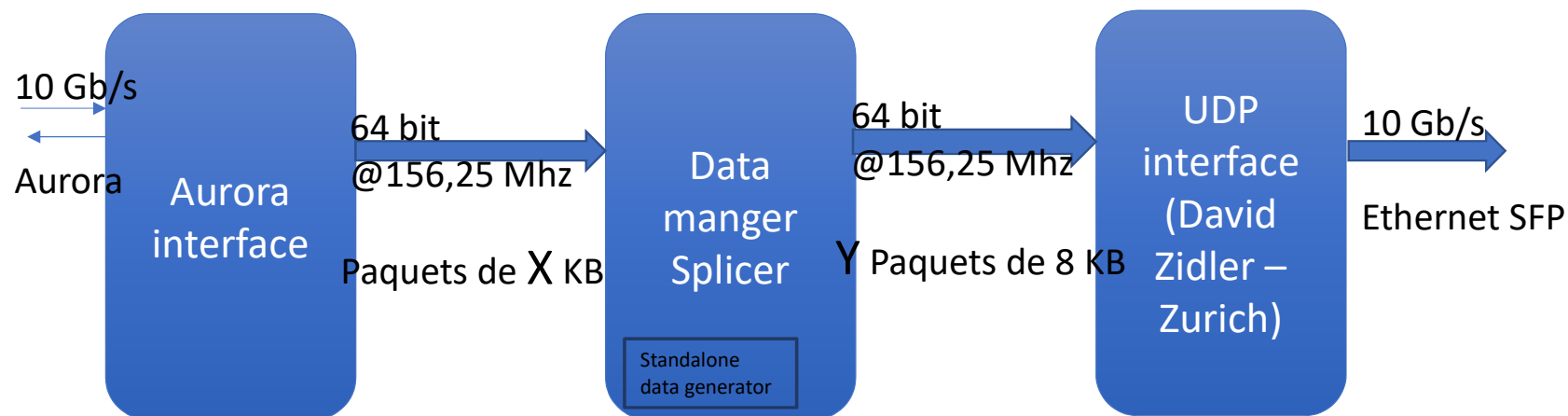
**STARE (Serial Transfer And Readout over Ethernet)**

# Firmware

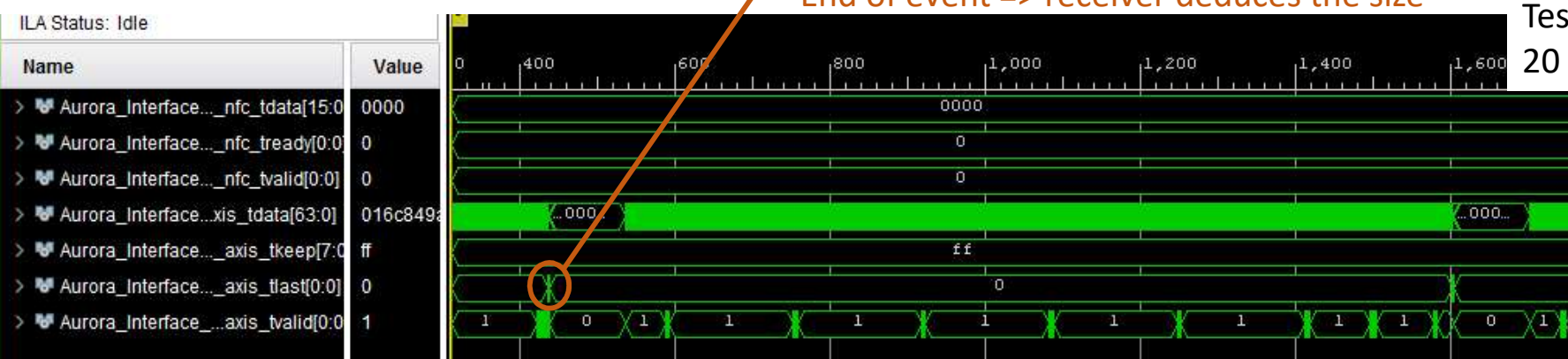
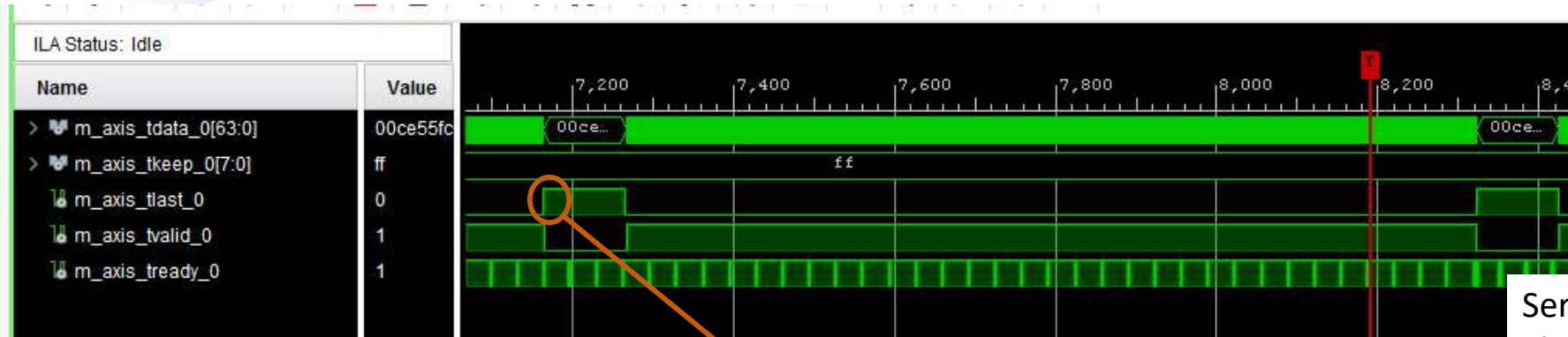
- R&D phase started with Google search of 10 Gbps TCPIP and found D. Sidler PhD student from Zurich. His subject helped us to have the UDP interface IP developpement.
- Andrea confirmed that 10 Gbps TCPIP is not feasible he showed the way to UDP.
- Melissa Nicolas and Marie Laure built the basement level of Powerup sequence, Ipbus and STARE schematics.
- Gustav showed the way to 10 Gbps Proof of Concept. Integrated the firmware baselin design on evaluation board, and from there STARE was born
- The electronic group then cooked all the above plus their own skills and designed the following board:



Melissa, Nicolas, (ESME)  
**Gustav** (Danemark)  
Marie Laure (ECE)  
**David Sidler** (Suisse)  
Andrea Triossi (visitor)



- \_ Slow control
- \_ EEPROM
- \_ Clock manager
- \_ Spare LVDS link

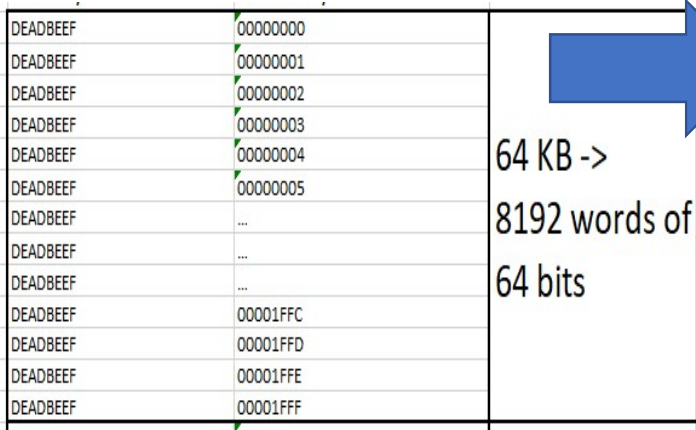
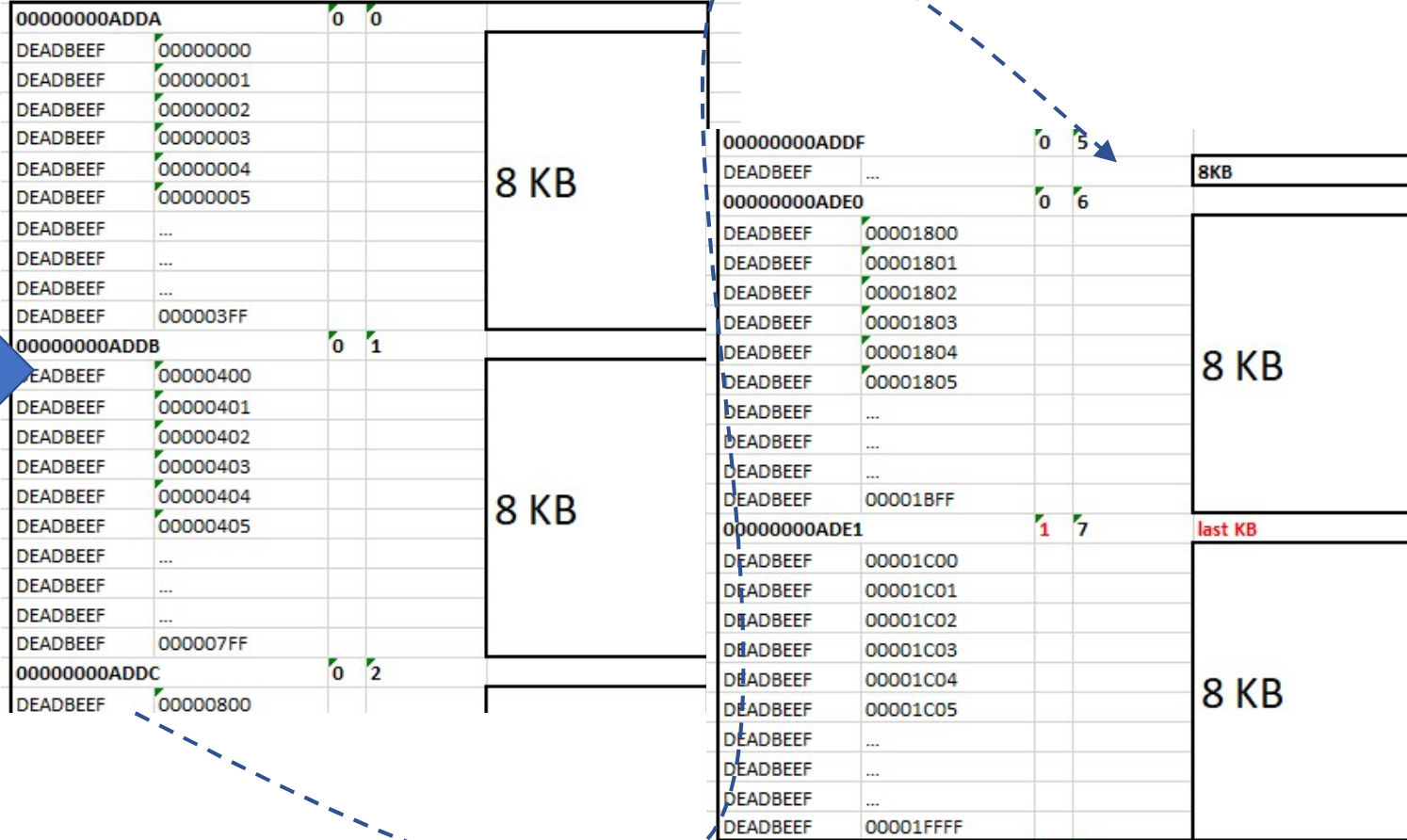


End of event => receiver deduces the size

Serial link  
Tlast signal = End of event  
Tested on 4 lines @10Gb/s  
20 hours => No error

Splice X KB of one event on paquets of 8  
Add header  
Sent paquets to UDP transmitter IP

UDP\_packet\_id (48 bits) + last\_packet of event(1bit) + packet\_id(15 bits)



Reuse of D.Zidler's code

Modification of frame size

Managed by slowcontrol (via EEPROM) :

- \_ MAC @ of each SFP
- \_ IP @ of each SFP (no DHCP)
- \_ other network stuff (IP server, port, gateway, etc)

64 bit  
@156,25 Mhz

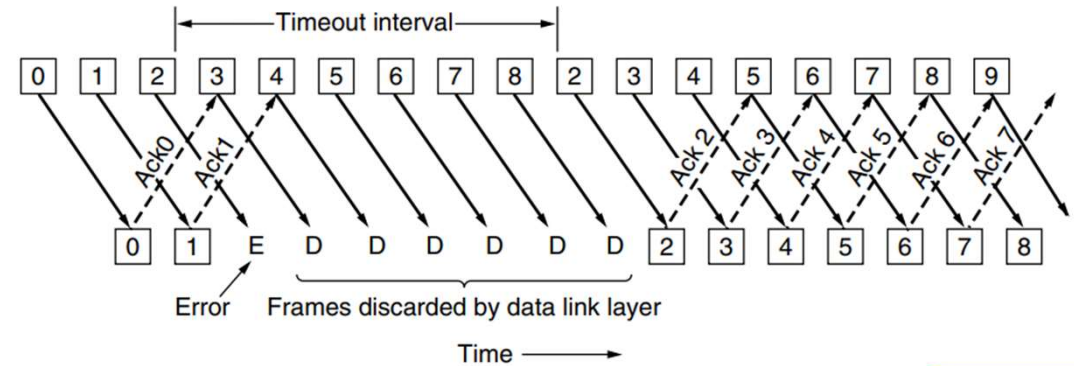
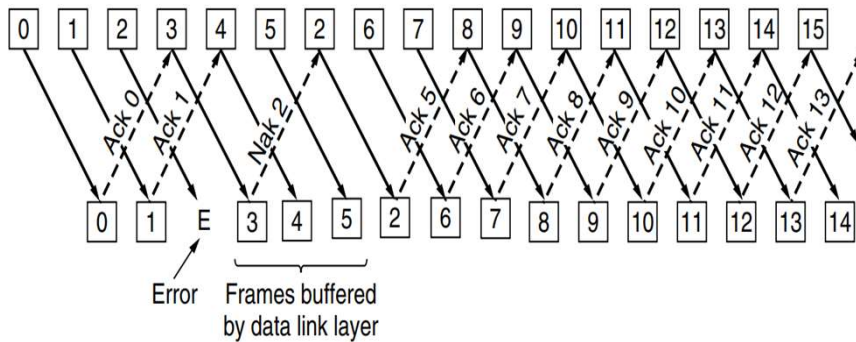
UDP  
interface  
(David  
Zidler –  
Zurich)

10 Gb/s

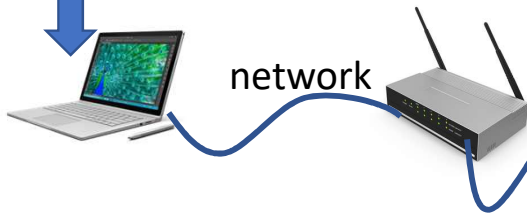
Ethernet SFP

X Paquets de 8 KB

Later improvement : RUDP : resent lost packets



\_XML module  
 description  
 \_Python scripts  
 \_uHAL



network

STARE

Ipbus interface  
 1G Ethernet

Ipbus fabric

IP Bus Protocol  
 Adress  
 Data

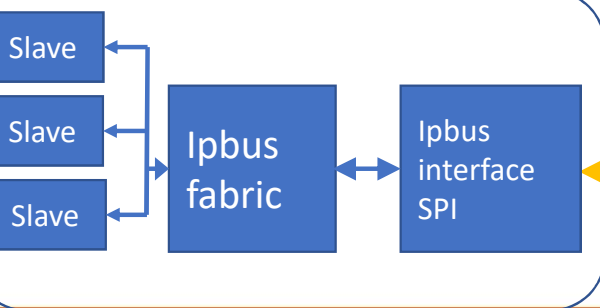
Slave  
 EEPROM

Slave  
 Splicer

Slave  
 PACE\_SPI\_bridge

SPI protocol

PACE



## Transfert @10Gb/s

=> 5 hours test : packets loss < 1.10<sup>-6</sup> ; no bit error

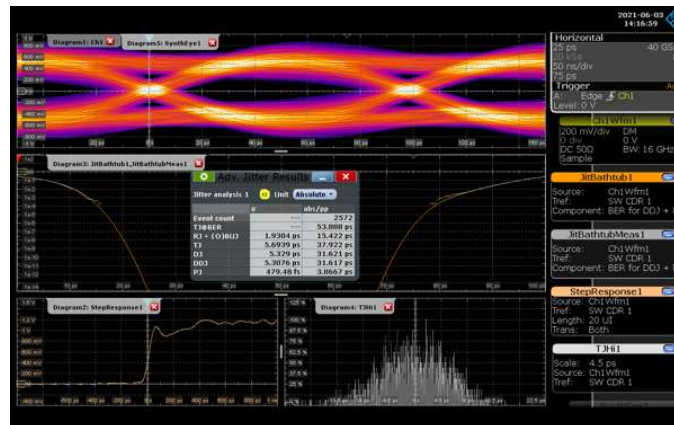
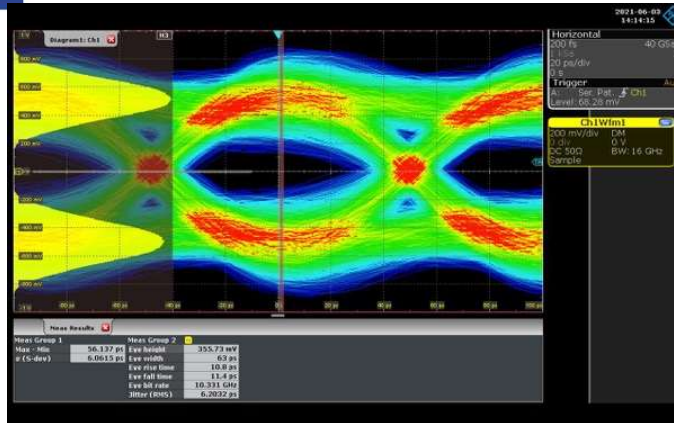
```

Receive 23606000000 Paquets for total size 1032000000 octets transfert time =879991 usec rate 1172.739267Mo/s lost 8329
Receive 23612000000 Paquets for total size 1032000000 octets transfert time =879990 usec rate 1172.740599Mo/s lost 8329
Receive 23618000000 Paquets for total size 1032000000 octets transfert time =879997 usec rate 1172.731271Mo/s lost 8329
Receive 23624000000 Paquets for total size 1032000000 octets transfert time =879986 usec rate 1172.745930Mo/s lost 8329
Receive 23630000000 Paquets for total size 1032000000 octets transfert time =880022 usec rate 1172.697955Mo/s lost 8329
Receive 23636000000 Paquets for total size 1032000000 octets transfert time =879997 usec rate 1172.757924Mo/s lost 8329
Receive 23642000000 Paquets for total size 1032000000 octets transfert time =879990 usec rate 1172.740599Mo/s lost 8329
Receive 23648000000 Paquets for total size 1032000000 octets transfert time =879992 usec rate 1172.737934Mo/s lost 8329
Receive 23653000000 Paquets for total size 1032000000 octets transfert time =880001 usec rate 1172.725940Mo/s lost 8329
1- Lost frame : curframeID 30d4 EventNumber 6 prevFrame 30b7 prevEventNumber 4 SizeEvent 8 => 226 lost
Receive 23655000000 Paquets for total size 1032000000 octets transfert time =879991 usec rate 1172.739267Mo/s lost 8555
2- Lost frame in last event pkt: curframeID 86a3 EventNumber 7 prevFrame 8686 prevEventNumber 5 SizeEvent 8 ==> 225 lost
Receive 23661000000 Paquets for total size 1032000000 octets transfert time =879965 usec rate 1172.773917Mo/s lost 8780
1- Lost frame : curframeID 5d02 EventNumber 0 prevFrame 5ce4 prevEventNumber 7 SizeEvent 8 => 225 lost
Receive 23667000000 Paquets for total size 1032000000 octets transfert time =879992 usec rate 1172.737934Mo/s lost 9005
1- Lost frame : curframeID 3346 EventNumber 6 prevFrame 3329 prevEventNumber 7 SizeEvent 8 => 223 lost
Receive 23674000000 Paquets for total size 1032000000 octets transfert time =880009 usec rate 1172.715279Mo/s lost 9228
Receive 23675000000 Paquets for total size 1032000000 octets transfert time =879978 usec rate 1172.756592Mo/s lost 9228
2- Lost frame in last event pkt: curframeID 5f65 EventNumber 7 prevFrame 5f48 prevEventNumber 5 SizeEvent 8 ==> 225 lost
  
```

	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
1	Serial number																				
2	producer (DIGITIZER/PACE/STARE)	DIGITIZER		PACE		STARE		Server		test time (hours)	rate (Gb/s)	Size event (kB)	paquet size UDP(kB)	paquets received	paquets lost		corrupted data		Server status	Observations	
3		SN	Slowcontrol version	SN	Firmware	SN	Firmware	SFP	name	Soft version					value	%	value	%			
5	PACE					116	V19	0			14,98	5 Gb/s	8 kB	8 kB	4418000000	0	0	7	2,41764E-14		
6	STARE					118	V19	0	STARE-01		13,17	6 Gb/s	8 kB	8 kB	4660000000	0	0	0	0		
7	PACE					116	V19	0			83,58	5 Gb/s	8 kB	8 kB	24649000000	3751	1,522E-07	17	8,41898E-14		
8	PACE			V7		118	V20.0	0	STARE-01		16,14	5 Gb/s	8 kB	8 kB	4760000000	0	0	3153	8,08588E-11		voir erreur screens
9	PACE			V7		118	V20.1	0	STARE-01		0,71	5 Gb/s	8 kB	8 kB	2100000000	0	0	0	0		Acquisition assez c
10	PACE			V7		118	V20.1	0	STARE-01		15,47	8 Gb/s	8 kB	8 kB	7300000000	0	0	0	0		J'ai été obligé de re
11	VC709					112	V20.1	0	STARE-01		21,67	5 Gb/s	8 kB	8 kB	6390000000	0	0	0	0		
12	STARE					113	V20.1	0	C6400-10		19,02	5 Gb/s	8 kB	8 kB	5610000000	72	1,283E-08	8	1,74075E-13		reboot, oublie de l
13	STARE					113	V20.1	1	C6400-11		19,02	5 Gb/s	8 kB	8 kB	5610000000	202	3,601E-08	8	1,74075E-13		reboot, oublie de l
14	STARE					113	V20.1	2	C6400-12		19,02	5 Gb/s	8 kB	8 kB	5610000000	NA	#VALEUR!	254475	5,53723E-09		reboot, oublie de l



# Eye diagram



**Rohde & Schwarz**  
106 071 abonnés  
1 mois

Belle collaboration entre le département électronique du laboratoire IJCLab et Rohde&Schwarz sur le projet AGATA.

Qu'est-ce que c'est ? C'est un projet Européen pour construire, maintenir et exploiter un nouveau type de multi détecteurs de photons basé sur le concept de tracking gamma.

Quelle était le besoin ? Les équipes du IJCLab devaient valider des signaux rapides à 10GB/s sur leurs cartes « Stare ».

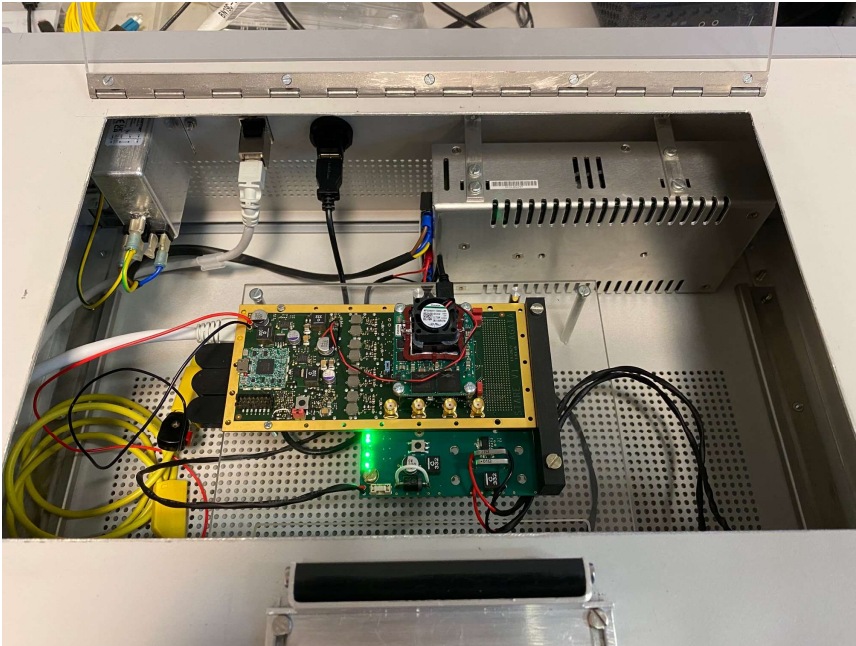
Quelle a été notre solution ? L'équipe a pu utiliser nos sondes différentielles modulaires pour souder plus facilement sur leurs points de test ; le trigger hardware « clock data recovery » à 16GB/s pour réaliser des diagrammes de l'œil en temps réel ; la décomposition du Jitter basée sur le « Step Response » pour faciliter la caractérisation et validation de leur transmission à 10GB/s avec un très faible Jitter ; l'oscilloscope R&S®RTP164 et la sonde différentielle modulaire R&S®RT-ZM160 pour leur très bonne intégrité de signal afin de valider la qualité des cartes.

Satisfaction partagée avec l'équipe de IJCLab pour l'implication dans ces belles expérimentations qui font avancer la science !

Plus d'infos :

- AGATA : <http://agata.in2p3.fr>
- La carte Stare : <https://bit.ly/3kFXXIU>
- Oscilloscope R&S®RTP : <https://bit.ly/3elcB86>

#makeideasreal #engineering



- Simple procedure :
  - program FPGA
  - Run script test
  - Enter serial number
- Managed by IP\_bus
- Test :
  - Clocks generators
  - EEPROM
  - 10 Gb links (sfp and FMC)
  - Low rate FMC links (100 MHz)
- Write EEPROM
- Log file
- TEST OK => Borad is ready to use