THE TECHNOLOGY TRANSFER NETWORK FOR PARTICLE PHYSICS: STATUS ON MPGD PILOT OFFER

RD51 Collaboration Meeting, Bari, 7 October 2010

Hartmut Hillemanns, CERN

Council approved the creation of the TT Network in March 2008

Purpose

- Establish a genuine partnership / collaboration amongst institutes active in Particle Physics in MS with a view to enhancing Technology Transfer activities
- Develop the image of the PP community as a source of knowledge that benefits society

Programme of work:

- 3-year project to develop tools and methods in order to support a permanent operation

Financing

- During the execution of the project, the TT Network members will cover their own costs

*TT Network members on September 2010, CPAN/SPAIN officially applied for full membership, KFKI, Hungary observer status

Institution*	Country
CEA/IRFU	France
CERN	
CHALMERS	Sweden
Copenhagen University	Denmark
CNRS/IN2P3	France
DESY	Germany
EPFL	Switzerland
GSI	Germany
INFN	Italy
JSI Jožef Stefan Institute	Slovenia
PSI Paul Scherrer Institute	Switzerland
National Technical University of Athens	Greece
LIP	Portugal
STFC, Scientific & Technology Facilities Council	UK
University of Sofia	Bulgaria

Results and Future Work Plans

Intellectual Property charter

- Intellectual Property policy, Knowledge and Technology Transfer policy, Collaborative and Contract research policy (while remaining compatible with open science)

Prototype version of the TT Network website for internal use and evaluation

- Make PP technologies & expertise more visible to industry
- PP Offer: Standard presentation of technologies, service capabilities & R&D opportunities
- Successful applications in research disciplines other than PP and in industry

Build Network corporate identity

- PP brand, concerted communication strategy, community building tools (web, training, mobility, ..)
- Development of Push/Pull mechanisms (incl. technology pooling) and Collaborative scouting
- Further exploratory actions for other possible pilots such as Si Strips sensors and Si photomultipliers

Set-up a programme of work to address socio-economic impacts of PP

Why a MPGD-Pilot Proposal ?

First pilot case: Micro Pattern Gaseous Detectors

- Large collaborative R&D efforts from PP community (RD-51, more than 70 institutions involved, not only PP institutes, important interest from industry);
  - Good case to define a collaborative scouting model
- Evidence for patent pooling (GEM, micromegas, front-end readout, software, etc.)
  - Very good case for the development of a collaborative push and pull model
  - First data to test community building tools; specify value and meaning of a PP brand
  - Test of concerted communication strategy
- Important and very visible case currently addressed by members of the TT Network individually with a limited collaboration at the TTO level
- TT Network member institutes participating in RD-51
  - CEA, CERN, CNRS, DESY, INFN, GSI, LIP
  - NTU, KFKI (TT Network Observer)

What are the benefits for RD51 ?

"The main objective of the R&D program is to advance technological development and application of Micro Pattern Gas Detectors." http://rd51-public.web.cern.ch/RD51%2DPublic/

- Increased visibility and awareness of RD51 technologies and expertise through concerted communication and building a MPGD community brand
- Image of an organised community:
  - More attractive R&D offer to industry in partnership
  - Concerted offer more attractive for industry to manufacture
- Promote and strengthen the image of RD51 as reference source for MPGD technologies
- Possibility to offer customer specific solution packages, expertise and services rather than raw technology components
- Simplified access to RD51 technologies, patent pool and expertise
- One SPOC (single point of contact) for facilitated identification of and access to RD51 technology offer

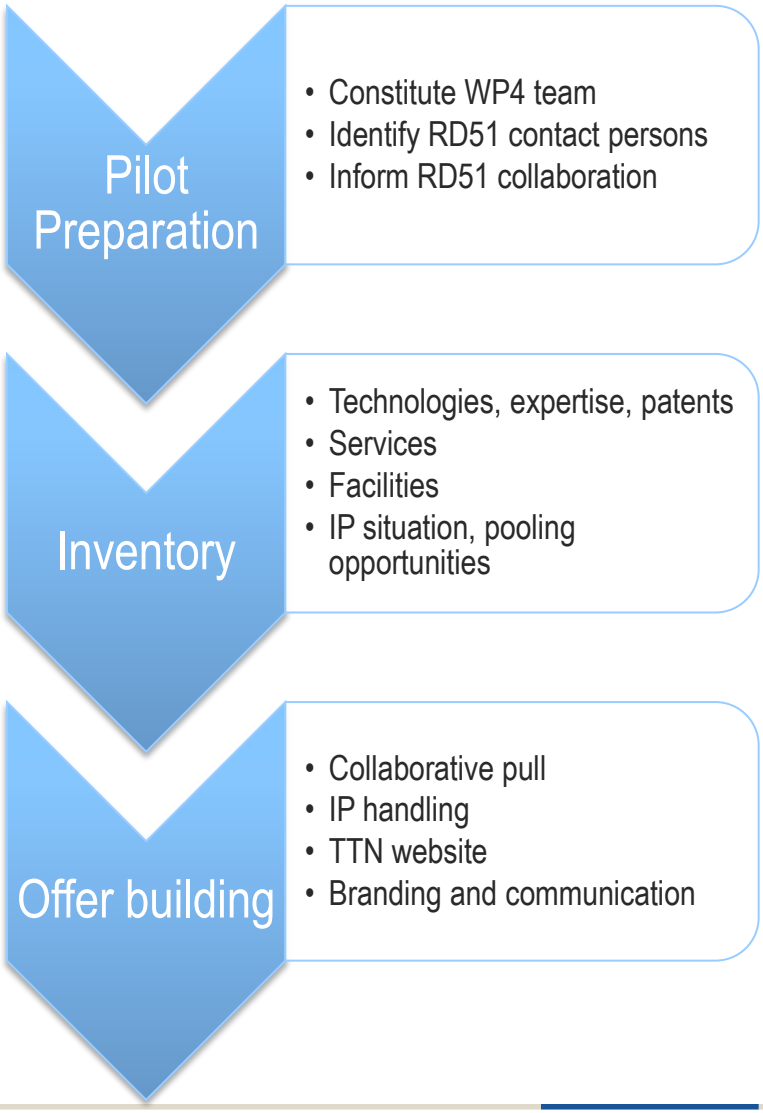
Achievements and To Do's

Achievements:

- ✓WP4 core team constituted
- ✓RD51 collaboration informed
- ✓TTN member contact persons for RD51 identified
- ✓MPGD Inventory

Ongoing :

- MPGD Inventory Consolidation
- MPGD Offer building
- Offer presentation



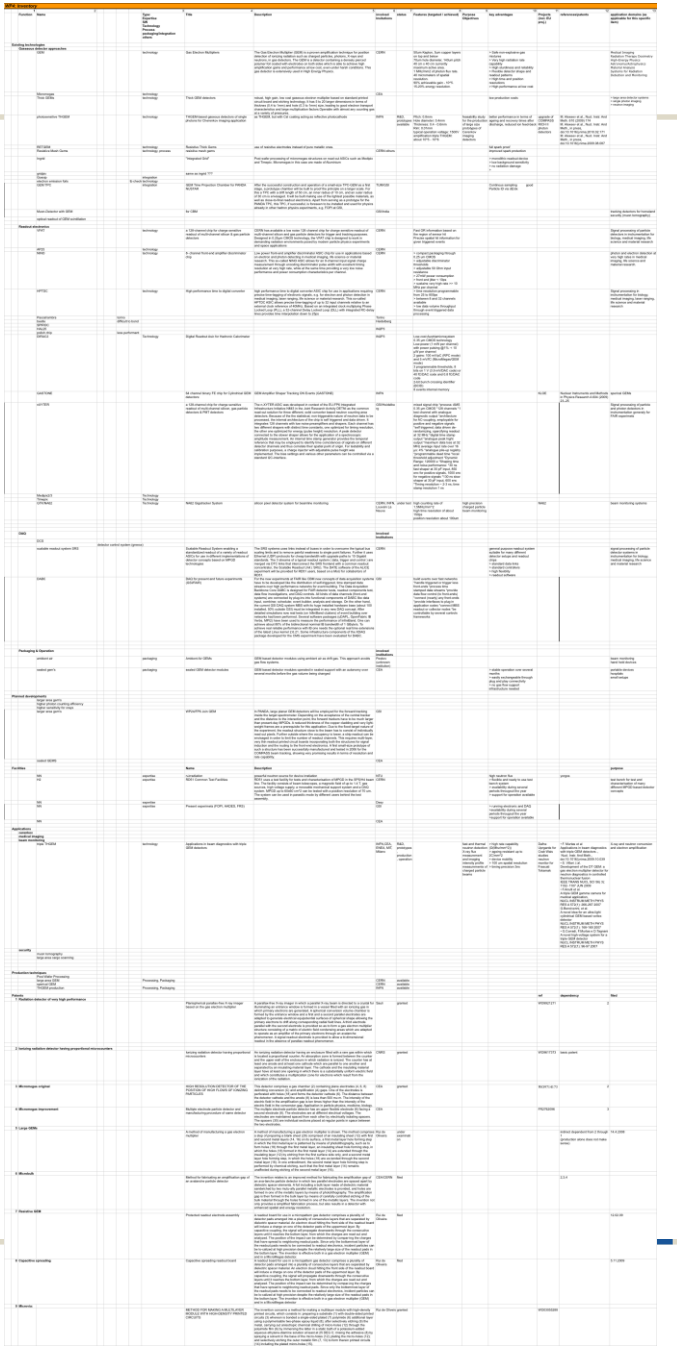
MPGD Inventory

Collect information on MPGD related technology:

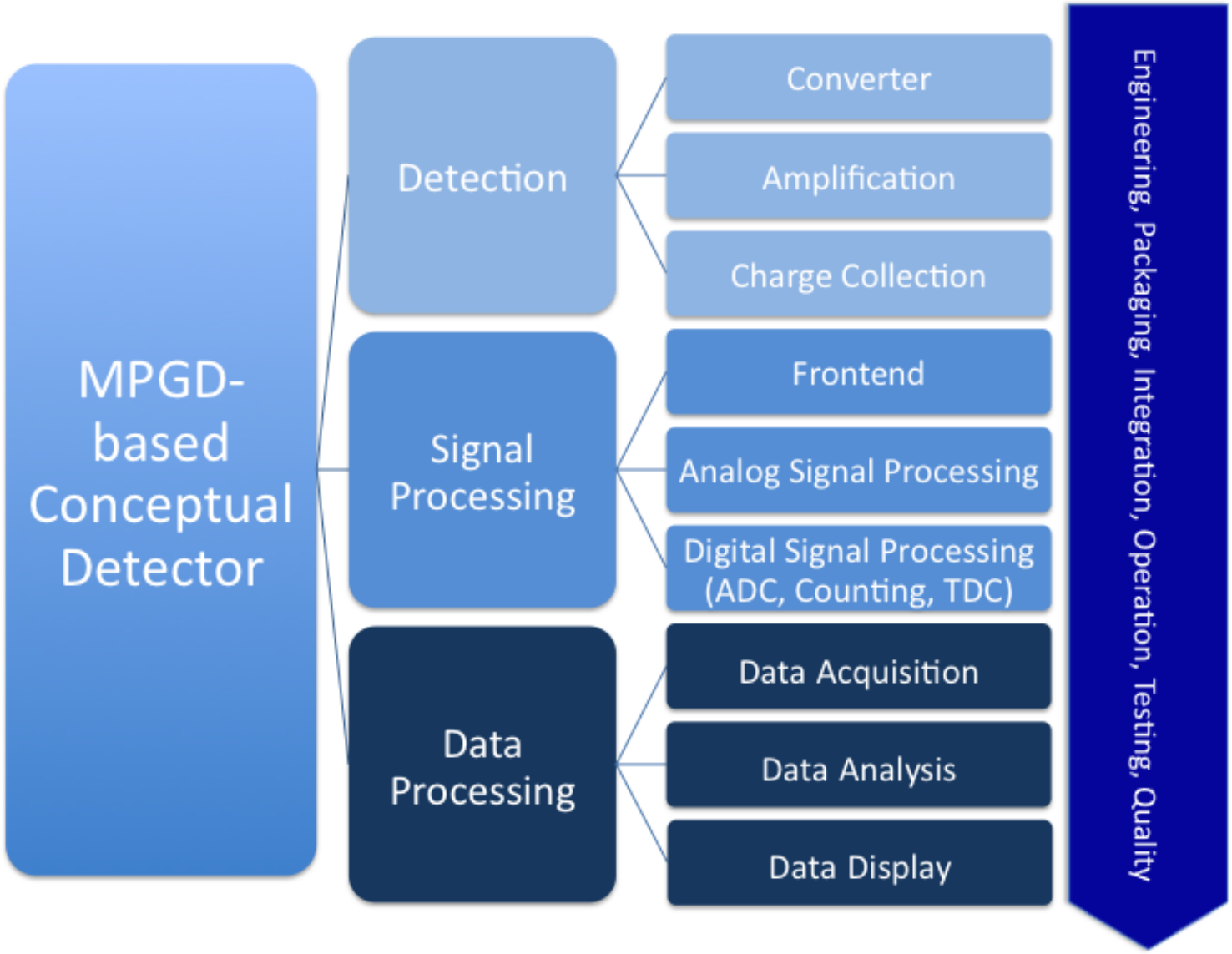
- GEM, Micromegas, THGEM, Ingrid, etc.
- Medipix, VFAT, NINO, HPTDC, etc.
- SRS, etc.
- Production of GEM, THGEM, etc.
- Applications
- Facilities
- Patents

Classify along a conceptual detector scheme

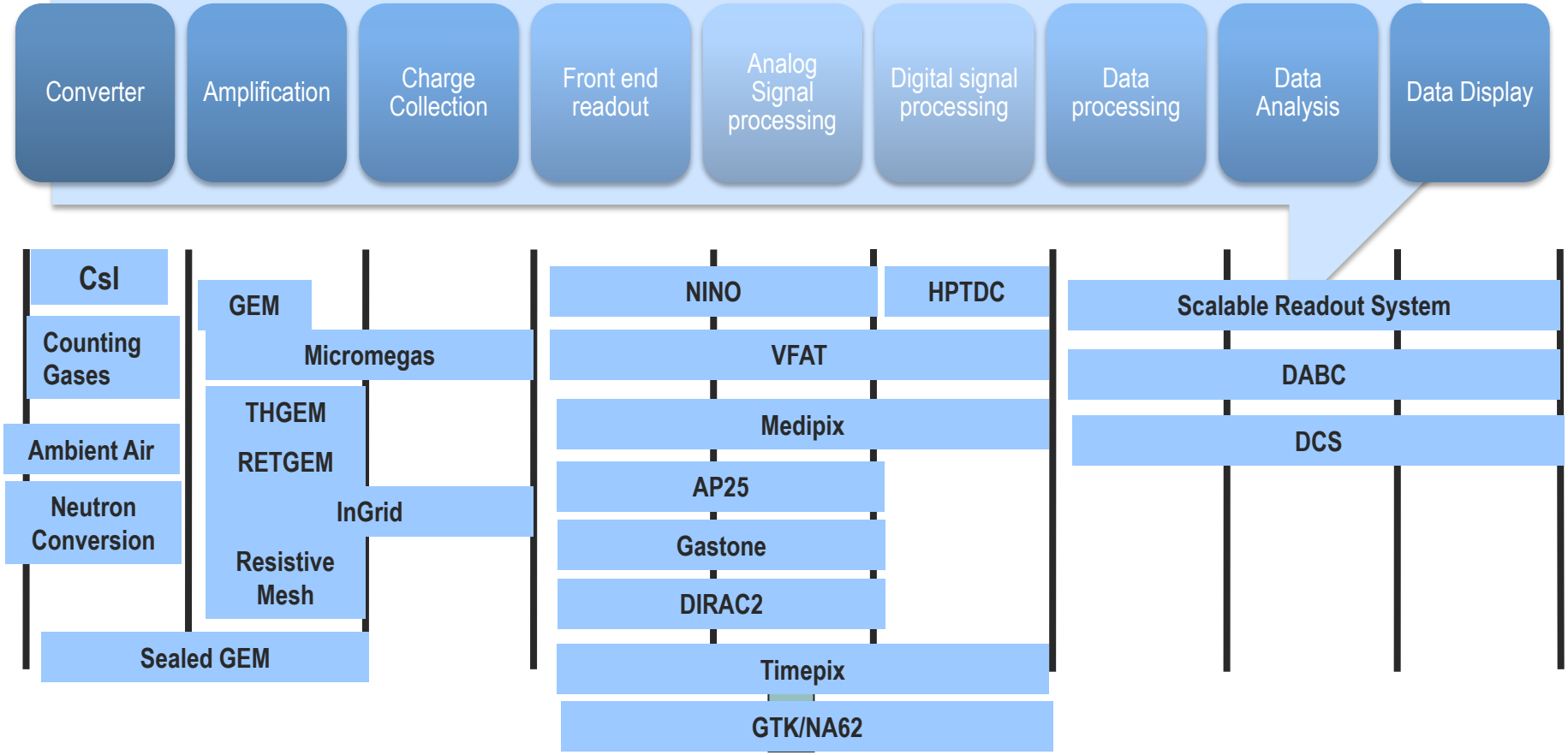
Make the inventory available through RD51 web (proposal)



MPGD Conceptual Detector



Classification of MPGD solution elements



Expertise (Engineering, Production, Packaging, Simulation, Integration, Operation, Testing, Quality)

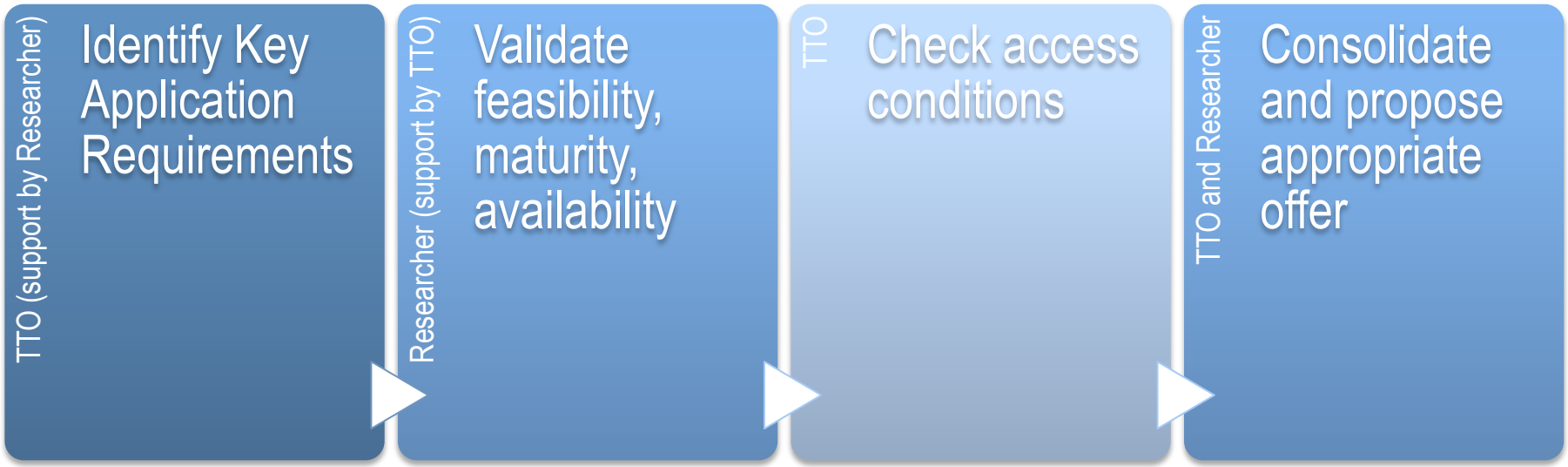
Key Requirements from Specific Applications (1/2)

Domains	Application	Converter	Amplification	charge collection	Frontend Readout	Analog Signal Processing	Digital Signal Processing	Data Acquisition	Data Analysis	Data Display	General Requirements
HEP research projects											
	Tracker systems										
	cerenkov detectors										
life science											
	Fluorescence Measurement										
health sector											
	digital radiography and CT	high detection efficiency (close to 100% to reduce patient dose rate)@140keV position resolution <0.5mm	>10^4 -10^5	< few ns	very fast signal shaping	fast discrimination	counting logic				dense conversion materials highly segmented photodetectors event rate: 100MHz/mm^2 (!) 1000 projections / s 10^5 readout channels
	PET imaging	high detection efficiency >90% position resolution <5mm no parallax error	>10^4 -10^5	< few ns	fast signal shaping: <10ns	signal discrimination with timing resolution <100ps	counting and/or time stamping (<100ps)	high bandwidth (some 10^5 readout channels !)	device specific	device specific	dense conversion materials highly segmented photodetectors 150 -200 detector modules per scanner 25cm^2 per module 100kHz typical single rate per module 1MHz maximum single rate per module 1MHz typical coincidence rate per scanner 4MHz typical coincidence rate per scanner
	beam monitoring	low material budget									
homeland security											
	Muon Tomography										
	combined gamma/neutron scanning in cargo scanners	high detection efficiency for high energy gammas (1MeV) and fast neutrons (14MeV)		pixel size: O(mm^2)			counting logic				short scanning time (1-2 minutes)
safety & environment											
	material inspection										
material science											
	X-ray Crystallography										
Neutron detection											
		detection efficiency 50% to 100% for thermal neutrons size: 0.1m^2 to 10m^2		Pixel size: 1mm^2 to 1cm^2	rate cap. >>100kHz	time resolution < 1us					Robustness Reliability Large scale manufacturability
cultural heritage											
Energy											
	neutron flux measurements										
	burning plasma diagnostics										

Key Requirements from Specific Applications (2/2)

Application	Converter	Amplifi-cation	charge collection	Frontend Readout	Analog Signal Processing	Digital Signal Proces-sing	Data Acqui-sition	Data Analysis	Data Display	General Requirements
Homeland security	High tracking efficiency, large area systems,	10^4 – 10^5, multiple GEM layers	Position resolution: <100µm, pixel or strip	Low rate (1 muon per cm^2 per min), standard readout systems	Simple fast OR trigger		Standard	Standard		Very high number of channel (10^6) Low particle flux rate Short scan time
N-detection	detection efficiency 50% to 100% for thermal neutrons size: 0.1m^2 to 10m^2		Pixel size: 1mm^2 to 1cm^2	rate cap. >>100kHz	time resolution < 1us					Robustness Reliability Large scale manufacturability

From Technology Bricks to Solution Packages: How to Proceed ?



Role of TTO:

- MPGD inventory maintenance, market analysis, IP situation, MPGD technology offer

Role of Researcher:

- Validation of MPGD technology inventory, validation of key requirements, consultancy for technology offer

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http://rd51-public.web.cern.ch/RD51%2DPublic/

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How to build a technology offer in practice: Ex.1, n/γ imaging

Case identification: combined neutron / gamma imaging for fast air cargo mass inspection in homeland security

Market needs and key user requirements for effective mass screening of air cargo containers:

- High resolution images over large areas (few m^2)
- Accurate scanning without unpacking
- Less than 2 min scan time per container
- Radiation safety compliance
- Low cost, reliable, easy to maintain

Method: Absorption measurement of 14 MeV neutrons and ^{60}Co γ's (1.17 and 1.33 MeV)

$$R = \frac{\mu_n}{\mu_g} = \frac{\ln(I_n / I_n^0)}{\ln(I_g / I_g^0)}$$

Each material has a specific R

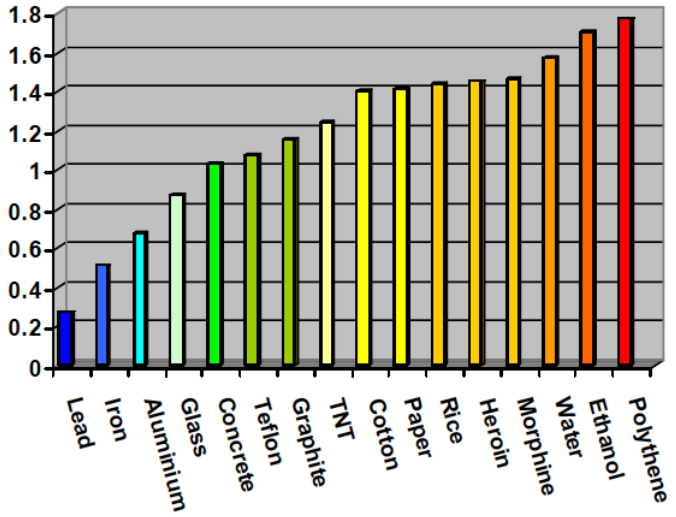
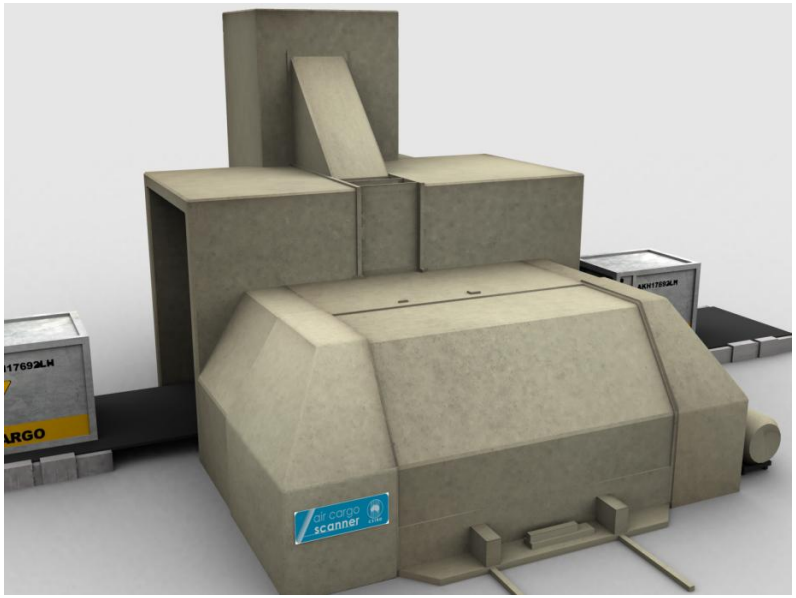


Figure 1. Calculated R values for a range of materials, using 14 MeV neutrons and ^{60}Co gamma rays.

J.E.Eberhardt, Y.L. (2006), Fast Neutron and Gamma-Ray Interrrogation of Air Cargo Containers, Proceedings, of Science (FNDA2006)

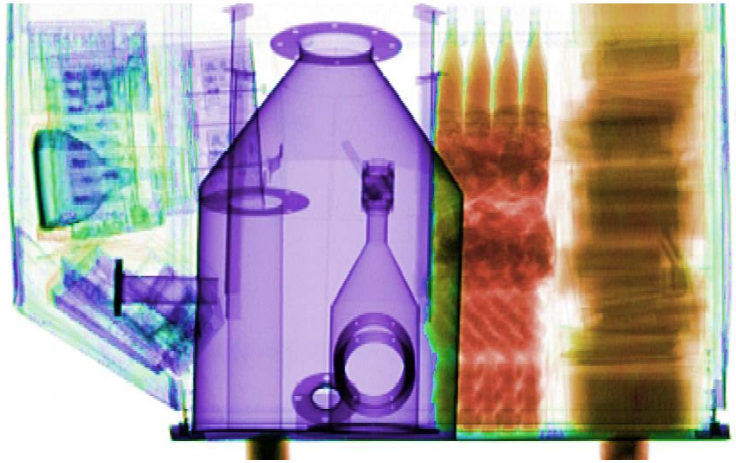
How to build a technology offer in practice: Ex.1, n/γ imaging

Prototype scanner (CSIRO) tested with Australian customs (2006):



Conventional Technologies:

- Plastic scintillators (n)
- CsI (γ)

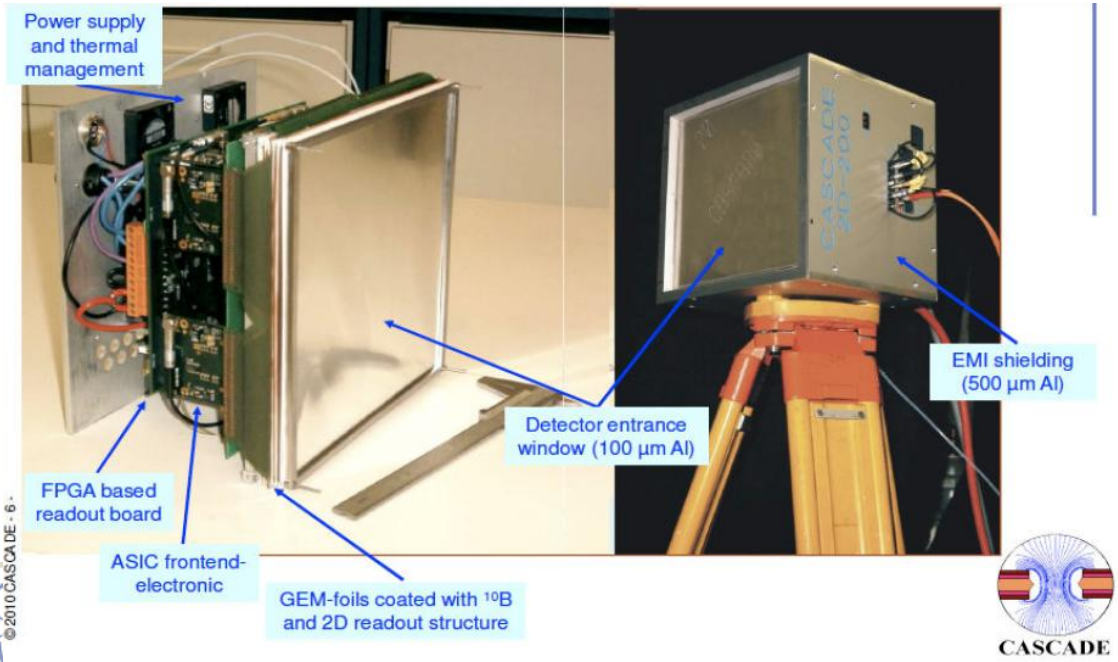


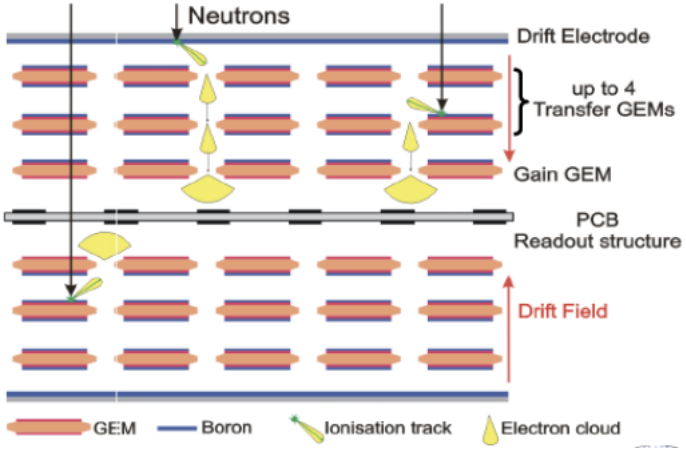
How to build a technology offer in practice: Ex.1, n/γ imaging

Can Particle Physics propose an alternative solution based on MPGD technologies from RD51 to meet user requirements ?

Combined neutron / gamma imaging with GEM detector stack:

- CASCADE detector system with photo-sensitive layer
  - GEM-based neutron detector module commercially available
  - Integration of photo-sensitive GEM feasible





M. Klein, CASCADE, Vienna 2010

CASCADE

How to build a technology offer in practice: Ex.1, n/γ imaging

User requirement	
Large area	y/n ?
Short scan time	y/n ?
Shape AND material info	y/n ?
Device costs	y/n ?
…	…

Check compliance with user requirements

Identify possible synergies with ongoing RD51 activities

- Are there similar developments ongoing within RD51's own research program ?

Validate with RD51 experts the availability of necessary technologies and support

- Performance
- Readiness
- Production
- Etc.

Develop "unique selling points"

- Why customs and others should use it ?

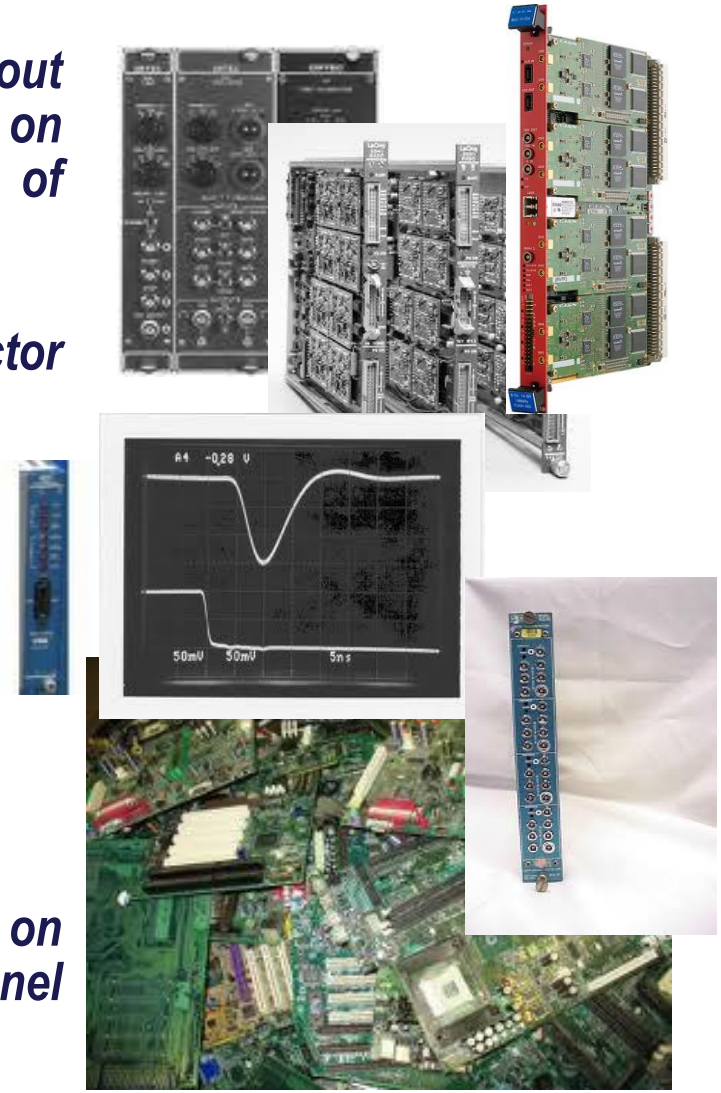
How to build a technology offer in practice: Ex.2, SRS

Case identification: a flexible, modular readout system for multi channel detector systems based on widely used industry standards for a wide range of applications

Market needs and user requirements for detector readout systems:

- Modular setup of user specific detector systems
- Support of widely used readout ASICs
- Maximum use of industry standards
- Programmable architectures and trigger schemes
- Easy to use, reliable, cost efficient

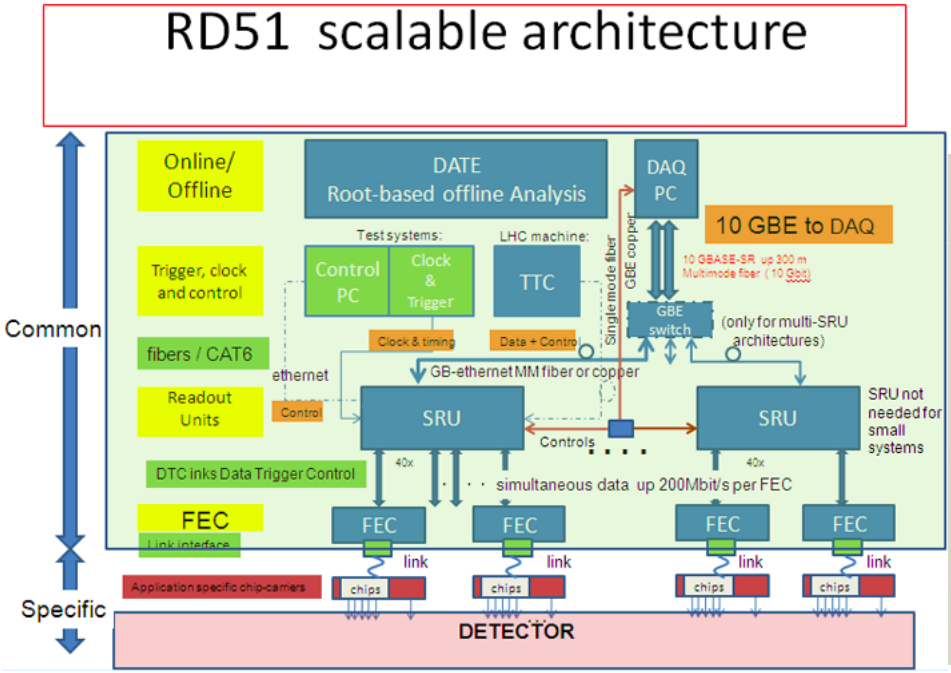
Problem: No One-Size-Fits-All solution available on the market matching all needs of multi channel detector readout systems

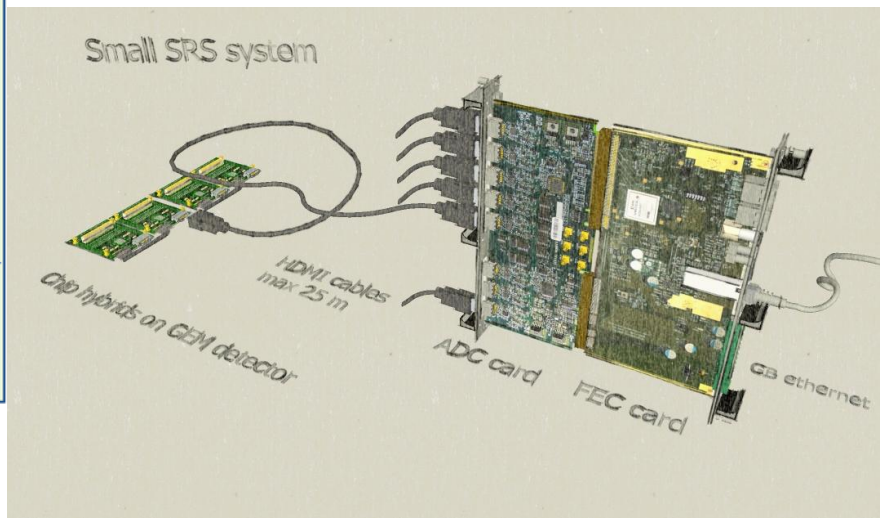


How to build a technology offer in practice: Ex.2, SRS

Can Particle Physics propose an alternative solution based on MPGD technologies from RD51 to meet user requirements ?

Scalable Readout System (SRS) as readout system for multi channel detector systems for many different applications





How to build a technology offer in practice: Ex.2, SRS

User requirement	
Modular setup	y/n ?
Wide ASIC support	y/n ?
Industry standards	y/n ?
programmable	y/n ?
…	…

Check compliance with user requirements

Identify possible synergies with ongoing RD51 activities

- Are there similar developments ongoing within RD51's own research program ?

Validate with RD51 experts the availability of necessary technologies and support

- Performance
- Readiness
- Production
- Etc.

Develop "unique selling proposition"

- Why various applications should use it ?

How to build a technology offer in practice: Ex.2, SRS

Build final offer:

- Scope
- Access conditions
- support

European Organization for Nuclear Research

Scalable Readout System for Multi Channel Detector Systems

Abstract

Based on developments for Micro Pattern Gas detectors for the detection of particles in many different application domains, the Scalable Readout System (SRS) for multi channel detectors to accommodate an interface to a wide range of commonly used readout ASICS, a scalability from low to large number of readout channels, a flexible data acquisition package enabling the implementation of various readout architectures and trigger schemes based on widely used industrial standards.

Technology stage

Various prototypes are available o the shelf or can be produced on sho CERN and RD51 provide support a solutions (data acquisition, chip boards readout software) for integration of the SRS with user specific detectors and support structures upon request.

Possible applications

- Homeland security
- Material research
- Beam monitoring
- Neutron imaging
- Medical Imaging
- Comparative ASIC testing

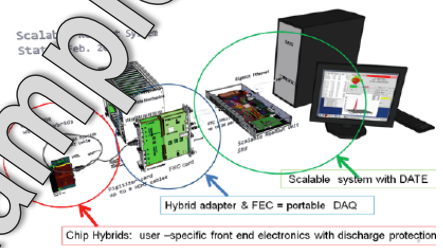
Applications at CERN

- Readout system for scintillator based detector and various MPGD based tracking detector systems

Innovative features

- Scalable from few channel systems up to a few millions of readout channels.
- User programmable trigger and clock interface
- Possibility to integrate application specific adapter cards
- Availability of low cost test systems for systems with few readout channels

ph ic overview SRS of RD51



Specifications

- 10 Gigabyte Ethernet standard readout links.
- Programmable Front End Cards (FEC's) for standard 6U x 220 Eurocard frames
- Standard connectors for commonly used readout ASICs

Advantages

- High flexibility through modular design of key components
- Possibility of configurable turnkey solutions

Contact

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Example

Thank you for your attention

For more information and questions please contact:

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