

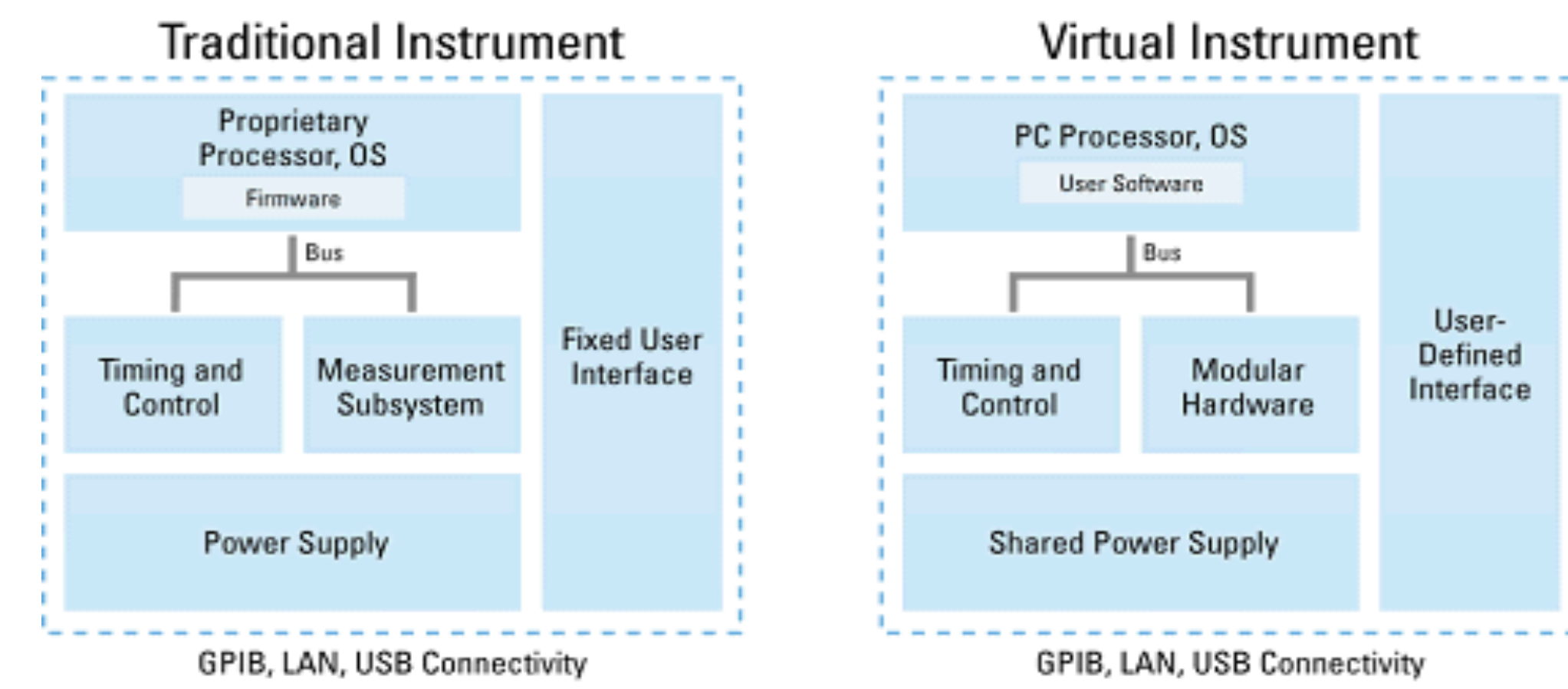
ABSTRACT

At CERN, many digitizers and scopes are starting to age and should be replaced. Much of the equipment is custom made or not available on the market anymore. Replacing this equipment with the equivalent of today would either be time consuming or expensive. In this paper we look at the pros and cons of using Commercial Of The Shelf (COTS) systems like National Instruments (NI) Compact-RIO (cRIO) and NI PCI eXtensions for Instrumentation (NI-PXIe) and their Field Programmable Gate Array (FPGA) capabilities as flexible instruments, replacing costly spectrum analysers and older scopes. We add some insight on what had to be done to integrate and deploy the equipment in the unique CERN infrastructure and the added value of having a fully customizable platform, that makes it possible to stream, store and align the data without any additional equipment.

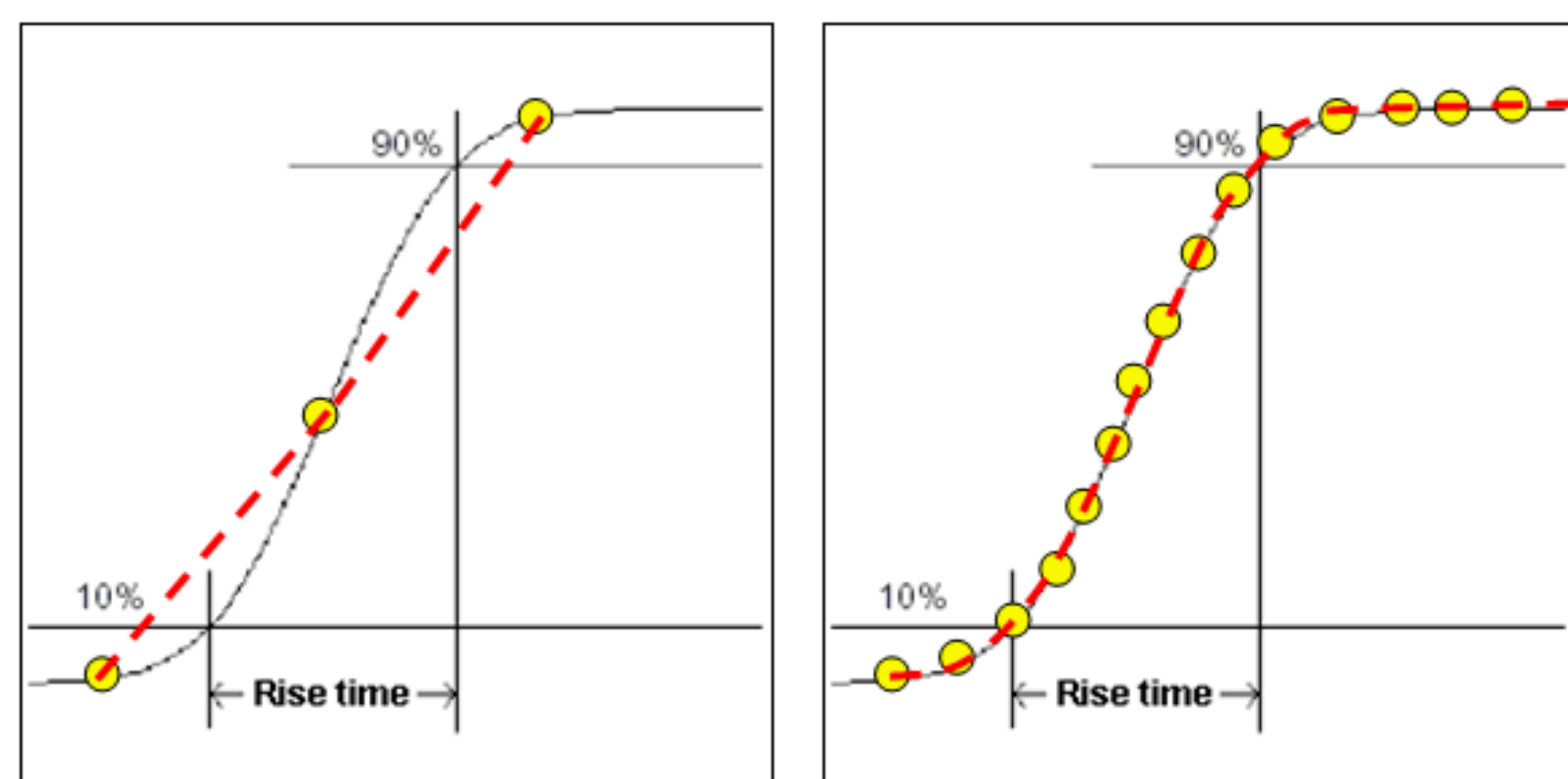
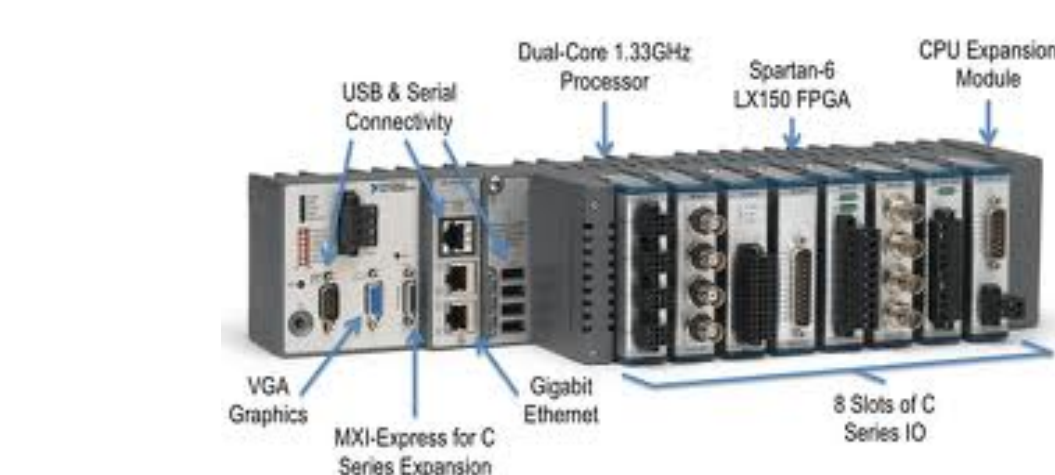
ARCHITECTURE

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Through the hardware platforms of cRIO and PXI, resources are easily duplicated by plugging in additional modules without changing any of the software, allowing the measurement equipment to be scaled as a factor of throughput. Traditional instruments use similar components, but the most obvious difference from a purely hardware standpoint is how the components are packaged.



MODULAR HARDWARE



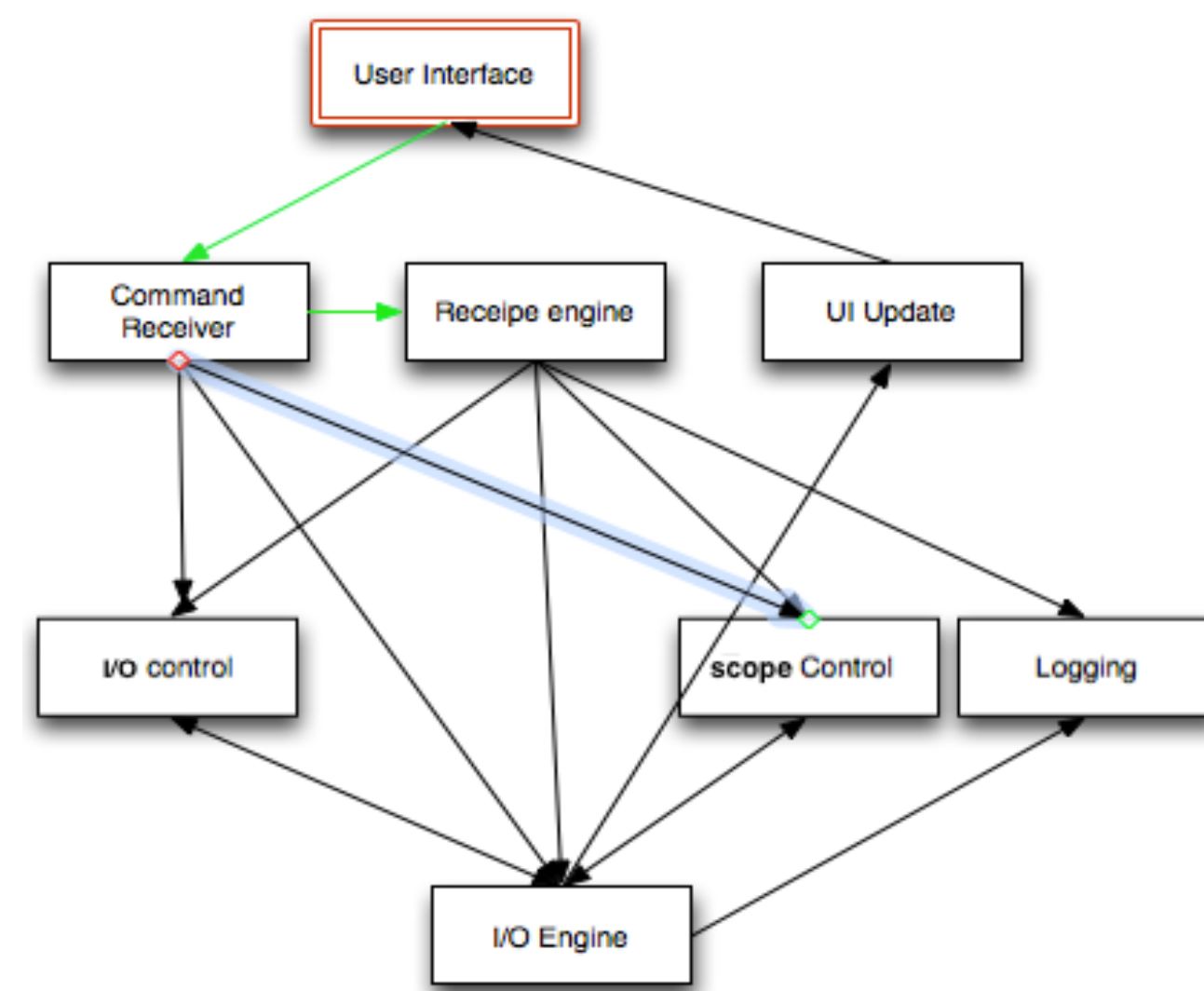
MODULAR HARDWARE

Modular instrumentation take several forms. In a well-designed system, many of the components are shared across instrument modules instead of duplicating these components for every instrument function. These modules include different types of hardware, including oscilloscopes, function generators, digital, and RF. As a result, modular systems can easily be scaled in every direction.

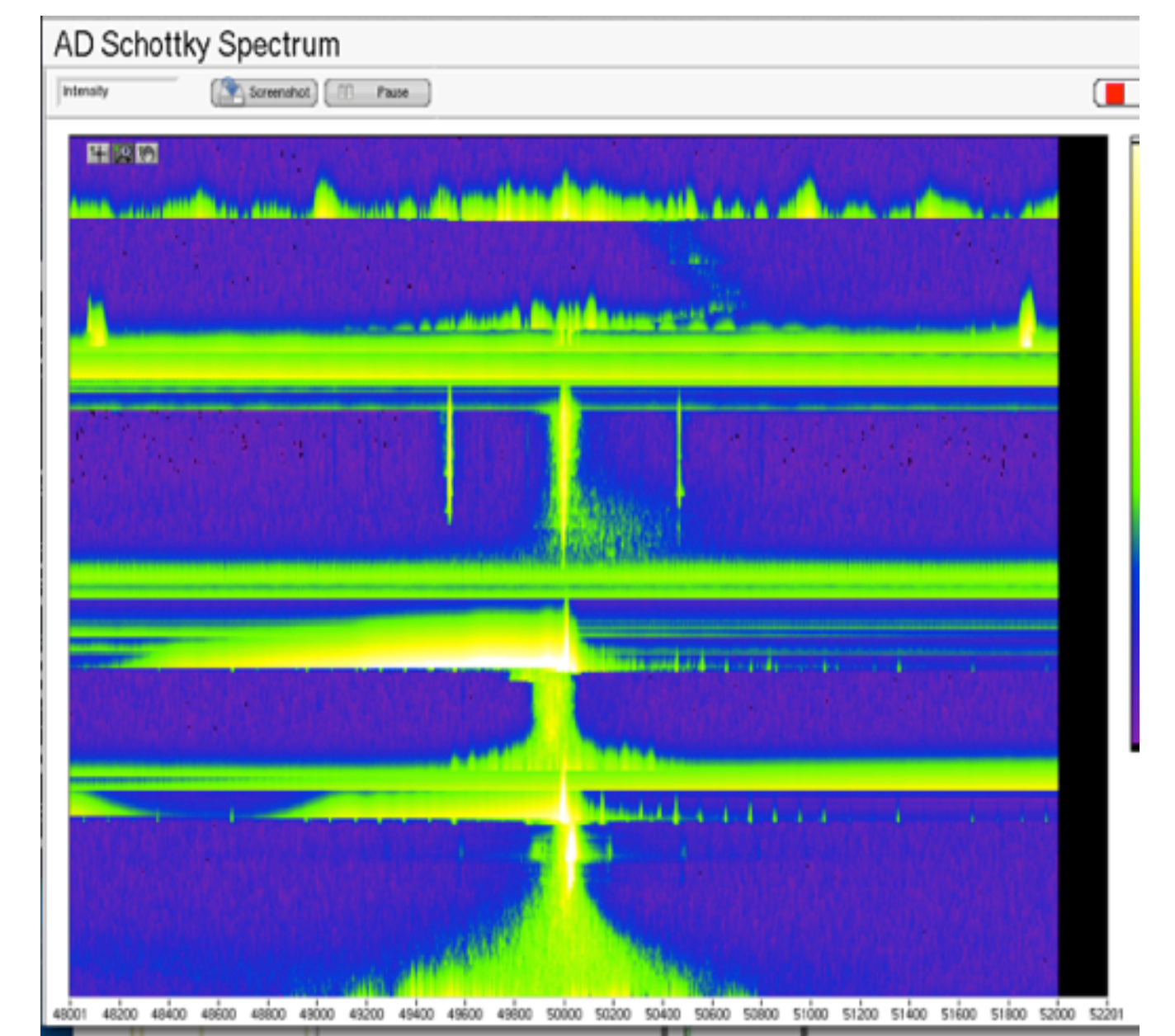
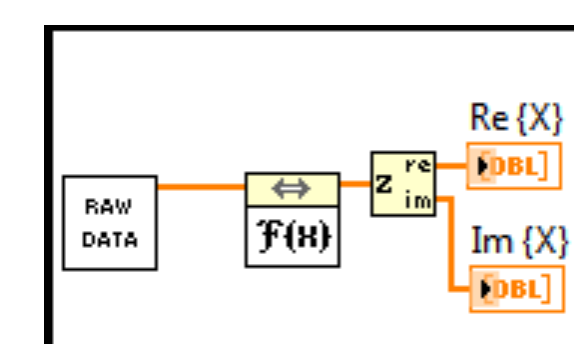
SOFTWARE

SOFTWARE

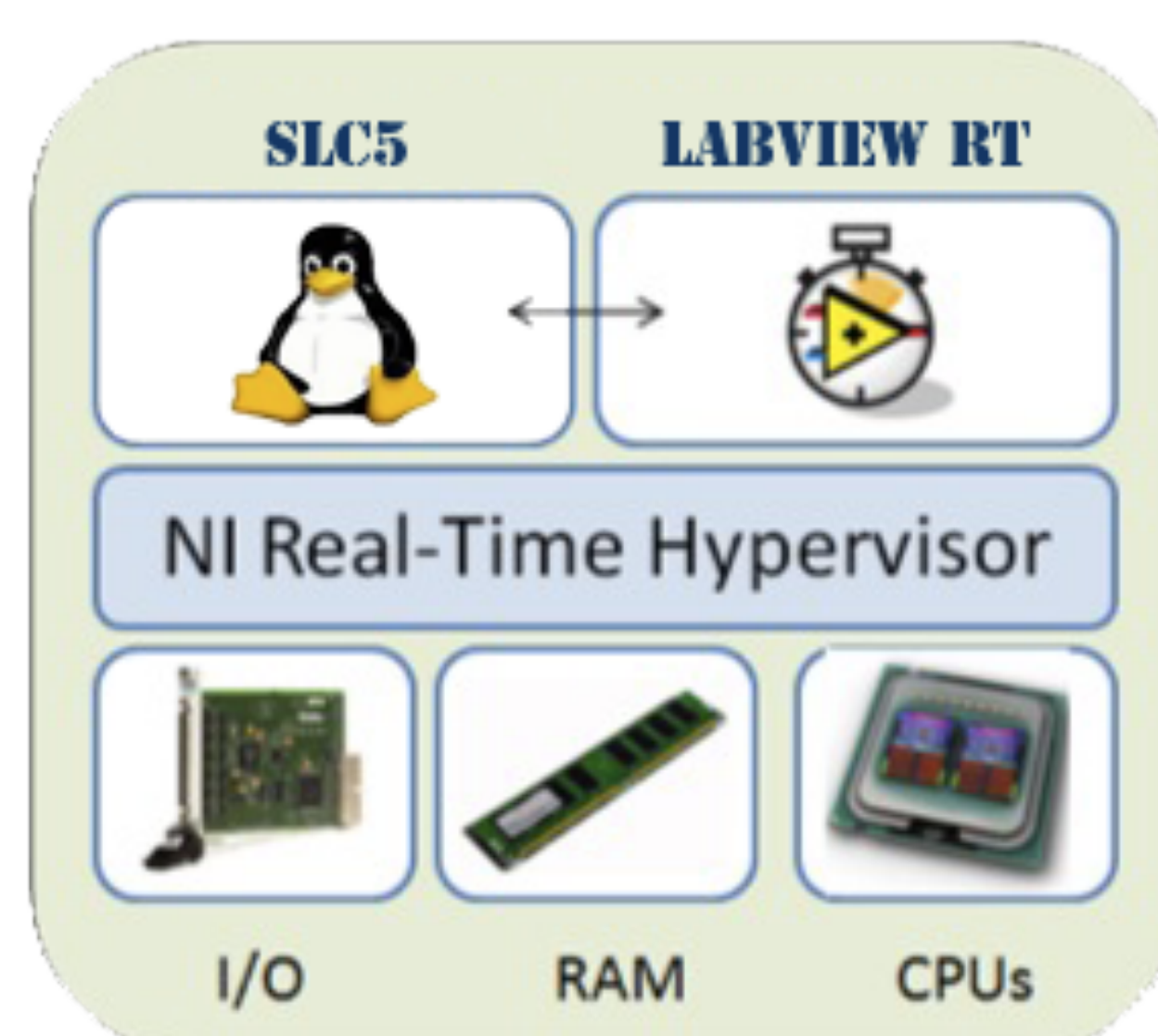
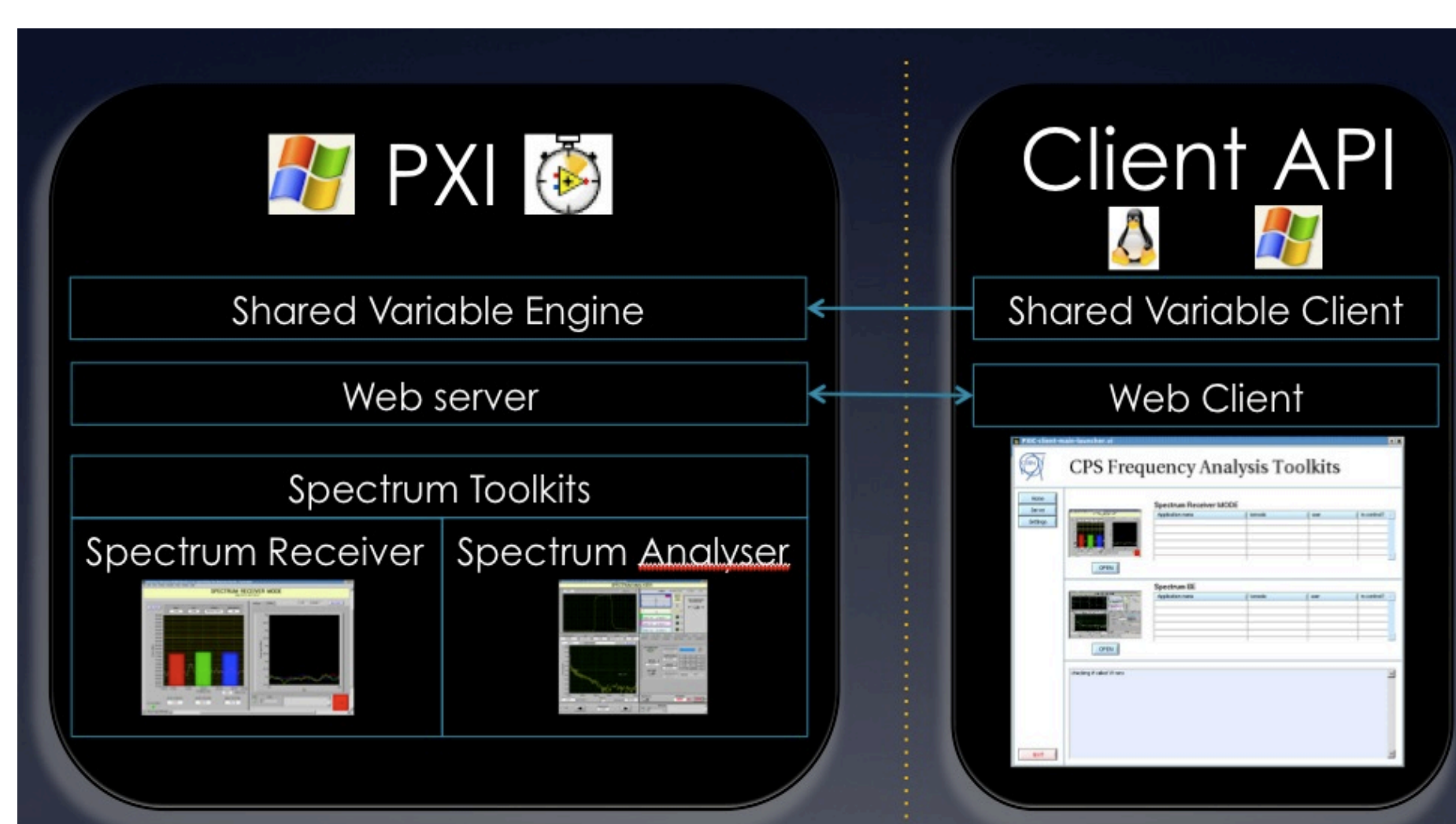
A traditional instrument is designed to perform one or more specific tasks defined by the vendor. The user generally cannot extend or customize them. One of the main advantages when considering virtualized instruments (VI) is the possibility of getting all the functionality of a regular scope or spectrum analyser through the hardware, but at the same time adding any type of interface or analysis needed.



$$X(f) = F\{x(t)\} = \int_{-\infty}^{\infty} x(t)e^{-j2\pi ft} dt$$



INTEGRATION



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The cRIO and PXI systems was successfully integrated in the existing CERN infrastructure by making use of NI's shared variables, the RADE framework and a customized tool called IE-PLC,

CONCLUSION

By using NI hardware, LabVIEW, FESA and IE-PLC we managed to create a fully scalable, modular and flexible measurement framework, capable of adapting to almost any measurement need using COTS components. The framework is fully integrated in the CERN accelerator control domain and can be easily extended to include any type of cRIO and PXI equipment