ANSI MEZZANINE MODULES FACILITATE FLEXIBLE RECONFIGURATION

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Abstract - This document examines the growing trend towards more modular forms of instrumentation and how they may be used across multiple instrument platforms. The multi-vendor support for this trend is shown as is its application to reconfigurable and legacy applications. Ongoing activity and future directions are briefly enumerated.

INTRODUCTION

The mezzanine approach to placing multiple functions in a single card slot has been around for a long time both in proprietary and open standard forms and valid arguments can be put forth for both of these approaches. One open standard that is gaining increasing popularity for instrument application is the M Module. This standard, which was originally developed in Europe for VME applications, has been embraced as ANSI/VITA 12-1996. The basic form of these modules is shown by Figure 1.

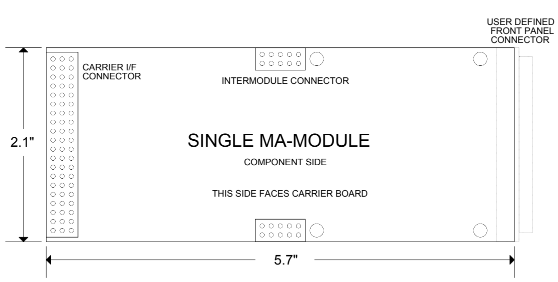

Figure 1. Single Wide M Module

In addition to the single wide form shown, M Modules can be developed in double, triple and quadruple wide configurations. Because of the standard's genesis in the VME world it is sized such that 4 fit in a 6U module and 2 in a 3U module. Conveniently, because of the way other backplane standards have evolved, 4 units easily fit the front panel space in VXI and 6U cPCI/PXI while 2 will fit in the front panel space of 3U cPCI/PXI.

At the present time a number of instruments are available in the M Module form factor. These include Pulse Generators, Function Generator, Arbitrary Waveform Generator, Digital Word Generator, DMM, Counter/Timer, Rubidium, OCXO, GPS, Distribution Amplifiers, switching, a wide range of serial interfaces including 1553, and numerous digital and analog I/O. Most of these have Plug and Play drivers.

A number of ATE related vendors are already embracing the M Module standard. Among these are Agilent, Racal Instruments, Ascor, Western Avionics, C&H Technologies, Talon Instruments, Chroma, Timing Solutions and Advance Vehicle Technologies. Also providing ATE instruments are two of the original co-creators of the standard; MEN Micro in Germany and Acquisition Technology in the Netherlands.

SUPPORTING THE STANDARD

As with any mezzanine card, a means must be provided through which the card may be adapted to a backplane or higher level interface. Such a device is generally referred to as a carrier. These come in two types: Non-intelligent and Intelligent. The functions preformed by the former include the simpler functions such as mounting and providing power as well as the more complex such as providing translation between bus types, protocols, routing on triggers and interrupts and making each mezzanine appear as a separate instrument to the host backplane. Intelligent carriers will generally perform all of the functions of the non-intelligent plus perform pre or post processing of data, allow the combination of multiple instruments into composite instruments that then may be controlled at a higher level, and perform translation of commands from older instruments so as to facilitate replacement of Legacy instruments. Figure 2 shows a typical carrier.

Figure 2. VXI M Module Carrier

Of equal or greater importance in the support of the mezzanine is the software. The majority of the M Module types referenced above come with VXI/PXI P&P drivers. However, a number of the more control oriented M Modules are supported only with C drivers. Actions are underway that are described below which will aid future application of the P&P drivers across multiple platforms.

ACHIEVING RE-CONFIGURABILITY

Perhaps the greatest advantage of an M Module mezzanine instrument is the ability of both the vendor and the user to become “Platform Agnostic”. From the vendors perspective, it is only necessary to develop one instrument, say a Pulse Generator, and with the use of carriers he can sell the same product into VXI, PXI, VME or Ethernet applications. This greatly reduces development costs when compared to the development of PGs for the 4 different busses.

From the users perspective it is now possible through the use of M Modules to use that same PG in say a factory test set that is VXI based and a field test set that is PXI based, thereby reducing the chances of CND (can not duplicate) problems which invariably occur when two different PGs are used. In the long term the user will also derive cost benefits because the vendor has not had to develop as many instruments to serve the different bus environments.

A further benefit to both parties occurs when some great new backplane or bus catches on (as VXI and PXI have in the past) because it is only necessary to develop a new carrier to allow migration of the M Module to the new environment. Table 1 shows the carriers presently availably or in design.

Bus/Backplane	Non-Intelligent	Intelligent
PCI	Available	
VME	Available	Available
3U cPCI	Available	
3U PXI	Available	
6U cPCI	Available	Available
VXI	Available	Available
USB	Available	
Ethernet	Available	In Design
Custom	Available	

Table 1. Busses with M Module Carriers

Within a system, regardless of the backplane, the use of M Modules allows a single carrier, such as the one depicted in Figure 2, to be reconfigured with different instruments to match the requirements of the application. Alternatively, configured carriers may be swapped out to totally change the character of a given piece of ATE.

With the addition of intelligence to a carrier one is now afforded a number of options. One of the more interesting is the ability to create composite instruments that use more than one basic instrument combined with on-board software to create a higher level instrument. Such a unit was recently delivered that incorporated an ARB with a measurement instrument to create a highly specialized Source Measurement Unit. A VXI P&P driver was developed with a command set that more closely resembling that of an SMU while the intelligent carrier interpreted these commands to make the individual instruments perform the required functions in a coordinated fashion.

A further advantage of the modularity and re-configurability gained with M Modules can be seen when the specialized signal generation and measurement requirements, needed when replacing Legacy Instruments, that require amplifiers and buffers which are not a part of a newer instrument. A recent case occurred with one customer that had to replace two different BCD controlled PGs, circa 1965 – 1970, which had very specialized signal generation (25V, floating, interlocks etc.). The general nature of the signal could be met with an MA204 PG, however this PG could not provide the necessary output levels and isolation. Working with the customer, who did the driver software for the new composite instruments, two amplifier M Modules were developed. This enabled the customer to replace two different PGs with common carriers and M Module PGs, but each with their own style amplifier, thereby placing all his unique signal amplification and isolation on a single M Module. Figure 3 shows the old and new PG units.

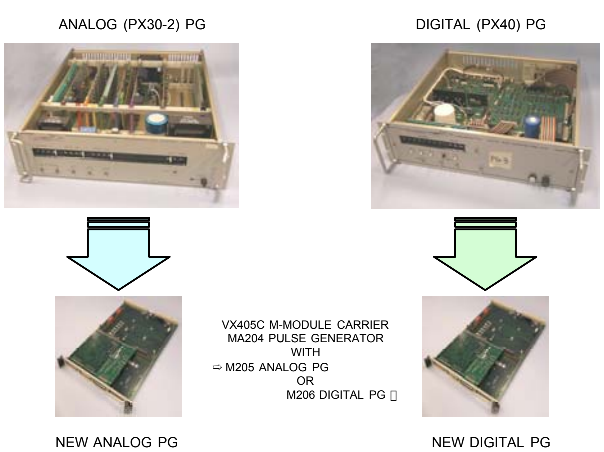

Figure 3. PG Replacement Examples

The above approach will be taken a step further on a pending program for replacement of a different manufacturer's Pulse Generator. The same M Module PG will be used with a new amplifier M Module. However, this time all will be placed on an Intelligent VXI M Module carrier that will also provide the translation of the commands from the current applications software. In all three of these examples the applications software is unaffected by the hardware change.

ONGOING DEVELOPMENTS

There continue to be a number of instrument developments using M Modules. At the present time a number of these activities are centered on adding to the complement of measurement instruments as this area has lagged behind the source, serial, digital and analog I/O developments.

Of greater importance is the development of software tools and methodologies to ease the task of obtaining cross platform driver applicability which matches the ease with which M Module hardware provides this capability. Work is underway with several vendors to adopt a method for doing this. Figure 4 depicts this concept.

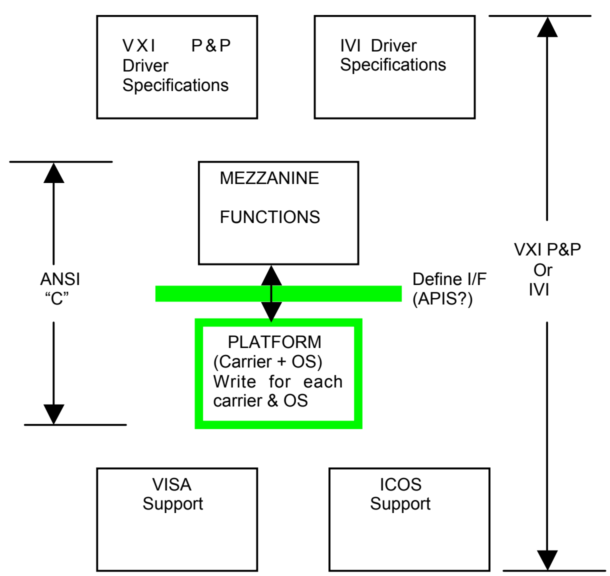

Figure 4. Cross Platform Software Support

The proposed method, which is already in wide use in the VME world, provides for a definition of the interface between those elements of the driver that relate to the carrier and the OS and those which are unique to the instrument. By adopting this method one then develops Platform software for each of the carriers and operating systems supported. This then enables one instrument driver to support multiple platforms.

On the Intelligent carrier side two approaches are used: One is to use an existing operating system such as Linux which while affording great flexibility may come at a penalty in terms of cost for a design and development support station. The second, that we have adopted, is to develop an embedded OS that has low support costs, ease of use and which crosses multiple intelligent carriers to support different mezzanine module types. This OS is depicted in Figure 5.

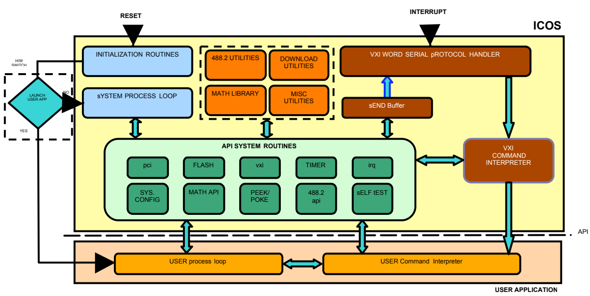

Figure 5. Intelligent Carrier OS (ICOS)

The ICOS will next be upgraded to support a multiprocessor environment where the M Modules will also be processor based. This is to support future approaches to reconfiguring instruments on the fly.

FUTURE DIRECTION

In general, we will continue to see increasing functionality and performance in M Module form factors as the semiconductor technology allows these gains to be practical. Further, the availability of Power PC cores within devices such a Xilinx Gate Arrays is going to add a level of flexibility and power that will make viable Synthetic Instruments in M Module form factor a reality.

The upgrades to ICOS, along with the ability to reconfigure a Xilinx on the fly and change software on board the mezzanine on the fly will enable a practical approach for implementing future synthetic instruments.
These capabilities, both existing and planned, along with the ability to quickly migrate M Module instruments to new platforms when necessary bode well for the increasing utilization of the ANSI/VITA standard for future instrument development and applications.

REFERENCES

[1] **ANSI/VITA 12-1996** "American National Standard for The Mezzanine Concept M-Module Specification", *VMEbus International Trade Association,* http://www.vita.com

[2] Gary Guilbeaux, et. al., "Use of Intelligent VXI Carriers for Legacy Instrument Replacement In VXI Systems", *Autotestcon*, Anaheim, CA, September 2003