FROST & SULLIVAN

November 2007

Movers & Shakers Interview with Charanbir Mahal, CTO of Phase Matrix, Inc.

"Partnering with clients to create innovative growth strategies"

Charanbir Mahal, CTO

Charanbir Mahal is VP Engineering, Chief Technology Officer, and co-founder of Phase Matrix, Inc., a small and innovative Radio Frequency/Microwave (RF/MW) Test and Measurement technology firm located in San Jose, Ca.

Charanbir is a Summa Cum Laude graduate of San Jose State University and has over 20 years of experience in RF/MW Test and Measurement. Charanbir is leading Phase Matrix`s RF/MW hardware development efforts in both VXI and PXI Synthetic Instrument technology and Microwave Frequency Counter technology.

S.Vidyasankar (SV): Can you share with our readers a brief on the genesis of Phase Matrix, Inc. and the vision for its formation and its role in the test and measurement (T&M) market today?

Charanbir Mahal (CM): Phase Matrix, Inc. was formed to develop and manufacture high quality and cost effective microwave and RF instruments. In June 1999, Phase Matrix purchased substantially all of assets of EIP Microwave, Inc., a long an established manufacturer of microwave test equipment and is currently pursuing the following strategy:

The development, manufacturing, and marketing of leading edge microwave components (VCOs and frequency synthesizers) in support of the RF/Microwave marketplace.

The development, manufacturing, and marketing of microwave test instruments (RF/MW Counters & Frequency Synthesizers) under the Phase Matrix/EIP brand and for well-established OEM customers who sell variants of these products under their own brand names.

The development, manufacturing, and marketing of leading edge modular (VXI & PXI) Synthetic instrument(SI) components (Down Converters, Up Converters/Synthesizers, and Local Oscillators) under the Phase Matrix brand for both commercial and military applications (dual use).

The support of the large installed base of legacy EIP products. EIP pioneered many innovations in microwave counter instrumentation technology and a number of its legacy instruments still offer unique solutions and significant value to our customers.

SV: That was indeed an interesting brief. What is the unique value proposition that Phase Matrix, Inc. brings in to the T&M market, and what are your key competitive differentiators in the market today? Could you highlight the top 3 things that you do that set it apart from competition?

CM: Going back to our days as EIP Microwave, our current staff has a long history in the development of complex RF/Microwave measurement technology and the associated manufacturing processes required to bring this measurement technology to the marketplace, in the form of both manufacturable and supportable products.

Three things we do that sets us apart from the competition:

1. A close knit multidisciplinary team (engineering, marketing, sales, & manufacturing) of T&M professionals with an excellent knowledge of the T&M marketplace; as well as a streamlined New Product Introduction (NPI) process which enables us to get products to market fairly quickly.

2. We have a corporate culture of close customer intimacy which enables us to be in tune with both our customer's explicit and implicit needs and requirements.

3. We are big enough to get the job done yet at the same time small enough to have the agility to react to evolving customer and market conditions. We are the perfect size to explore and develop disruptive technologies such as SI.

SV: Of late, there has also been a lot of hue and cry about synthetic instrumentation (SI) in the T&M market, and we also understand that your company offers SI products. Could you elaborate on that? Also, where do you see that technology moving in the future, and what do you feel is going to drive the growth of this technology?

CM: That is a frequently asked question that a number of our customer's have been asking us for a while now. The short answer is that we strongly believe that SI will over the next five to ten years precipitate a major sea change in our industry that will forever change the way customer's specify and buy classical signal analyzer and signal generation types of products. The technology enablers for widespread SI use are already in play : the continuing advances of digitizer/AWG technology into the GHz sampling range, the evolution of high speed PCI Express/PXI Express I/O technology, and the wide spread use and increasing functionality of T&M related software technologies such as LabVIEW. It should be noted that the SI market is in the process of being validated in the military DOD market place (BAE and the Air Force's IAIS test system for the F16 aircraft; DME Corp and the Marine Corps Viper/T (a.k.a TETS)). Also both Aeroflex and Agilent Technologies have SI related product offerings in the marketplace as well.

SV: In terms of evolving technology demands, how are Phase Matrix, Inc.'s product development strategies going to remain commercially relevant?

CM: Our strategy is quite straight forward and pragmatic- periodically solicit and listen to both our existing and emerging customer's needs and wants. We affect this strategy on a biannual basis, at a minimum. Our industry is currently moving at a rampant pace compared to previous decades and customer needs can change very quickly on a technology turn in any one of our primary market segments (i.e., Telecommunications, Aerospace/Defense). In this regard, we try to keep our technology development life cycles short (< 1 year) to ensure we can respond to emerging market needs within evolving market windows.

From an evolving technology perspective, we see a continuous need to decouple/partition the functionality within our products that have different technology life cycles. This approach mitigates technology obsolescence and enables our customers to ride the technology wave. For example, in the measurement side of a synthetic instrument the fundamental down conversion process typically employs a combination of mixers and filters. This technology is not prone to too much disruptive change but the critical component that works in unison with it – the Local Oscillator (LO) - does. That's why we partition the functionality of our down converter products to employ an external as opposed to an internal LO. If there is a technological breakthrough in frequency synthesizer technology, we can simply insert this new technology into our product line with another external LO module without disrupting the stable part of our design- the Down Conversion functionality. This approach enables us to upgrade our products with minimal engineering effort and disruption to our customer: simply swap out and replace the old LO module with the newer technology that employs a faster switching speed which in turn accelerates and enhances the frequency translation/ down conversion process. The same partitioning strategy applies to the Analog-to Digital Converter functionality. Rather than marry it to the Down Converter, we keep that functionality as separate and distinct so that the customer can benefit from the technology advancements in this arena without disrupting the relatively stable portion (Down Converter) of a synthetic instrument.

SV: We did see the proof of concept of your product at Autotestcon 2007. Could you elaborate on that front?

CM: Thanks for asking. We leveraged the initial EIP product line we procured from EIP into our flagship 1313B/ 20309 Down Converter/LO and 1440X Up Converter/Synthesizer product lines. These products are currently being employed by our mainstream SI customers in transportable/portable test system applications. The Navy was aware of this situation and wanted to take the reduced footprint of these SI components one step further via the employment of PXI technology. The Navy subsequently competed a Small Business Innovative Research Program looking for innovative approaches for designing a RF/MW Down Converter in a PXI form factor. We were one of four awardees for the Phase I competition and were the sole awardee for Phase II (prototype development competition). As a result we are currently developing, demonstrating and manufacturing a family of five PXI modules for dual use application (military & commercial). The first module under development that you are referring to and that we demonstrated at Autotestcon 2007 is the Microwave Band Input Module. This core Down converter module is capable of down converting RF/MW signals in the 2.7-26.5 GHz range into base-band IF signals of 21.4 MHz (50 KHz & 8 MHz BW) or 250 MHz (+/-175MHz min.). This module is the first of a series of five modules intended for dual use in PMI`s emerging family of RF/MW down converter modules. The family of modules includes a Low Band Input Module (DC-2.9 GHz), RF Input Signal Conditioning Module, IF Output Conditioning Module, Local Oscillator Module, and a Microwave Band Input Module (MBIM) (2.7-26.5 GHz).

SV: What are some of the existing and emerging industry application markets that Phase Matrix, Inc. is pursuing? How are you making your products versatile to meet the diverse testing needs and budget limitations of customers?

CM: The current markets we serve are the Department of Defense, aerospace & defense prime contractors, instrumentation suppliers, and telecommunications & Wireless providers. We have always had a corporate culture of designing and developing products which are applicable across market segments; not custom to any one segment or customer.

In terms of our focus on affordability, an example of the approach we have taken in our emerging PXI product line is worth noting. As we planned our entry into the PXI SI arena we realized that we will be encountering diverse customer needs in terms of both functionality and cost. That is why we took a modular approach in our developmental efforts whereby the customer can configure an SI solution using a combination of modules or all of our family of down Converter modules to synthesize a solution to fit the customer's needs – DOD or Commercial.

In closing I should mention that integral to our instrument development process is customer involvement. We typically engage and interact with a select group of commercial and Aerospace Defense power users/system developers during our product development cycles. This approach enables us to leverage their applications perspective during our critical design reviews. This approach also enables our customers to align their system development activities and associated hardware /software design interfaces with our products in order to better maximize their use.

SV: How are you as an organization keeping yourself on your toes to better understand your customer requirements from their perspective? What process do you adopt to identify them, and how are you addressing them?

CM: This is a very timely question. We are currently in the process of initiating an E-Commerce initiative at PMI to affect communications and electronic commerce between PMI and our key account customers, manufacturing reps, and business partners/alliance members. Via this initiative, we are putting in place a communications and collaboration infrastructure and associated processes that will enable us to better communicate on a real time basis about both current and emerging customer market needs & requirements. We are also in the process of developing a series of technical seminars on our core technologies/products (RF/MW counters, SI Technology, and RF/MW components) to better educate our customers, reps, and business partners on our technology as well as provide a vehicle to solicit their feedback on how our technologies and products match their current and future needs. All of this information is leveraged within our New Product Introduction (NPI) process which is employed to manage a product over its life cycle from product conception to disposal/obsolescence.

SV: What geographic markets do you see as a primary focus for present and future growth?

CM: We have reps and a strong presence throughout the US, Europe, and Asia. From a DOD perspective, the US and Europe are key strong markets for us. In support of the manufacturing sector, we look for continued growth in China.

SV: What are some of the growth strategies that your company has implemented to foray into untapped markets and expanded client base?

CM: Being a relatively small company we rely quite heavily on OEM agreements and joint alliances in support of those technology/product areas where we don't have the marketing/distribution might or a whole product solution. This approach maximizes the market footprint for our technologies. As an example, in the SI technology area we have entered into a joint alliance with BAE Systems and National instruments to design and develop a totally integrated PXI Express based Synthetic Instrument. PMI`s contribution will be in the RF/MW Down Converter, Local Oscillator, and Up Converter/Synthesizer technology focus areas. BAE Systems contribution will be in System integration, calibration, and DSP/FPGA based SI application software. NI`s focus will be in PXI 3U Chassis technology, PXI Express I/O technology, High Speed IF digitizers, Arbitrary Waveform Generators (AWGs), and the application of their LabVIEW software platform in the context of an SI environment. By virtue of this alliance we can all pursue customer's and markets which were previously unobtainable to each of us individually.

SV: What have been your biggest challenges and how have you re-aligned your strategies to overcome them?

CM: Perhaps our biggest challenge is in constantly aligning our technology development processes with our manufacturing processes. That is, ensuring that the R&D solutions emanating from our lab can in effect be turned into manufacturable and testable products. This challenge requires constant communications and vigilance by both our engineering and manufacturing staffs to ensure that we are all on the same page as we cross the chasm between the engineering development and the manufacturing worlds. In this regard, we have recently realigned our product execution strategies to ensure that manufacturing has more of a say as to what design for manufacturing attributes should be incorporated into our prototype/beta module designs.

Another significant challenge we constantly encounter as a small business is R&D funding. We mitigate this challenge by teaming up with key customers for those R&D endeavors that are mutually beneficial. This typically is a win/win situation in that the customer gets a product that satisfies his immediate needs and we (Phase Matrix) retain the IP. We typically only accept non-recurring R&D funding for those projects where a technology can be re-used/ applied in support of a COTS product. Some of our key customers typically fund us for special projects in order to satisfy not only an immediate need they have but also to influence our technology roadmaps and future direction to be in better alignment with their needs. We try to stay away from custom designs whenever possible.

SV: How would you rate your company's performance in 2006 and what influenced this performance? What was your main obstacle in 2006 and how did you overcome them? Going forward, what do you expect for 2007?

CM: We had a very good year in 2006 fueled by a double digit growth rate over our FY 2005 performance. Growth in both our RF/Microwave counter line and the SI sector of the Aerospace & Defense market were the key contributors to our growth. Our primary impediment in 2006 was ramping up our manufacturing/production line to accommodate the increased volume over FY 2005. We overcame this impediment by allocating more engineering resources to assist manufacturing in this ramp-up.

SV: How would you define success for yourself and for Phase Matrix, Inc.?

CM: Success is a relative measure. For me (Charanbir Mahal), success is defined as achieving my dream of leading a product design & development team in the execution of RF/MW projects that are leading edge and will make a difference in the RF/MW marketplace. That being said, I feel very blessed in that regard since my dream has been realized. When I first joined PMI our initial focus was on being profitable and leveraging the EIP legacy product line. Almost eight years later that goal has been achieved and we (Phase Matrix) now have both the financial and operational flexibility to undertake exciting new developments under the Phase Matrix brand.

For Phase Matrix, I believe success can ultimately be defined, besides being a survivor and profitable, as being a recognized and respected brand in the RF/MW marketplace- similar to the position EIP Microwave had over a decade ago. We are still a work in process in that regard but we have seen measurable results over the past five years in our brand recognition and the acceptance of our products, both commercially and in the DOD marketplace.

SV: Who would you consider as key competitors, and how is Phase Matrix, Inc. trying to differentiate yourselves from them?

CM: In the Synthetic Instrument marketplace we have positioned ourselves as a component supplier to both Aerospace Primes and commercial instrumentation suppliers. SI subsystem suppliers buy our Down Converters, Local Oscillator, and Up Converter /Synthesizers products and provide value added software and measurement science to render our SI components into an SI subsystem. In the SI subsystem space, our OEM customers compete against SI subsystem suppliers such as Aeroflex and Agilent technologies.

In the SI component space, we primarily compete against small form factor T&M suppliers such as Gigatronics / Ascor. We have differentiated ourselves in the SI component marketplace by being easy to work with and designing our components with flexible hardware & software driver interfaces that enable our products to be easily integrated into a customer's SI subsystem.

SV: The battle for the choice of platform continues. VXI or PXI or LXI so on and so forth. Frost & Sullivan believes that in future, vendors in the T&M world will have to co-exist, and play it safe and nice. What is your view on this going forward?

CM: Our approach to this issue is somewhat holistic in nature. Our primary mission as a company is to design and develop stimulus and measurement "bricks" that can be hosted into the platform environment of choice of our target customer segment. We are somewhat platform agnostic in this regard. We are not platform zealots; we try to do what is right for the customer. In many instances a hybrid approach may be the answer for a particular customer's use case which requires a best in class approach in order to provide an optimum solution to their problem.

Each of the platforms can be thought of as a host city or community with its own unique attributes: zoning laws/design constraints (i.e., form factor/module size), protocols (i.e., laws/rules), and topology (i.e., infrastructure/physical media). The customer must choose the community that is right for them in terms of the attributes that satisfy their needs and intended application. That being said, PMI`s strategy is to provide the hooks that will enable us to build our stimulus/measurement bricks in the customer's community of choice: LXI, VXI, or PXI.

SV: As a conclusion, what role can we expect Phase Matrix, Inc. to play in shaping the future of the T&M market, or what does the future hold for Phase Matrix, Inc., more specifically

CM: We firmly believe that RF/MW will be a growth market in the years to come. The emergence of wireless technology and an increased focus on managing the frequency spectrum in the out years will lead to tremendous opportunities for a technology centric company such as Phase Matrix in the RF/MW counter and SI marketplaces. We also strongly believe that test systems of the future will have to be more flexible and adaptable as well in order to support shrinking market windows and an increased emphasis on reducing T&M costs.

From an SI perspective, we plan to shape the market by continuing our focus and emphasis on developing SI components that can be incorporated into small portable/modular test systems utilizing small form factor (sff) technologies such as VXI & PXI.

We plan to continue supporting and collaborating with our OEM Aerospace /Defense partners and our OEM instrumentation partners in the commercial marketplace as well in order to develop new leading edge products

that will make a difference in the marketplace. We truly do live in a most exciting and dynamic time period in this era of instrumentation technology - Phase Matrix is excited to be an integral part of it.

SV: Do you have any additional comments?

CM: On behalf of the Phase Matrix Management team (Pete Pragastis (President), George Clark (Chief Financial Officer), Mike Granieri (VP Advanced Programs/Business Development), Paul Khanna (VP, Microwave Components), and Rick Bush (VP Sales)) who helped formulate the responses to this interview, I would like to thank Frost & Sullivan for giving Phase Matrix the opportunity to tell our story.

By S.Vidyasankar, Senior Research Analyst