



# Microwave Musings

## Process of Disintermediation and MTT

■ Amarpal (Paul) Khanna

Disintermediation means the elimination of the middleman or middle process as made possible by the continuously evolving technology, including automation, the Internet, computing, etc. Among the physical functions that continue to be disintermediated are those of wholesalers, retailers, distributors, bank tellers, insurance brokers, travel agents, and gas station attendants. Indeed, even professionals such as engineers, technicians, doctors, and scientists face disintermediation. As long as it's not one's own livelihood that is affected by disintermediation, one is likely to embrace these developments. People who benefit from disintermediation are the ones who can develop a product or service that disintermediates something or someone else, make money, and then get out before suffering disintermediation themselves. There is no end to the human functions that can be disintermediated, and today's world is rapidly becoming one in which many people are busy working on unemploying others by replacing their job with technology.

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The process of disintermediation (POD) seems to have started centuries ago. One recent example in the United States is when Sears, Roebuck & Co. published a catalog in 1894 that allowed people to make purchases without visiting local stores. Telephone operators were one of the first to be disintermediated in large numbers when auto trunk dialing started in the late 1950s. The first credit card was introduced in the United States in 1950 as a Diners Club debit card. In the late 1950s and early 1960s, credit cards became popular and disintermediated one of the functions of cash in the market, revolutionizing the finance industry. Photocopiers and computers decimated a large class of typists in the 1960s and 1970s. Popularity and affordability of personal computers in the 1970s affected the jobs of secretaries, assistants, and data keepers, for example. The invention of barcodes and barcode scanners in the 1970s aided retailers

and manufacturers alike to reduce cost and labor.

In the 1980s, answering machines took over jobs of people who took messages. The Internet picked up speed in the early 1990s, and it tremendously increased the pace and power of disintermediation in practically every industry. E-commerce for business to consumer (B2C), business to business (B2B), and consumer to consumer (C2C) completely changed the face of the retail and wholesale business. Web sites like ebay.com and amazon.com are shining examples of changes in



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the way retail items are being purchased and sold, indirectly changing the labor field. Travel agents who at one time ran a lucrative business are wondering what happened. Newspapers have finally given up on calling people and promoting their publications because its value proposition has been significantly reduced by the Internet. The need for

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local libraries is being threatened by the Internet and handheld e-book readers. Today, you can download almost any new book wirelessly into your e-book reader, which is capable of carrying greater than 1,000 books. The list of areas in which the Internet is aiding POD is endless.

A new set of job functions have been simultaneously introduced by almost all of the factors of POD, creating job opportunities requiring different skill sets. Famous search engines have empowered consumers beyond what one could imagine a decade ago by removing intermediaries between the consumers and vital information to make decisions. In reality, these search engines can be considered virtual new intermediaries between the consumers and the information. The number of jobs created directly and indirectly by this new agent of intermediation or reintermediation is by no means a small feat. Nonetheless, in general, every new POD eliminates more jobs than it creates.

The RF and microwave industry has experienced its own share of this process. A number of applications of microwave and RF technology have played a leadership role in the evolution of POD. Some key examples are wireless communications, global positioning systems (GPSs), and RF identification (RFID) systems. These technologies are responsible for the disappearance of a large number of jobs and, like other technologies, creation of new jobs in high-technology areas. The microwave and RF community has been touched by POD in a different way. All three key operations: assembly, test, and design have been affected significantly by advances in automation and computing. These processes started in the early 1970s. Assembly automation represents what is likely the largest eliminator of jobs in our industry. It has also liberated the manufacturers from staying close to the highly skilled labor areas available only in certain parts of the world. Microwave engineers might remember the days when an ace assembler who could consistently do a good eutectic die attachment and wedge bond was a prized possession. Automation in assembly has not only shrunk the related labor pool

in privileged countries but also enabled spreading it around the world.

The test and measurement field in microwaves has changed beyond recognition. There was a time when all measurements were made manually. The engineer working on the measurement knew exactly what he or she was doing, understood the theory behind the measurement, and, in many cases, was able to find a better way to do the same. Gradually, when computing power started showing its muscle, it was adopted, originally to make the measurements more accurate, faster, and, of course, use reduced labor. Once the automated measurements were proven to work satisfactorily, the test technicians and engineers with the know-how on how to make manual measurements were disintermediated.

Of course, everything was moving faster and at a lower cost and it was now easier to move offshore, but, in the process, we eliminated a class of fine engineers with the basics of measurement technology. Knowledge was now resident with a much smaller number of engineers at large T&M corporations who knew both measurement theory and how to get the techniques embedded in the new machines, rapidly replacing innocent and unaware engineers. However, this process also enabled diversification in disintermediation (or reintermediation) by creating job functions in the nonmicrowave fields, including computing, controlling, and digital technologies. After allowing decades of POD proliferation across test and measurement, today, our new breed of engineers in the field is comfortable in pushing buttons on the advanced pieces of test equipment and test sets without understanding the fundamentals behind the measurements.

RF and microwave design methodology has experienced similar changes. Going from designing a circuit using Smith charts and slide rules to automated optimization of a complex subsystem is nothing short of a revolution. However, in the process, one smart engineer today can accomplish the

design work of a significant number of engineers thanks to computer-aided design (CAD) systems. Once again, the fundamental knowledge behind the design is taking a backseat; you are more likely to be asked in an interview about the number of software packages you can use to design rather than the design techniques themselves.

We need to realize that we cannot live without continued progress in technologies to improve efficiency, reduce cost, and enhance performance, which automatically fuels POD. However, the immediate challenge is finding new ways to propagate the knowledge and set guidelines and certifications so that all of us not only enjoy the fun of POD but also do not get disconnected from the essential knowledge. Fortunately, the same tools that are responsible for the process of decreasing our knowledge can be manipulated to enhance our learning. A conscious effort in developing training and educational courses is necessary. Industry and academia needs to join hands before it is too late. The following are some specific suggestions for the community to ponder:

- 1) standardized certification at different levels for engineers, technicians, and assemblers; these should be reviewed and renewed after a reasonable interval
- 2) establishing classes and training in the area of design, measurement, and assembly
- 3) emphasize lab and practical classes at colleges and universities
- 4) Internet-based video training courses on basics as well as advanced techniques.

Many establishments have done a remarkable job in setting up good training courses. The IEEE Microwave Theory and Techniques Society has established an education committee and has been making fundamentals training available through tutorials, workshops, and video courses. We need to do our best to not let POD become a destructor of fundamental knowledge for the next generation of engineers.

When I try to extrapolate the progress and imagine what can happen

in the future, options are unlimited. In the design world, cloud computing can further enhance the impact of the POD. Continued conversion of complex hardware functions to MMICs is not going to slow down. In the testing world, potentially, there will be unmanned automated test stations (UATs), which can be

not only operated remotely but can be diagnosed and, in some cases, repaired by the experts sitting in a different part of the world. Another idea will be to capture and send an RF signal sample over a high-speed line for analysis, much like the way it is done in the medical world. All these processes undoubt-

edly will unemploy many, although it will, admittedly, create some jobs in new areas. Therefore, let us pledge to work in phase with the process of disintermediation and participate actively in diversifying our skills and keep ahead of natural forces to disintermediate us prematurely. 

## ARMMS RF & Microwave Society News

### A frequency source achieving fast switching and very low phase noise wins best paper award at the November ARMMS Conference

An innovative frequency synthesiser design was described at the recent ARMMS conference at Corby in England. Alexander Chenakin of Phase Matrix Inc. explained how rather than dividing the output of the VCO, frequency multiplication is applied, resulting in very low output phase noise of  $-122$  dBc/Hz at 10 GHz measured at  $\pm 10$  kHz offset. This figure is comparable with a YIG oscillator while maintaining fast tuning speeds. The 42 delegates awarded Alexander's paper the prize by popular vote.

Damien Camut of Europa Electronics demonstrated a 10MHz crystal oscillator having frequency accuracy approaching  $10^{-9}$ . This was achieved by microprocessor applied compensation utilising an innovative method of establishing the crystal temperature. The frequency of a secondary oscillation at the third overtone response of the crystal was shown to be a reliable method of establishing compensation required. The technique eliminates an oven and so gives rapid start up.

In total fifteen papers were presented over two days. Focus areas included CAD software tools where the phrase "Throw-The-Die-Over-The-Wall" was introduced to delegates. Advances in device non-linear modelling was addressed by Malcolm Edwards of AWR who described the Cardiff model, S functions and X parameters. Millimetric wave systems up to 400 GHz were discussed by several presenters. Byron Alderman of Rutherford Appleton Laboratory reported sub-harmonic mixers and multipliers at 300 GHz, and explained how to solder the diodes with solder 5um in diameter! A focal plane imaging antenna array at 220 GHz was discussed by Greg Ball of QinetiQ. This technology has the potential to produce images without mechanical scanning.

The exhibition space featured equipment from a wide range of radio frequency and microwave companies including live demonstrations of phase measure measurements. In addition, the dinner provided a further opportunity for networking and the meeting of old and new friends. Wide ranging discussions continued until late in the evening and were not strictly limited to technical topics.

Guy Purchon of Anritsu, treasurer of ARMMS, closed the conference by thanking the speakers and reminded the delegates that the next meeting is at Oxford on Monday 19th and Tuesday 20th of April 2010. The programme co-ordinator will be Dr Steve Nightingale, Chief Consultant in Electronic Systems at ERA Technology. Visit [www.armms.org](http://www.armms.org) to book a place, offer a paper or download past papers.

The ARMMS RF and Microwave Society is an independent professional society comprised of Electronics Engineers with an interest in high frequency (RF & Microwave) design and measurement. [www.armms.org](http://www.armms.org)

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