NARTE NEWS

Volume 23 WINTER 2006 Number 1

Semi-anechoic Chamber

Semi-anechoic chambers are used in EMC testing so that there is a manageable ambiant for emissions testing, so that communications and broadcasting interference is suppressed during immunity testing and so that the fields are not effected by nearby conductors and other vageries as in outdoor testing.

COVER The cover photo is of a Semi-anechoic chamber and was contributed by ETS-Lindgren. Thank you.

contents

ARTICLES and FEATURES

HEADQUARTERS HIGHLIGHTS

Russ Carstensen Retires

This may be my last editorial for NARTE News. I have been honored to lead the organization for the past 6+ years but I have reached the point that I must retire. I have had the opportunity to report to you some of the funny things that have happened to me (see "Getting out of Calcutta" in this issue) as well as serious concerns for the organization. For me, it has been the greatest job I could have ever imagined but it is time for me to pass the baton to another player. I have volunteered to continue to support NARTE and I continue to believe in its mission.

It was my dear friend, Dick Ford, who pushed me into a concern for quality in the EMC arena that led to my involvement with NARTE certification. For Dick, it was just one part of an overall program for excellence in EMC. For the EMC community, it was a significant step toward professional recognition.

Much remains to be done both internally at NARTE and in professional relationships. The U.S. military needs to re-energize its efforts for hiring and contracting certified personnel. When the EMC certification process first started there was a lot of intertribal warfare related to the decision to participate. We have an opportunity to rethink those positions. The EMC program has been a continuing success.

NARTE will see competition from other organizations interested in providing certification services. For example, the IEEE Communications Society is currently looking into establishing such a certification program. The ESD Association has established a program manager certification in ESD control that compliments NARTE's technical certification. Only time will tell if their approach returns quality and value competitive with NARTE.

The NARTE Board is working on my replacement. At this point, a selection has not been made. When it is, I pledge to support that individual by providing the benefit of my experience and by continuing to write for NARTE News. To all of you who hold NARTE certificates, I would like to express my appreciation for your support and your patience. Your dedication to your profession has sustained me in my efforts. It has been a hell of a ride, but this is my stop and I must get off. I wish you the very best.

A tear comes to Russ's eye as he contemplates retirement

Good News!

The month of December is traditionally quiet and 2005 was no exception. However, due to the press of members to expense their renewals to 2005, revenue exceeded expenses for the second year in a row. Please understand that appreciation needs to go to the NARTE Medway staff for their ability to hold down costs in the face of an ever-increasing cost base. Careful management of our resources and attention

to outlays is a key to holding down expenses and fee increases.

NARTE Attends WCAI Symposium

NARTE staffed a booth at the 12th Annual Wireless Communications Association International Symposium and Business Exposition January 18-20, 2006, at the Fairmont Hotel in the San Jose, California. The show was at record size in every respect. The exhibition space was oversold so NARTE was moved into a smaller booth. If you are familiar with intelligent design you know that problems create opportunities. In this case, we were moved to the area around the front entrance. More than half of the attendees had to walk by our booth. And who could resist the balsa wood airplanes that NARTE gave out as souvenirs. As a consequence we had excellent booth traffic.

NARTE News Wants to Hear from You

What a great way to let off steam and build your ego at the same time. NARTE News readers want to hear about the work that you do. We are looking for individuals who would like to contribute articles for the newsletter. Readers have shown a preference for articles dealing with everyday project work. The News is just that; a newsletter not a refereed journal. Articles can be about anything in the fields in Telecom, EMC, ESD, Product Safety, or Wireless. If you are nervous about content, layout or structure, we will help with the editing. We would like any stories, letters, contributions, feedback, or anything you think would be of interest for other NARTE members. Send your stuff to nartenews@narte.org.

Office Technology Upgrade Progress

SalesCTRL is integrated with Microsoft® Office and helps manage our company and multi-contact information, account relationships, business opportunities, sales forecasting, lead tracking, automated marketing, sales cycle analysis, mailing list names, report generation, appointment scheduling, data synchronization, internet broadcast email, and customer service functions.

Your operations director, Terri Marinucci, has been working directly with the company that develops Sales Control and she has had a major breakthrough! The current version of Sales Control will now print certificates that are satisfactory for NARTE directly. We have been conducting demonstrations with the vendor to prove their claims. When we install the upgraded version, we will eliminate dependence on DOS and allow us to migrate to a windows environment.

Technician Pass/Fail Rates

We recently did a quick look at pass/fail rates for EMC engineers and technicians taking the NARTE EMC examination. What we discovered was curious. Engineers passed at a rate of about 69% (which is very close to our target rate of 70%) and technicians had a pass rate of 60%. The last issue of NARTE News carried an article about the difficulty of technicians getting an even break because of the great variety of experience in their background.

NARTE is looking for technicians who sat for the certification examination who are willing to talk about their experience. We would like to know what you studied, how you studied, what you encountered in the examination and where your weak points are so that we can raise the pass rate closer to 70%. Please provide your contact information to NARTE staff by email at narte@narte.org or by calling (toll free) 1-800-89(NARTE). We will interview you over the phone at your convenience.

New NARTE Test Centers for 2005

Don Bosco Technology Center
Cebu City, Philippines 08/03/2005

Advanced Solutions Institute
Tunapuna, Trinidad 10/06/2005

NC Elite Career Service Center
Cary, North Carolina 04/21/2005

Craven Community College
New Bern, North Carolina 04/07/2005

Individual Proctor
White Bluff, Tennessee 05/12/005

NEW

INTERFERENCE TECHNOLOGY eGUIDE

This issue is now online.

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NARTE Administrative Page

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Electromagnetic Environmental Effects (E^3) Technical Performance Measures (TPMs)

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Abstract

A way of communicating Electromagnetic Environmental Effects (E^3) concepts to project/program management is discussed in this paper. Called "Technical Performance Measures" (TPMs), it is a method for evaluating performance attributes using consistent judgment criteria. Attributes of subsystems may be evaluated and combined together to form system-level TPMs. While calculating system performance, weighting factors can be assigned to stress the importance of some subsystem attributes. Once the attributes are defined, judgment criteria established, and weighting factors determined, it only takes a minimal amount of time to update the TPMs periodically using a common tool such as Microsoft ™ Excel. This paper describes how TPMs can be constructed for E^3, but the same concept can easily be extended to other engineering disciplines.

Introduction

As leaders of E^3 teams working on large and complex aircraft development programs, we have historically struggled with communicating our technical concerns to our management in effective manner. We would try to discuss CS101 and RS103 for example, but our management would just look at us with a confused glaze in their eyes – a deer in the headlights look, so to speak. We realized that we needed to establish a common ground for communications, in order to make it easier for them to understand our concerns and the technical basis for those concerns. We recognized that we needed a more consistent methodology for expressing our engineering judgments to management. It was also necessary to develop a tool whose data could be updated quickly and easily so that the tool was not a burden to use.

E^3 TPM Concept

Risk management techniques were chosen as an easy method to communicate with management using familiar concepts and red, yellow, green colors to form stoplight charts. Starting with the subsystem components of a complex system, the E^3 requirements are broken down to their lowest level. These can commonly be found in the "shall" statements in subsystem requirement documents. Each "shall" attribute is evaluated based on the confidence of compliance with the requirement. Each requirement is then assessed for your confidence that the subsystem does (or will) comply with it. The challenge is to decide at what complexity level it is practical to do requirement compliance evaluation (major subsystems only, all subordinate subsystems, or some of both). Usually, the assessments are done most easily at the level that will be tested for specification compliance, such as the subsystems which will be tested individually for RTCA DO-160 compliance.

All these attributes ratings can be combined with other subsystem attribute ratings to form a single system score. System scores can be grouped together for successive higher-level systems ratings to come up with one rating for the entire system.

In the end, you will have an overall E^3 rating for a highly complex system that you can present to your management in a way that they can understand. When a problem is indicated, you have a tool to drill down to identify exactly what the problem is, which subsystem has the difficulty, and how serious the problem is to the overall system.

Rating Criteria

Establishing ground rules for rating criteria is a very important step in setting up the tool. A standardized set of evaluation criteria that is applied across the entire system is essential. We found it helpful to assign numeric ranges to the stoplight colors. If numeric ranges are utilized, you'll need to determine a scale (i.e. 1-5, 1-10, 1-100) and decide whether larger

numbers indicate a good rating or a bad rating.

When creating a rating system, it is important to understand that the definitions of the ratings will change as the maturity of the system develops. The early days of a development program are dominated by design reviews and proposal evaluation activities. For that phase of the program, a red rating would indicate an insufficient design to meet the requirements; a yellow would mean that some uncertainty exists that the design would meet the requirement; and a green would show that you have confidence that the design will meet the requirements.

It is much easier later in a development program to determine ratings as verification testing is taking place and test data is available. During that phase, a red rating would indicate that there was a failure to meet the requirement, with no variance to the requirement anticipated; a yellow score might indicate that the requirement was nearly met and a variance is expected; and a green rating would indicate that the requirement was met by test. New TPMs can and should be defined as necessary. Rating criteria should be adjusted as a project/program matures.

Weighting Factors

Some E^3 attributes of a subsystem may be more important than others to overall system performance or safety. Weighting factors can be applied to the E^3 attribute itself to relate it to the system-level consequences if a particular E^3 requirement is not met. For example, a transient susceptibility of a particular subsystem may be deemed to be of more concern than radiated emissions. Different weighting factors can be assigned as the ratings are rolled up from the subsystem level and combined to a system level rating. i.e. Interference to a radio receiver may not be as important as interference to a flight control computer.

Subsystem E^3 performance can also be affected by integration E^3 attributes, such as electrical bonding, signal routing, and shield terminations. These attributes are usually found in integration or interface control documents, and are not as easily identified as a “shall” in a subsystem requirements document.

We found it very difficult to determine the values of the weighting factors in the beginning, and we spent a great deal of time doing that the first few times we used this tool. We recommend that you not worry too much about the values that you assign to your weighting factors, at first. Use your experience and just make a decision. Then you can use the tool and see how it works out. You can and should adjust the weighting factors to incorporate common sense and lessons learned. Manual corrections to the calculated roll-up values may be necessary to represent reality more accurately. Don’t be afraid to change things during the first few rating cycles. Remember, this is your tool to help you communicate issues to your management. Let the tool work for you.

Generic Example of E^3 TPMs

The numerical range of Confidence Scores is chosen to be between 0 and 5, with 5 representing the highest confidence level. There are four Confidence Rating colors selected for this example: red, yellow, green, and gray. The numerical ranges for each color are established as 0.01 to 1.66 for red (low), 1.67 to 3.33 for yellow (moderate), 3.34 to 5.0 for green (high), and 0.0 for gray to indicate a not-applicable (N/A) condition. The combination of stoplight colors and numeric values makes it easy for the audience to understand the system status at a glance.

The next two figures illustrate different ways to display the TPM status of the system and subsystems. Figure 1 is a bar chart that shows the percentages of subsystems that are categorized in each of the Confidence Rating colors. The three bars pro-

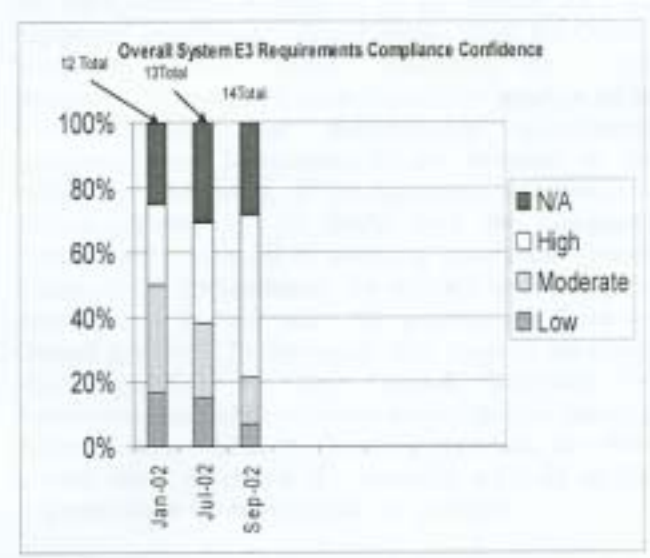

Figure 1 - Overall System E^3 Compliance Confidence History

vide the data from September 2002 as well as two previous assessments, so that the audience can understand the trends of the ratings changes. The total number of subsystems that were assessed is shown at the top of each bar. The number can change as subsystem designs become mature enough to evaluate, or when it makes sense to break down subsystems into their subordinate subsystems and assess those individually. In a well-run project, the confidence ratings would be expected to progress to high as the product design matures and completes its requirements verification testing.

Figure 2 demonstrates a different approach for displaying system status. It is also a bar chart, but this one provides the confidence rating for each subsystem for the latest assessment. This snapshot in time allows for a comprehensive display of the status for all the subsystems.

Table 1 is an example Excel spreadsheet that represents a system that includes four major subsystems (A, B, C, D) and their subordinate subsystems. The top row names all possible E^3 requirements or attributes that could be applied to any of these subsystems, and there is a row for each subsystem. The bottom five rows provide roll-up data for each attribute for each major subsystem, as well as for the total system. The first three columns provide identification data for each subsystem. The columns entitled “CE102”, “CE106/RE103”, and RE102” address emissions requirements. Columns “CS101” through “Lightning Indirect Effects” cover susceptibility attributes. System-level requirements for interfaces and equipment installation are addressed by columns “TPDs” through “Installation.” The “Performance Criticality” column is not a requirement, but we needed to keep track of this designation, and found it useful in the weighting calculations and for data sorting purposes. The “Subsystem E^3 Susceptibility Performance Value” column shows the combined susceptibility requirement compliance assessment for the subsystem. The “Subsystem E^3 Emissions Performance Value” column consolidates the emissions evaluations for each subsystem. The “Overall Subsystem E^3 Performance” column shows the results of roll-up calculations from the installation, susceptibility, and emissions assessments for each subsystem. Each populated cell in a row displays a number and a color for the evaluation of that particular requirement or attribute. There is a “Notes” option available in Excel that allows you to record comments or brief explanations about why the rating was chosen, or reminders to check on particular details during future reviews.

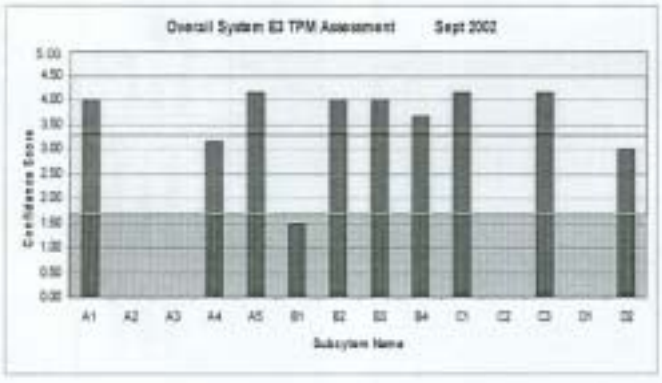

Figure 2 - Overall System E^3 Compliance Confidence Snapshot in Time

We recommend creating the weighting formulas by starting with top-level logic statements for each subsystem in words, before going into details of the formula itself.

For the example in this paper, the initial logic statements are as follows:

• Experience with these types of systems indicates that the susceptibility and the emissions characteristics are of equal concern.

• Poor or inadequate equipment electrical bonding has resulted in unsuccessful subsystem EMI qualification testing or EMI problems on the system in the field.

The resulting logic sentence for the subsystem row therefore concludes that the “Overall Subsystem E^3 Performance” equals the average of its own Emissions and Susceptibility performance parameters, AND the subsystem “Installation” configuration can be Acceptable or Not. The consequences of the “Installation” are then defined in more detail. We wanted to indicate that an inadequate Installation can have serious adverse effects on subsystem E^3 performance, so we decided that the Installation attribute value can be either 1 for “good” or 0 or “bad.” This is consistent with the rest of the ratings in this example, for which bigger values are better. So, if the Installation is Acceptable (1 for Good), then the equipment

installation will not detract from the Overall Subsystem E^3 Performance. The Overall System E^3 Performance value equals the Average of its own Emissions and Susceptibility performance parameters, and Installation in not included in the calculation. However, if the subsystem Installation is Not Acceptable (0 for Bad), then the equipment installation is expected to seriously reduce the Overall Subsystem E^3 Performance. To indicate how severe the impact could be, the value 2.0 is subtracted from the Overall System E^3 Performance. The range of calculated values possible for the Overall Subsystem E^3 Performance should be explored ensure that the resulting values remain within the boundaries set in the TPM ground rules, which for this example are 0.01 to 5.0. Adjustments to the formula may be necessary.

The final version of weighting logic formula for a particular subsystem row is:

IF [AVG (Susceptibility & Emissions) + (Installation)] is <0, then the Overall System E^3 Performance is 0.01,

ELSE Overall System E^3 Performance = AVG (Susceptibility & Emissions).

The roll-up formula for the subsystem columns can be derived in the same way, or could be chosen as the average, minimum, or maximum of the cells in each column, as appropriate.

TPM Usage Caveats

These TPMs are intended to provide insight into only the technical performance of the system and subsystem equipment. They are not intended to be used as an “earned-value” cost/schedule management tool, or as metrics for management of costs or sched-

Subsystem	Supplier Company	Configuration	CE102	CE106 / RE103	RE102	CS101	CS116	RS103	Ground Reference Plane Noise	Lightning Indirect Effects	TPD's	Cable Shields	Electrical Bonding	Installation	Performance Criticality	Subsystem E3 Susceptibility Performance Value	Subsystem E3 Emission Performance Value	Overall Subsystem E3 Performance
A1	RRR	1.0	5		5	5	5	4	5	5	5	5	4	1	1	4.00	5.00	4.50
A2	RRR	1.A													2			
A3		1.0													1			
A4	RST	1.A	4		4	5	5	4	5	4	5	3	5	1	1	4.00	4.00	4.00
A5	RRR	1.0	4		4	5	5	5	5	5	5	5	5	1	1	5.00	4.00	4.50
B1	SSS	1.0	5		5	5	5	4	5	3	4	5	5	0	2	3.00	5.00	2.00
B2	RST	1.0	5		5	5	5	4	5	3	5	5	5	1	1	3.00	5.00	4.00
B3	RST	1.0	5		5	5	5	4	5	3	5	5	5	1	1	3.00	5.00	4.00
B4	SSS	1.0	4		4	5	5	4	5	3	5	4	5	1	2	3.00	4.00	3.50
C1	TTT	2.0	4		4	5	5	5	5	5	5	5	4	1	2	5.00	4.00	4.50
C2	TTT	1.0													2			
C3	TTT	1.0	4		4	5	5	4	5	4	5	5	4	1	3	4.00	4.00	4.00
D1	RST	1.0													2			
D2	RST	1.A			5	5	5	5	5	5	5	5	5	0	1	5.00	5.00	3.00
		Sum Subsystem "A" Rqmt Performance	4.00		4.00	5.00	5.00	4.33	5.00	4.67	5.00	4.33	4.67			4.00	4.00	4.33
		Sum Subsystem "B" Rqmt Performance	4.00		4.00	5.00	5.00	4.00	5.00	3.00	4.75	4.75	5.00			3.00	4.00	3.38
		Sum Subsystem "C" Rqmt Performance	4.00		4.00	5.00	5.00	4.50	5.00	4.50	5.00	5.00	4.00			4.00	4.00	4.25
		Sum Subsystem "D" Rqmt Performance			5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00			5.00	5.00	3.00
		Sum Total Subsystem Rqmt Performance Value	4.00		4.00	5.00	5.00	4.46	5.00	4.29	4.94	4.77	4.67			3.50	4.00	3.80

Table 1 - Example E^3 TPM Spreadsheet

ule or critical path activities. There is no actual or implied relationship between E^3 engineering personnel performance and equipment technical performance. Good E^3 engineering advice can be overridden or ignored by project and/or program management, when technical performance is balanced against product cost, weight, schedule, reliability and other valid requirements or constraints. TPMs are not intended to take the place of risk evaluations, even though they are based on risk assessment techniques. Risks should continue to be identified, assessed, and mitigation plans developed for requirements compliance or system integration issues.

Conclusion

This E^3 TPM tool has successfully been used at Lockheed Martin and has proven to be useful for communicating E^3 concerns and status to program management. It is fast and easy to use because it is based on a readily-available spreadsheet application, and uses familiar project risk assessment techniques. It provides multiple layers of performance evaluation that enable justification of complex technical assessments. Although this spreadsheet is intended for use primarily by the E^3 specialists, it can be useful to share the detailed assessment data with project/program management. They seldom want or need all the minutiae supporting the top-level system E^3 performance confidence assessment, but are often reassured to know that it exists and can be produced if necessary. E^3 TPM evaluations can easily be defended when they are based on supplier qualification test data or very detailed assessments by subject matter experts.

This E^3 TPM approach provides a consistent methodology for assessing, predicting and tracking E^3 performance by allowing for archiving assessments to give a way to track the history of system and subsystem performance and the historical performance can be used with trend analysis for predictions for future similar equipment. This tool also provides technical assessments with little time invested. The most recent evaluation update required only three man-hours of labor for more than 45 subsystems on a current Lockheed Martin program. It is expected these TPMs will evolve further, as we refine our tools for effective communications with our program and technical managers.

February 2006 Reflector Submission from the Reliability Chapter

CENTER SECTION
Reliability – 6:00 PM, Wednesday, February 8
Impact of the ESD Trend Toward Ultra-sensitive Components

Terry L. Welsher and G. Theodore Dangelmayer

The IEEE Reliability Chapter held a joint meeting with the ESD (Electro Static Discharge) Society. This meeting focused on proactive measures to deal with the challenges of unexpected ESD failures in new locations in the manufacturing process due to the industry wide trend towards ultra-sensitive (ESD Class 0) components. The interactive discussion stressed countermeasures including both manufacturing and design enhancements.

The meeting was held at RSA Security in Bedford, MA. Visit the IEEE Boston Reliability Chapter website: http://www.ieee.org/bostonrel.

ARTICLE

Reliability Society – 6:00 PM, Wednesday, February 8

Impact of the ESD Trend
Toward Ultra-sensitive Components

Terry L. Welsher and G. Theodore Dangelmayer

ESD failures are occurring with increasing frequency, in unexpected ways and at new locations in the manufacturing process due to the industry wide trend towards ultra-sensitive (ESD Class 0) components. Even wafers are now failing due to ESD damage and mathematical models indicate these failures will increase with the scaling trends. Device design experts are experiencing increasing difficulties designing-in adequate ESD protection. The SEMETECH and ESD Association technology roadmaps are projecting sensitivities below 100 volts for all three simula-

tion models (HBM, CDM, MM) by 2010.

The IEEE Reliability Chapter held a joint meeting with the ESD (Electro Static Discharge) Society. This meeting focused on proactive measures to deal with the challenges of unexpected ESD failures in new locations in the manufacturing process due to the industry wide trend towards ultra-sensitive (ESD Class 0) components. The interactive discussion stressed countermeasures including both manufacturing and design enhancements.

Dr. Terry L. Welsher retired from Lucent Technologies-Bell Laboratories Engineering Research Center in 2001 as the Director of the Quality, Test & Reliability department. He has also been active in quality standards and roadmapping activities with SEMATECH, the ESD Association and the JEDEC 14 Quality and Reliability Committee. He holds a BS in Chemistry from Florida State University and Ph.D. in chemical physics from the University of Texas at Austin.

G. Theodore Dangelmayer is the president of Dangelmayer Associates, L.L.C. and has been developing ESD programs since 1978 for large global corporations as well as individual proprietorships. He is currently president of the Northeast Chapter of the ESD Association and a member of the ESD Association International Council of Education, 2003 Technical Program Committee and is the chairman of the ESDA Corporate Sponsorship Programs.

This meeting was held on Wednesday, **February 8** at RSA Security in Bedford, Massachusetts. It will began with pizza and personal networking at 5:30 PM. The presentation followed at 6:00 PM. IEEE members and non-members are welcome. See the RSA Security website at http://www.rsasecurity.com/node.asp?id=1059

GETTING OUT OF CALCUTTA

By Russell V. Carstensen, PE, NCE

It started at 1 AM. First, let me say that I hate flying into or out of Orlando. It is like flying out of Calcutta. Everyone wants to go at the same time. They are traveling in great family hordes. They are tired and cranky with mouse ears on their heads – not an example of humanity at its best. Even so, sometimes you just have to bite the bullet and go with the flow.

Such was my case. I had flown in for a one-day meeting. I had trouble getting a flight in at a reasonable time and even worse luck getting out. The best I could do was a 6 AM departure. Loyal to the "two hour rule," I concluded that I would have to be at the airport at 4 AM. I asked the hotel for a 3 AM wake up call to allow for shaving, packing and checkout.

My wife called from home (10 PM her time, 1 AM my time) to say that my flight had been delayed until 9 AM and I would not get to Denver in time to catch my scheduled flight so I have been booked on a 2 PM departure for Seattle. That schedule will have me in at about 5:30. I had a prior commitment to a meeting that evening at 7:30, but if all went well I could just make it. My wife then casually mentioned an "800" number I could call for details. She then announced that it was her bedtime and left the matter in my hands.

I called the 800 number. It apparently was the airline's Bangladesh office. The fellow on the other end had a thick accent along the lines of Apu from the Simpsons. He confirmed that the flight had indeed been delayed but added that I still had to check in for the 6 AM departure in case the plane left earlier than the now anticipated 9 AM. In my sleep deprived state I accepted his fuzzy logic. It was now 1:45 AM. My 3 AM wake up still stood. Did you ever try to go back to sleep with the pressure of only having one hour to do it? Don't tell me about your success because I really don't care. I can only say that it does not work for me.

I counted cracks in the ceiling for about an hour. At 2:45 AM I said (well, we will forget what I said - but rest assured that it wasn't nice) and got up to shower. I finished freshening up, packing and straightening the room and headed to the check out desk. When I got there the night clerk couldn't check me out because she was backing up their accounting system

and it would be some time before the computer would be available. However, she offered to fax me a receipt.

I caught the shuttle and headed for the airport. Because everything went smoothly, I arrived at the check in counter at about 3:50 AM. There were a dozen people in line already and more were arriving every minute. A skycap came by and announced that the ticket counter would open at 4 AM. I pointed to the clock on the wall and reminded him that it was now 4:05. He corrected himself by saying that the counter would open at 4:15.

At 4:20 the agents appeared. Apparently the ticket people were delayed in the secret room where all agents go to plot frustration of the public. They had worked out a new game plan. As they came out of the secret room, they announced that anyone going to Philadelphia, Pittsburgh or Washington needed to go to the airline next door. They also pointed out that those of us with e-tickets needed to be in another line. I thus moved to the newly designated e-ticket line. After the line formed, she then announced that those on the flight to Denver (my flight) needed to be in other ticket line because they had to be re-ticketed. I said some unkind thing to myself (the joy of traveling alone) and jumped back into the line I had just left. I lost ground by a half dozen mouse eared munchkin pods but was not as far back as if I had gone to the end of the line.

After a respectable wait, I found myself at the counter prepared to lose another battle of wits. I calmed myself by taking a deep breath and swearing not to answer “How are you?” with a litany of my adventures so far. I was faked out by a greeting of “This is going to be a terrible day!” We then started the transaction. She confirmed that I had been rescheduled and was ticketed through to Seattle as my wife had said. I did not ask why Apu didn’t know. As a reward, her computer froze and she had to reboot. Then she did an unexpected reversal and pointed out that by her scale, my bag was seven pounds over the limit. I could take out seven pounds or pay a fee of $25.00 (for which I would not be reimbursed). I opened the bag but could not find seven pounds that I could take with me (I already had two carry on bags, my computer and my briefcase) and threw in the towel. When she went to print the ticket, her computer froze again and she had to reboot. While we were waiting, she mentioned that yesterday a man had become so agitated that he jumped the counter to get the agent. Instead of registering shock, I asked, “Did he score?”

As I arrived at my assigned gate. I cracked the code. They didn’t have a pilot to fly the plane! The pilots would not arrive until 9:30 so, of course, the flight will be delayed yet a bit more. Meanwhile, we were told that we could board the aircraft to be ready to depart as rapidly as possible after the captains reported. Oh, and by the way, without a pilot they can’t run the air conditioning. So it will be hot in the plane but please bear with. Miraculously, a passenger offered to start the air conditioning. Turns out that he is a commuter pilot who is checked out on the same aircraft type. The ground people knew him and let him go ahead.

My seat group was called to board. I headed for my seat. I was on the aisle. The boarding slowed to a trickle. No one has come to fill up my row. The boarding completed and still there is no one in my row. They close the doors. I have the row to myself! At last things are beginning to turn. I have room to stretch out and no one to climb over me to get to the restroom. I am out of Calcutta. I can look forward to four hours of sleep. Life is good!

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A Brief History of Spark Gap Transmitters

By Art Marshall, w1fji
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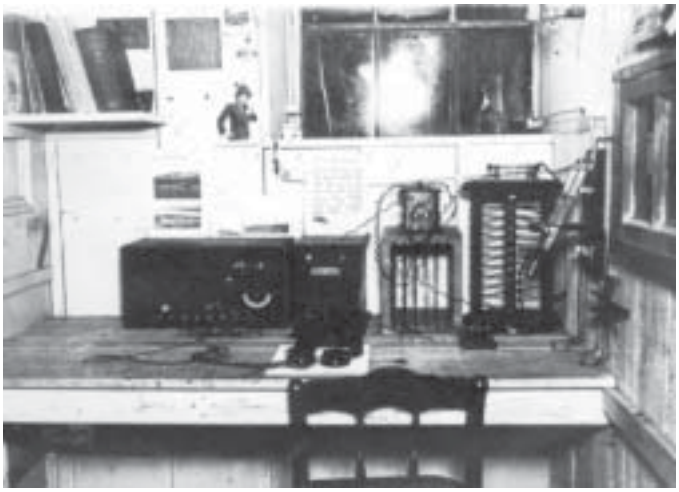
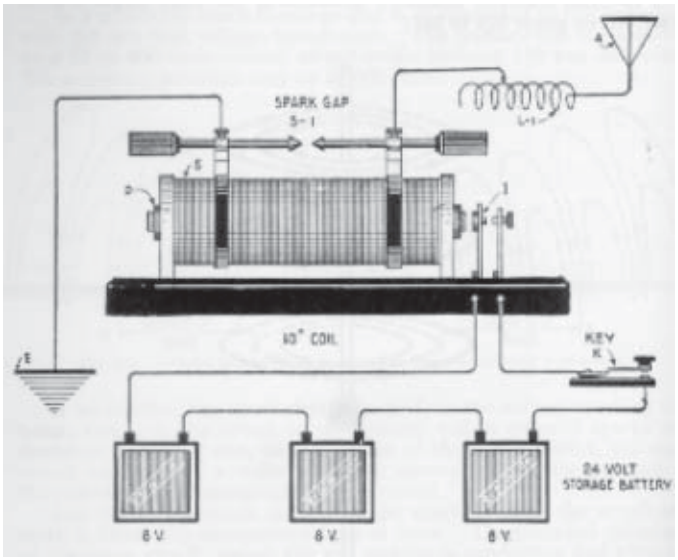
The first thing to stress is that "SAFETY WAS NOT A MAJOR CONCERN" during the days of Spark, some of the methods used were VERY DANGEROUS. That having been said that, lets move on. There was a certain amount of excitement that was associated with Spark Gap transmitters. Without getting into the theory or design of these Spark Gap Wireless transmitters, lets attempt to get an over-view of their operation.

In their simplest form, some of the early models' of the wireless transmitters were designed by Guglielmo Marconi a young Italian inventor. By the age of 21 he had studied many of the experiments of Maxwell and Hertz, and was convinced that it was possible to transmit signals by electromagnetic waves. After having performed many of the experiments himself, Marconi had proven that it was indeed possible to communicate by electromagnetic waves. Some of his early wireless transmitters were powered by either low voltage storage batteries, or a D.C. dyamotor which would produce 5 to 30 volts D.C. The low voltage was fed to one side of a telegraph key. As the telegraph key was depressed, and the circuit closed, current would flow into the primary side of an induction coil. This would induce high voltage currents to flow in the secondary windings of the coil.

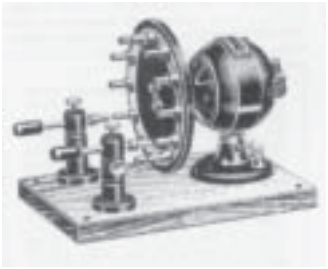


These high currents would charge the antenna, then discharge across the spark gap electrodes to ground. This action would produce electromagnetic waves for each discharge across the Spark Gap electrodes. The antenna was connected to the induction coil by means of another coil with a moveable tap. A broad band wave would then be radiated from the antenna.

Another of the Marconi designs employed a low voltage A.C. source. This low voltage A.C. was fed to the primary side of a transformer. When the telegraph key was depressed, this induced high voltage currents to flow in the secondary windings of the transformer. The high voltage alternating currents at the secondary of the transformer could range from 2000 volts to 25,000 volts A.C. These secondary high voltage currents were then fed into a tuned circuit, which is inductively coupled to the antenna. The alternating currents in the secondary would alternate back and forth within closed oscillator circuit, which was made up of a coil, high voltage condenser an spark gap electrodes. The high voltage currents would first charge and then discharge at a frequency twice that of the source voltage across the gap electrodes. Next the currents were induced into the antenna through a transformer and then radiated.



Other designs would employ a rotary spark gap, also known as a multiple spark system, which was motor driven. On the shaft side of the rotary would be a rotating arm with two electrodes 180 degs apart which would rotate like a wheel. Around the outside of the two rotating electrodes were several fixed electrodes. As the rotary spun, and the telegraph key was depressed, the high voltage currents would discharge across the gaps of the rotary. With each make and break of the heavy copper contacts on the telegraph key, sparks would jump the gap of the electrodes. The rest of the circuit would be somewhat the same as was discussed above. As you can imagine, the contacts of the telegraph key needed to be able to handle 16 to 18 amps. Not only did the telegraph key have to employ heavy contacts, but the electrode gap contacts themselves would heat up due to the discharging of the stored energy. The rotary in the museum uses heavy copper blocks on both the rotary wheel, and for the two stationary contacts. In a Steam and Wireless Museum in South Rhode Island they had a working spark gap transmitter. One can hear the sounds that were made not only from the rotary but likewise the sparks that produced when the telegraph key was depressed, it was quite a sight.

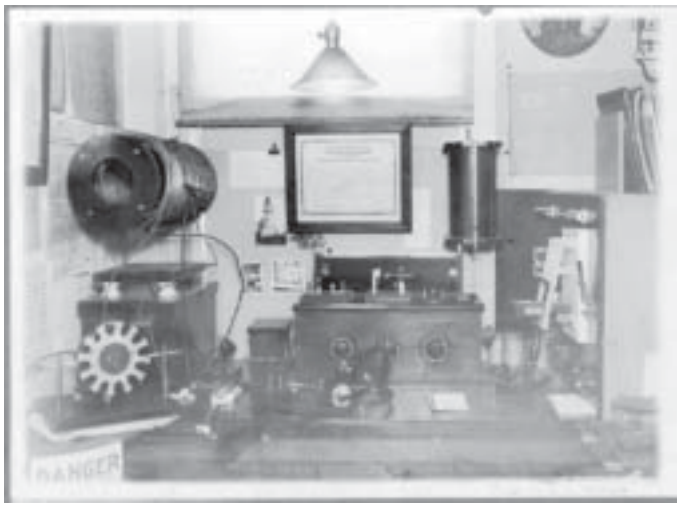


The sounds of the rotary turning and the sparks jumping the air gaps can be heard all over. In the early days of radio these were common sounds. The energy generated by this method was very powerful and obviously dangerous. These were the days when amateurs were experimenting with various ways of generating a wave, various antenna configurations, and receiving apparatus possible. The actual signal produced by this method was very crude sounding as the waves were produced by alternating currents.

Large coils had to be hand wound for use as transformers, oscillator and antenna coils. Large knife switches were used to switch not only the power, but were also used to switch the antenna from the spark gap to the receiving apparatus, as well as antenna to ground. The greatest distance they were able to transmit was about 100 miles. Some might remember pancake transmitter inductances and loose couplers that made up important parts in the then modern station. A typical station in 1916 might include a ½ kw transformer that supplied 14,000 volts, an eight section condenser and a Hy-Tone rotary gap. The receiver, or Audion was used for reception with Crystaloi and Perikon detectors which served for most of the work. Completing the station might be a six wire antenna 70 ft high. Although this structure is now called an antenna, it was also known as an aerial.

Radio communications had come a long way from the early on experiments of Hertz, Maxwell, Marconi and others. Although the Spark days were quite unique, radio was moving forward. Like everything else, Spark was destined to give way to the next phase of radio. For some, the move to the next phase would be an easy one. While for others the change from Spark would not come so easy.

The American Radio Relay League was founded



by Hiram Percy Maxim and Clarence D. Tuska around June or July 1914. Amateur radio was growing and it was now time for the hobby to move out and make its' mark in the world. Somewhere around 1920 through 1922, spark was on its' out, and radio was beginning a new era.

There are many articles on Maxwell, Hertz, Marconi and others who have contributed. You can visit your local library and read up on some of the very interesting experiments they had performed. Even today radio is undergoing many changes. Tramsmitting modes have changed from CW and AM to SSB and DSB, from SSB, DIGITAL, DSP, BAUDOT to ASCII CODE and AREALS to SATELLITES.

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Mr. Willie W. Smith 9/7/05
Mr. Ralph E. Stimphic 4/7/05
Mr. Keith B. Stone 8/3/05
Mr. Joseph Targhy 4/7/05
Ms. Mary L. Thomas 1/5/05
Mr. Andrew S. Usher 12/21/05
Ms. Sarah-Ann West 9/7/05
Mr. Kenneth D. Worthen 2/24/05
Mr. Gavin J. Wright 7/6/05

NARTE Certified Wireless Installer Technicians

Mr. Adam L. Chedester 8/17/05
Mr. Ryan J. Olson 1/5/05