eSyst Implementation Webinar Series Part Six: Electronics Communication

Maricopa Advanced Technology Education Center

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A presentation of eSyst.org

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at the
Maricopa Community Colleges.

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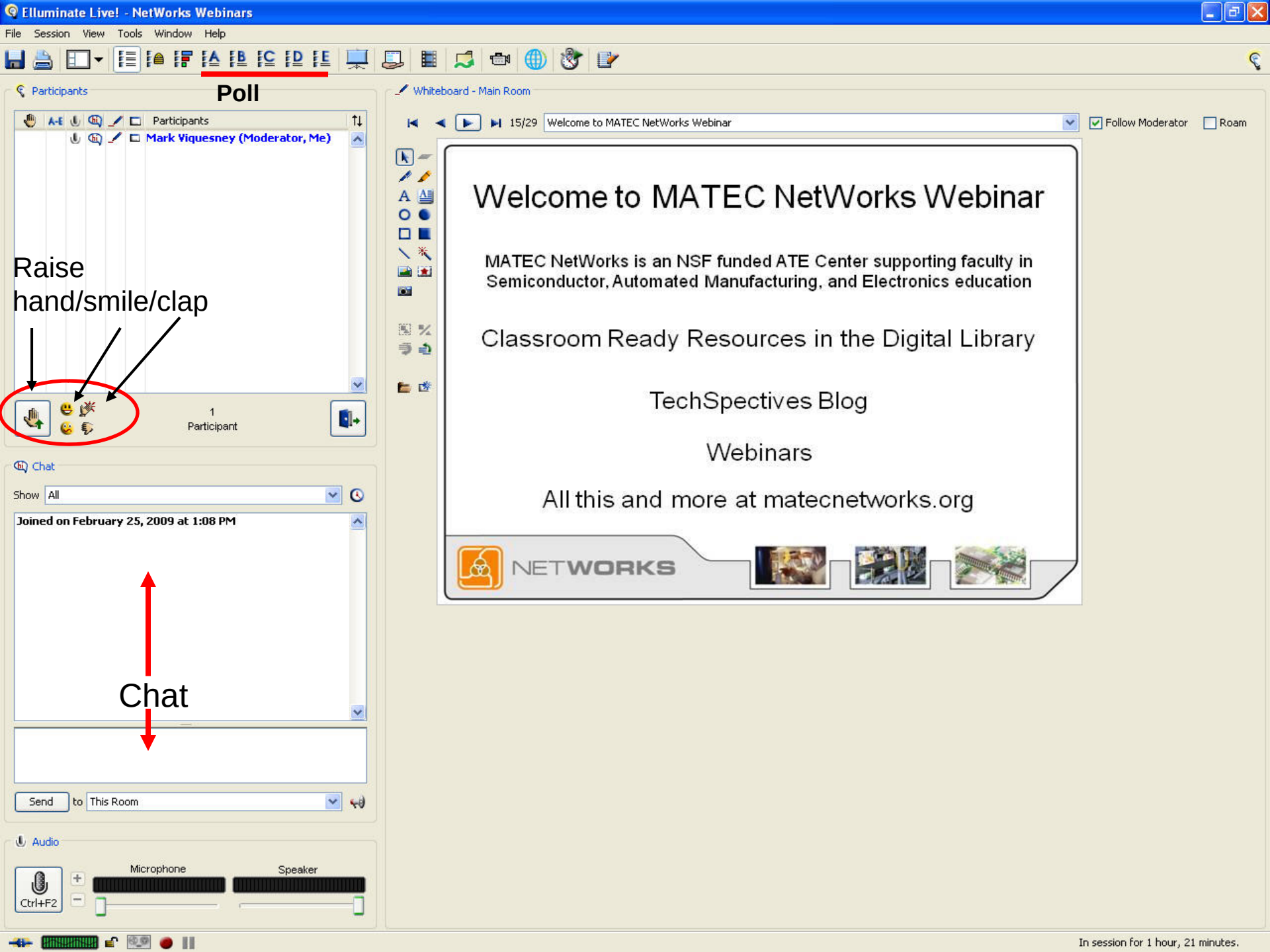
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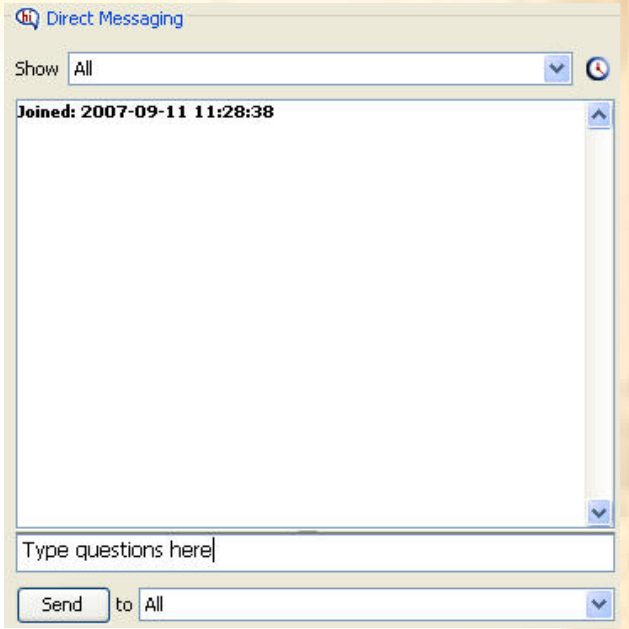
NETWORKS
In session for 1 hour, 21 minutes.

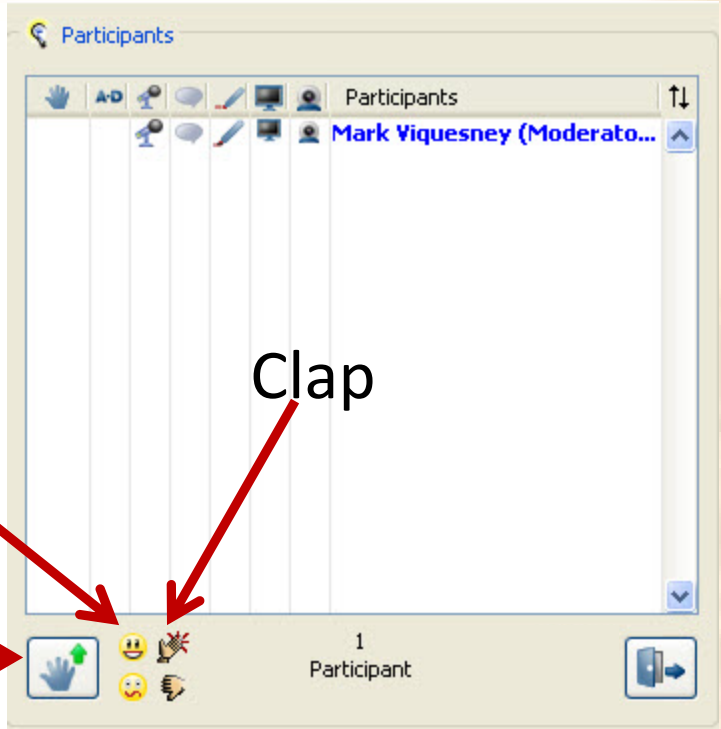
Chat Box

- If you have questions during the presentation, please submit them in the Chat Window and Send to "All" so that others can follow along.
- Throughout the presentation and at the end of the session we will answer as many questions as we can.



Participants Box

Allows you to respond to the presenter's comments.



eSyst Webinar Presenter

Tom McGlew:
eSyst Project Manager

eSyst Webinar Agenda

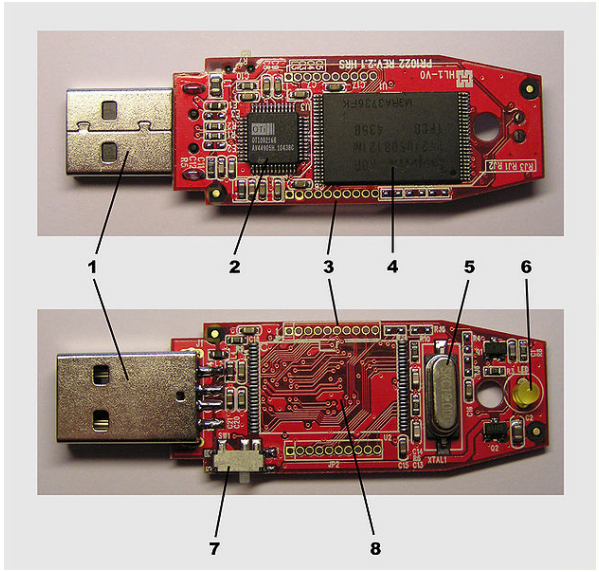
- Overview of the eSyst Project
- Review of the eSyst Implementation Guide
- Demonstration of the Transmission Line Measurement System Lab
- Web site tour
- Survey and Final Questions from Participants

eSyst Project Overview

A presentation of eSyst.org

So what has changed and what is a System?

Then to Now

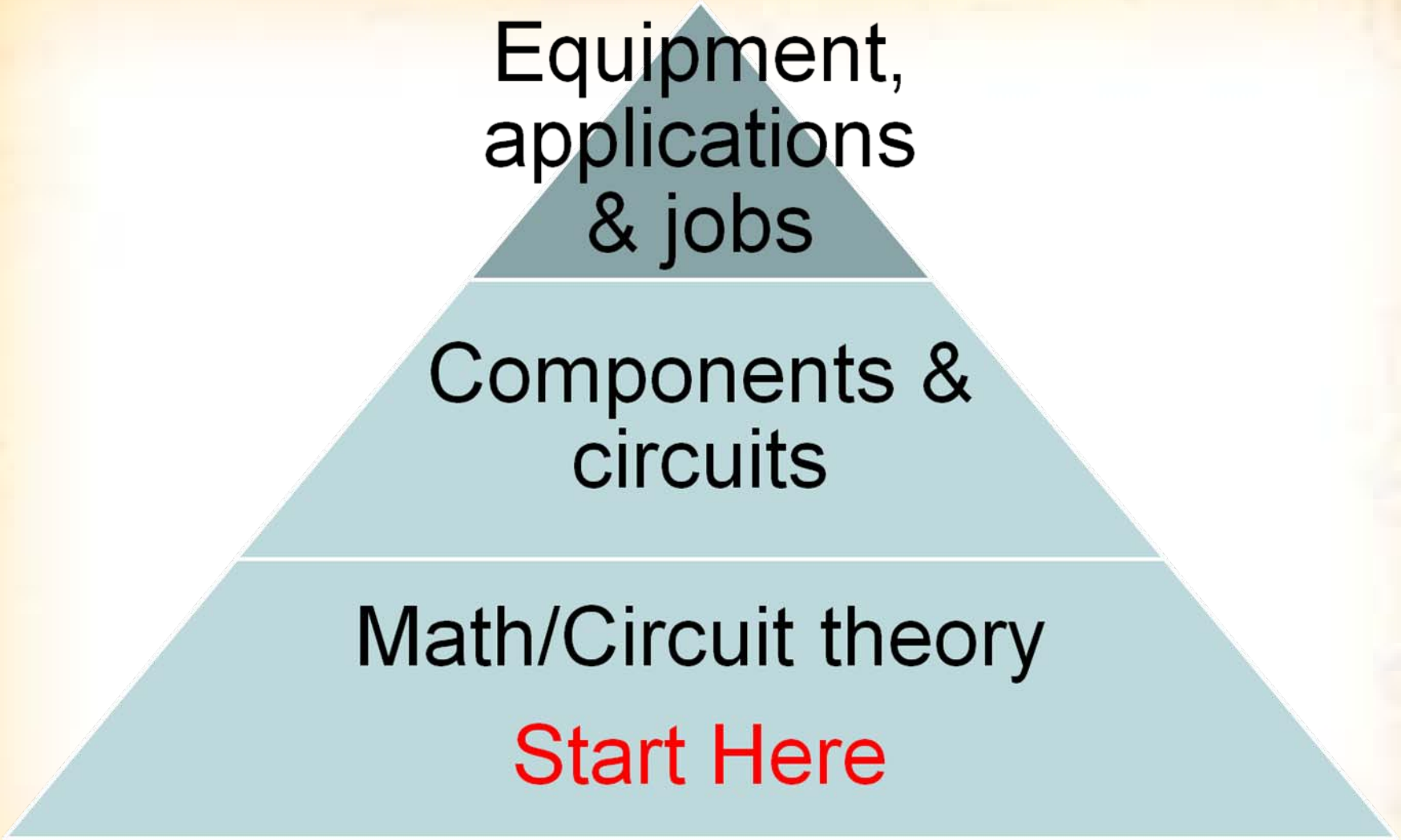


Now to the Future

eSyst Home Media Animation

http://www.esyst.org/Courses/Entertainment_System/animation900.html

The Legacy Bottom Up Approach



Impact to Graduating Technicians

- Major implications for graduating technicians
  - Less troubleshooting to the component level
  - More system troubleshooting, measurement, and test
  - More equipment interaction via software operating systems
  - Few, if any engineering technician jobs

Results in:

- Legacy programs being out of touch with reality

Questions?

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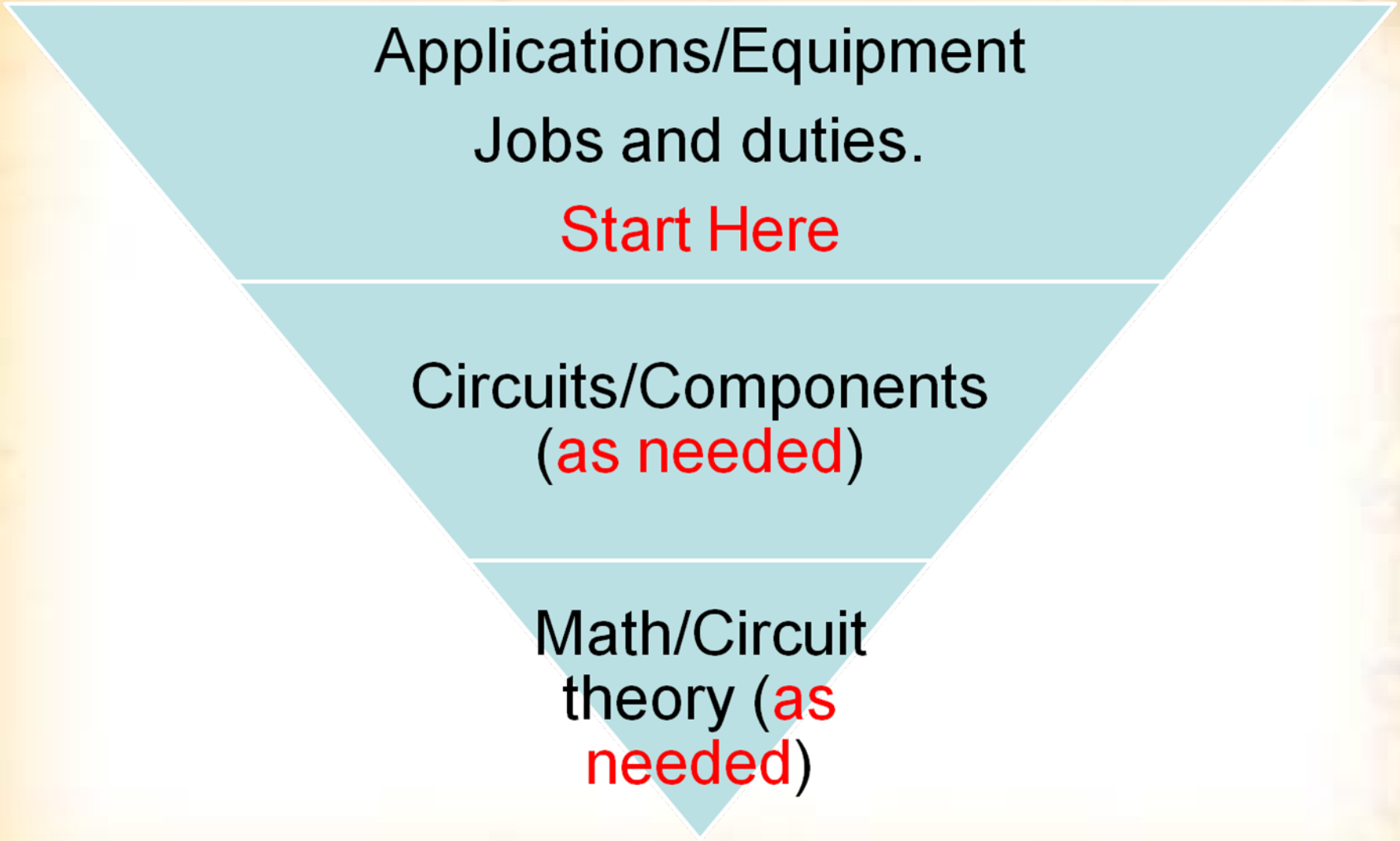
So what's a Faculty going to do?

The Top-Down Approach



One Solution: eSyst Resources

- An NSF project conceived to address the systems view of electronics to meet industry's current needs by:
  - Development of new systems resources
  - Creation of a guide to help facilitate the changes
  - Encourage colleges to update programs

Electronics Courses Identified by eSyst Project Team

- DC and AC Circuits
- Solid State Devices
- Digital Fundamentals
- Microprocessors including microcontrollers
- Data Acquisition and Measurement
- Electronics Communications

Project Status

- Project has resources for the following on eSyst.org:
  - Implementation Guide
  - DC/AC Circuits
  - Solid State Devices
  - Digital Fundamentals
  - iLabs Remote Phase Two is now available on the Student Resources webpage
  - Microprocessors
  - Data Acquisition
  - eCommunication

Questions?

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Implementation Guide: Project Information

- eSyst Drive for Revision and Project Goals
- eSyst Approach to Electronics Systems
- Definition of an Electronics System
- Technicians and Systems Applications
- eSyst Program recommendations
- eSyst Course recommendations
- M.I.T. iLabs eSyst Project description

The ***Implementation Guide*** can be found on the **Faculty** tab menu on the eSyst web site.

Implementation Guide: Course Information

- Traditional View versus Systems View
- General Course Recommendation
  - De-emphasized Topics
  - New Systems Topics
  - General Lab Recommendations
  - Textbook Recommendations
- Student Learning Outcomes
- Systems Course Outlines
- Systems Instructional materials

Rationale for a Communications Course

Rationale:

- All electronic products and systems involve some form of communications.
- Communications is essential to learning electronics.
- Communications should be a core course and required of all students in AAS programs.
- Most colleges do not offer a communications course currently.

General Communication Course Recommendations

Recommendations:

- Because of the broad nature of communications, a comprehensive course is generally not possible.
- A good alternative is a generic survey course of the most widely used technologies.
- The course should be a mix of fundamentals, wireless principles, and wired networking.

Wireless Coverage

Coverage:

- The frequency spectrum and its regulation.
- Basic modulation/demodulation, multiplexing and access methods with emphasis on digital formats (I/Q, DSP, SDR).
- Radio architecture at the block diagram level.
- Antennas, transmission lines and propagation.
- Overview of widely used technologies like cellular, Bluetooth, Wi-Fi, ZigBee, ISM, etc.
- Wireless related tests and measurements.

Wired Networking

Networks:

- The frequency spectrum and its regulation.
- Basic modulation/demodulation, multiplexing and access methods with emphasis on digital formats (I/Q, DSP, SDR).
- Radio architecture at the block diagram level.
- Antennas, transmission lines and propagation.
- Overview of widely used technologies like cellular, Bluetooth, Wi-Fi, ZigBee, ISM, etc.
- Wireless related tests and measurements.

Other Recommendations

Recommendations:

- Take a full systems approach to the course as that is the level at which communication techs work.
- Include more communication related test equipment in labs as funding permits (spectrum analyzer, analyzers, generators, power/swr meters, etc.)
- Integrate the FCC GROL license exam requirements into the course leading the students to pass the exam.

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De-emphasized Topics

The following traditional topics should be de-emphasized for a Electronics Communication course:

1. Discrete component circuit analysis.

   Rationale: Most communications equipment is made up of ICs that form boards, modules and subassemblies. Very few discrete component circuits like oscillators, amplifiers, mixers, etc. are actually used. Most of these circuits are inside ICs and cannot be analyzed or repaired. There are a few exceptions: LC and other filters and RF power amplifiers which still use discrete components.

De-emphasized Topics continued

2. Overemphasis on analog circuits and techniques.

   Rationale: Most radios use digital techniques and circuits such as I/Q modulation and demodulation and DSP. Stress these new methods over the older AM/FM emphasis of the past.

3. Less coverage of the lower radio frequencies. Emphasize the higher frequencies.

   Rationale: Lower frequency radio (< 30 MHz) is still used but the bulk of modern communications equipment operates at VHF, UHF and microwave frequencies. The emphasis should be on microwaves (> 1 GHz) as that is where most of the new equipment operates.

New Systems Topics continued

The following new systems topics should be integrated into a Electronics Communication course:

1. Increased coverage of antennas and transmission lines.

Rationale: With most communications equipment implemented with ICs, there is little a technician can do to troubleshoot or repair such equipment. As a result, the emphasis should shift to topics that technicians actually do get actively involved in.

– Antennas and transmission lines

– Techs install, test, troubleshoot, and repair antennas

– Major antenna types and their applications

– Main transmission line types with emphasis on coax cable.

– Transmission line tests and measurements (attenuation, impedance, SWR, etc.) are essential to a good system.

New Systems Topics continued

2. Emphasize propagation

Rationale: Radio wave propagation, especially at VHF, UHF and microwave frequencies, is critical knowledge for any tech doing installation and testing of wireless systems. The success of any radio system relies heavily in knowing propagation characteristics and how to take advantage of them or how to overcome their disadvantages.

New Systems Topics continued

3. Increase use of modern test instruments.

Rationale: What modern communications techs do is test and measure. Most of the work is done with instruments other than the digital multimeter and oscilloscope. Instruments such as the spectrum analyzer, modulation analyzers, vector signal analyzers, signal and arbitrary waveform generators, power and SWR meters, and other RF instruments are more commonly used.

Such instruments are expensive and this is a major disadvantage for most colleges. However, any good modern course should at least introduce these instruments and where possible provide one of each to demonstrate or use in the lab. Used or rental equipment can also provide for this need. Virtual test instruments offer another option such as NI LabView or Multisim etc..

New Systems Topics continued

4. Cover computer networks, especially Ethernet.

Rationale: Virtually all PCs, laptops, and other computers are networked today. All techs will at some point work with these networks and connections. Most computer networks use Ethernet. All courses should cover the basic Ethernet protocols, physical layer (PHY) and media access control (MAC) layers of this ubiquitous networking technology. Equipment like network interface cards, hubs, switches and repeaters should be included. Cabling coverage is essential, both CAT5/6 and fiber.

New Systems Topics continued

5. Cover Internet related technologies.

Rationale: The Internet is connected to everything. Techs must know the basic Internet protocols (TCP/IP, UDP, etc). Coverage of basic Internet communications should be introduced with emphasis on routers and routing.

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New Systems Topics continued

6. Cover fiber optics.

Rationale: The Internet backbone is fiber optics and the higher speed Ethernet networks use fiber connections. Fiber is also common in cable TV systems and other broadband connections in metropolitan area networks. It is also widely used in cellular base station backhaul. It use is increasing. The course should provide a basic introduction to the basic cabling, signaling, components, equipment and protocols.

New Systems Topics continued

7. An excellent guide and supplement for this course is to provide preparation for passing the FCC's General Radio Operators License (GROL) exam.

Rationale: This license is still a highly regarded credential in the communications industry and is often used as a hiring screen. Most communications courses will already cover the core material. Much of the FCC exam is basic electronics covered in earlier courses. But the communications related items could be covered in the course. The exam is truly system oriented as GROL holders do system type jobs. The final exam could be a practice FCC exam. The student could go into the job market with an AAS degree plus the FCC license making him or her far more valuable and employable than others.

General Lab Recommendations

One of the major deterrents to the implementation of a communications course in a community college is the cost of the laboratory. This is especially true of the test equipment generally needed to do RF and microwave work. Yet, since the key job of a technician in any communications job is testing and measuring, some hands-on experience is essential. This can be obtained with lower cost equipment in most cases that simulate actual practice. Here are a few general recommendations:

General Lab Recommendations continued

1. Acquire at least one spectrum analyzer despite its cost. Used and limited frequency versions can be acquired at a reasonable cost. The spectrum analyzer is “the” key communications test instrument, not the oscilloscope as in other segments of the industry. Students must fully understand the frequency domain and know how to use a spectrum analyzer. If insufficient funds are available, use an alternative lower cost approach such as the digital signal analyzer that is part of most virtual instrument software packages such as National Instruments’ LabVIEW.
2. Include transmission line experiments typical of those in the lab manual supplement to the PECS text recommended above. These use low cost RG-58/AU coax and BNC connectors and the MFJ-269A tester. It contains a signal generator with an output to 470 MHz, a frequency counter, and SWR and impedance measuring circuits all at a very low cost affordable in any lab. This instrument is invaluable in all antenna and transmission line tests and measurements.

General Lab Recommendations continued

3. Demonstrate data transmission using commonly available short range wireless modules using popular standards (ISM band, 802.15.4/ZigBee, etc.)
4. Plot antenna patterns of popular configurations (dipole, Yagi, patch, etc.)
5. Demonstrate common hardware for digital modulation and demodulation. (ASK, FSK, BPSK, QPSK, QAM, etc.) A recommended system is that produced by Emona Instruments (www.tims.com.au). Their Telcoms Trainer ETT-202 works with the National Instruments ELVIS platform and uses the LabVIEW virtual instruments on a PC for low frequency demos and tests. It is ideal for this course lab.

General Lab Recommendations continued

6. Set up a WiFi access point.
7. Demonstrate and test Ethernet cabling with PCs, hubs, switches.
8. Demonstrate basic fiber optic communications. The Emona Instruments ETT-211 Fibre Optics Trainer is a good choice and works with NI ELVIS.
9. If the instructor is a licensed amateur radio operator he could demo a variety of communications techniques like HF CW, VHF/UHF voice, satellite, and digital communications like PSK31.

Questions?

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Transmission Line Measurement System Lab

Louis Frenzel
Electronic Design Communications Magazine

Project Lead Subject Matter Expert

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Web Site Tour

Demonstrate eSyst web site:

- Implementation Guide
- Communication Systems Lab Activities
- General tour of the available resources

eSyst Web Site

Project Development Team Members

Mike Lesiecki – Principal Investigator

Lou Frenzel - Project Lead Subject Matter Expert

Roy Brixen – Project Developer

Wayne Phillips – Project Developer

Jesus Casas – Project Developer

Ui Luu – Project Developer

Bassam Matar – Project Developer

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John Robertson – Project Consultant

Tom McGlew – Project Development Manager

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