Affordable Test & Evaluation in a Complex World

27th Annual National Test & Evaluation Conference

"Test & Evaluation: Serving the Warfighter"

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Agenda

- Increasing System / Software Complexity

- Increasing T&E Costs or more Delivered Defects

- What can T&E do to be more Affordable

Increasing System / Software Complexity

- The environment of systems is ever an increasing complexity with more and more software
    - One engine manufacturer predicts that the cars and trucks of 2020 will have over a billion lines of code

- It appears that every new weapon system has more and more software

- Testing this much software is impossible with current methods

Increasing System / Software Complexity

Some Background

Last years NDIA T&E Conference presentation titled "Closing the T&E Gap…"

- "The funding and research for testing & evaluating new technologies is not keeping pace with the rate of technology change"

The Exponential Times We Live In
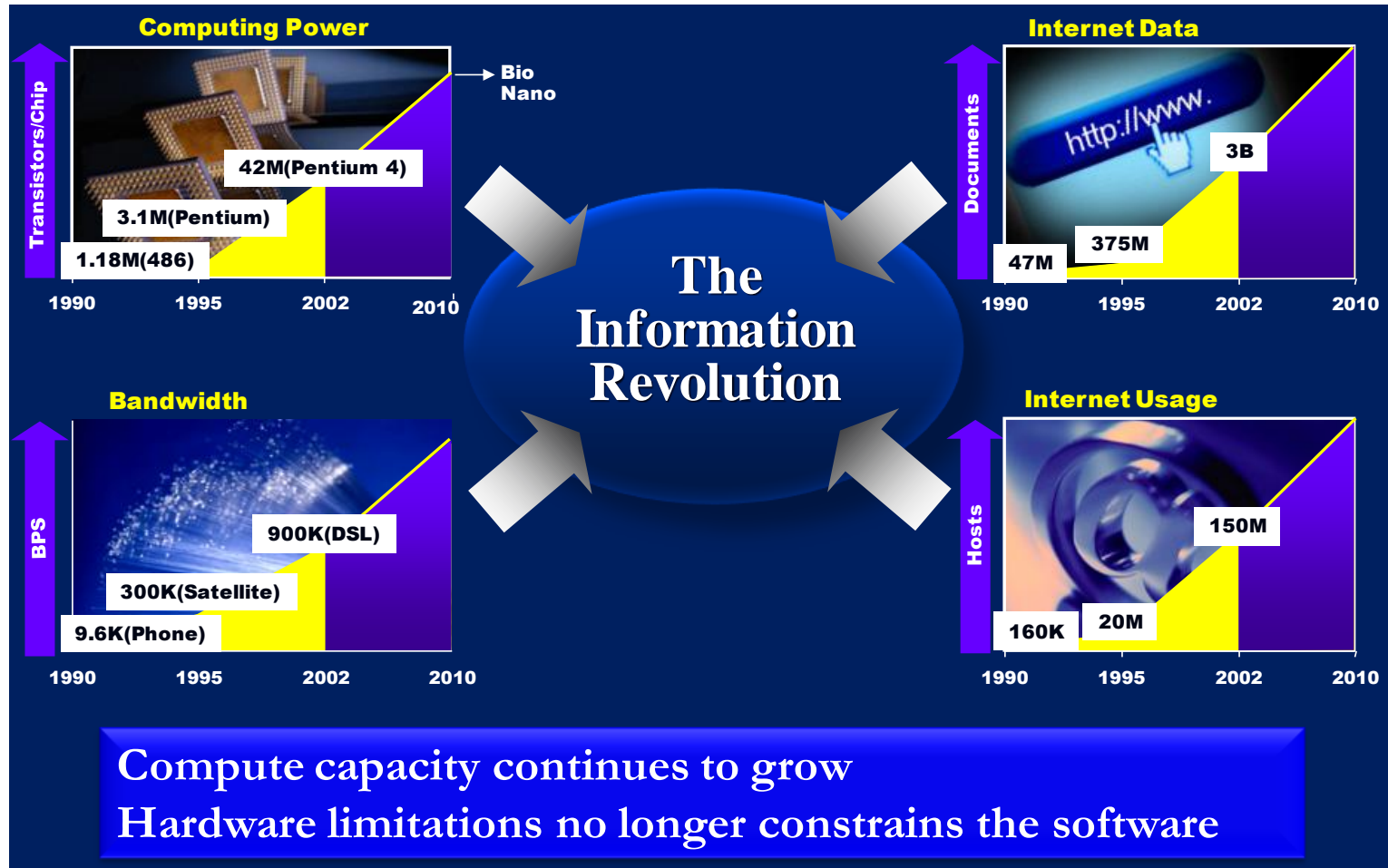
Current Rates

- **New technology information doubles every 2 years.**
- **Adoption of technology is accelerating**
  - To Reach 50 million users
    - *Radio 38 years*
    - *TV 13 years*
    - *Internet 4 years*
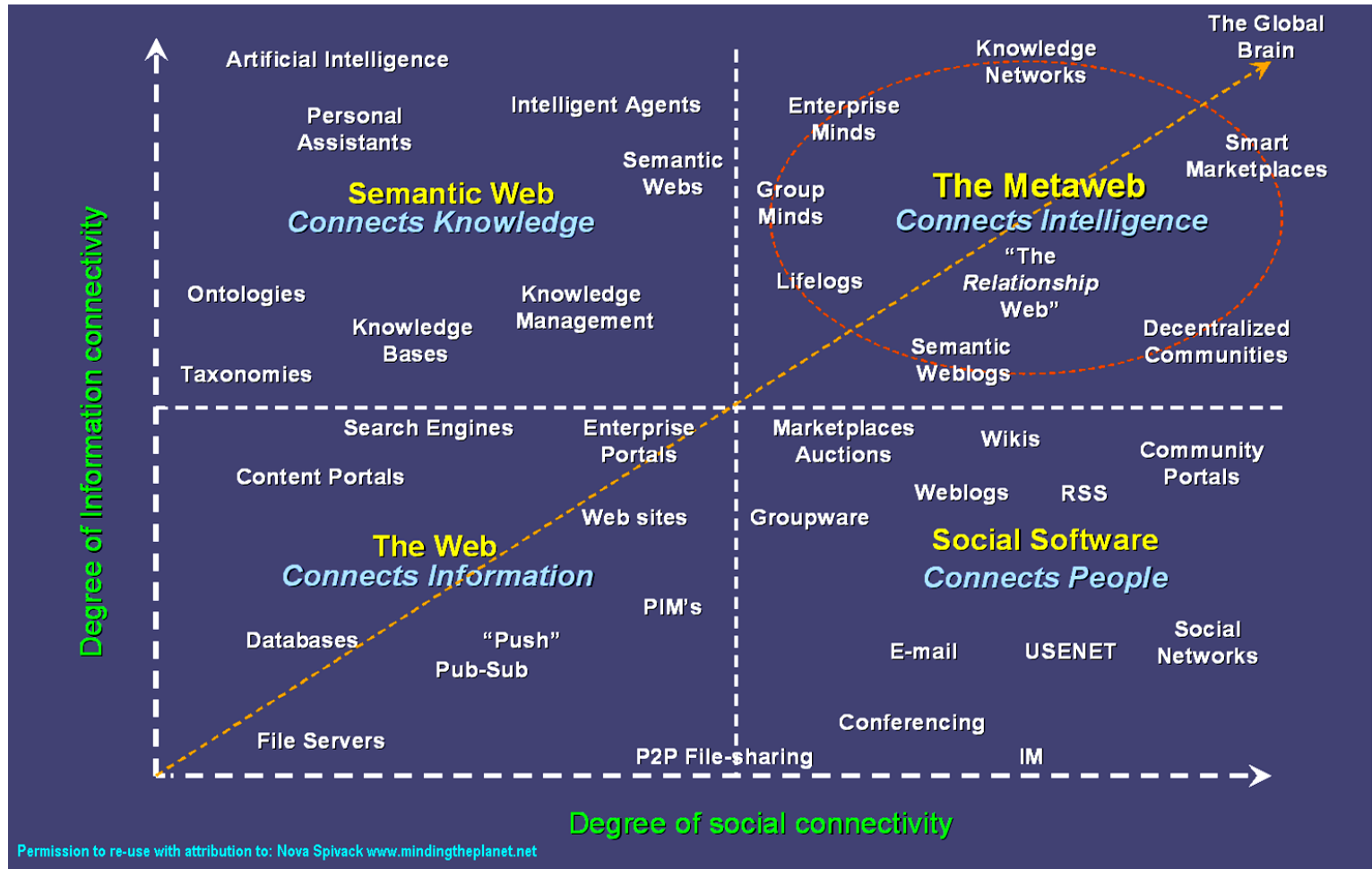   - *IPOD 3 years*
    - *Face Book 2 years*

Predictions

- **By 2013, a super computer exceeds capability of human brain**
- **By 2049 $1000 computer exceeds the capability of the entire human species.**

This data is from the "Did You Know" series

Compute Power and Bandwidth Increasing

Computing Power

Transistors/Chip

Bio Nano

42M(Pentium 4)

3.1M(Pentium)

1.18M(486)

1990 1995 2002 2010

Internet Data

Documents

3B

375M

47M

1990 1995 2002 2010

The Information Revolution

Bandwidth

BPS

900K(DSL)

300K(Satellite)

9.6K(Phone)

1990 1995 2002 2010

Internet Usage

Hosts

150M

160K 20M

1990 1995 2002 2010

Compute capacity continues to grow
Hardware limitations no longer constrains the software

Where is Connectedness Headed?

Degree of Information connectivity

Artificial Intelligence

Personal Assistants

Intelligent Agents

Semantic Webs

Semantic Web
Connects Knowledge

Ontologies

Knowledge Bases

Knowledge Management

Taxonomies

Enterprise Minds

Group Minds

Lifelogs

Knowledge Networks

The Global Brain

Smart Marketplaces

The Metaweb
Connects Intelligence

"The Relationship Web"

Semantic Weblogs

Decentralized Communities

Search Engines

Content Portals

Enterprise Portals

Web sites

The Web
Connects Information

Databases

"Push" Pub-Sub

PIM's

File Servers

P2P File-sharing

Marketplaces Auctions

Wikis

Community Portals

Weblogs

RSS

Groupware

Social Software
Connects People

E-mail

USENET

Social Networks

Conferencing

IM

Degree of social connectivity

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Diminishing Constraints

Diminishing hardware constrains

Increasing software complexity

Self Adapting, Collaborative Systems

Anywhere –Anytime Computing

Interconnected Systems

Applications

Calculations Small Programs

Merging of Biology, Nanotechnology and Artificial Intelligent

The future

Mobil to Hybrid Devices
2000 -2010

Computers to Internet
1970 - 1990

Transistors to Microprocessors
1950 - 1970

Relays To Vacuum Tubes
1930 - 1950

Old paradigm of testing no longer effective

Increasing T&E costs or more delivered Defects

- The cost of T&E for these very complex systems is increasing significantly when there is a real attempt to detect defects before delivery

- My observation is that the following is occurring:
  – Some test automation is attempted with marginal success
  – Test times are not generally being increased so less test coverage of functionality is actually occurring
  – Results: more (complex) defects are being delivered

- Constant pressure to reduce T&E cost & schedule

Test Technology & Research Funding Gaps

Test **Technology** Gap

Technology Explosion

Test Research

Test Research Gap
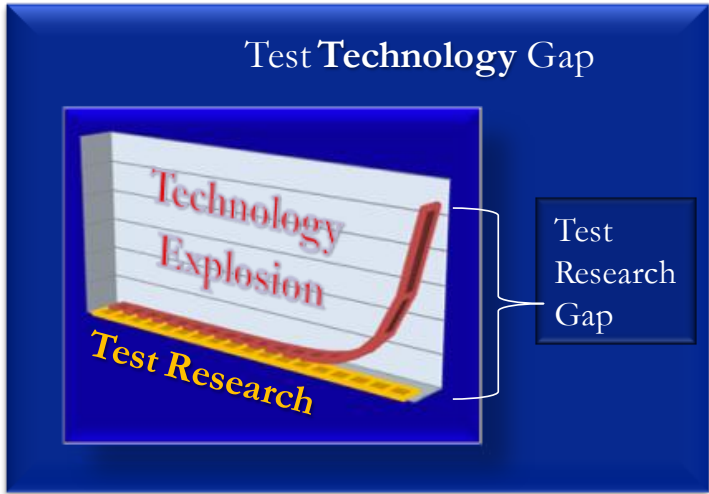
← What about the Technology Readiness Level Process?

What about T&E S&T and Corporate IRAD projects? →

Research Funding Gap

Technology

Individual Corp R&D

I&T Funding
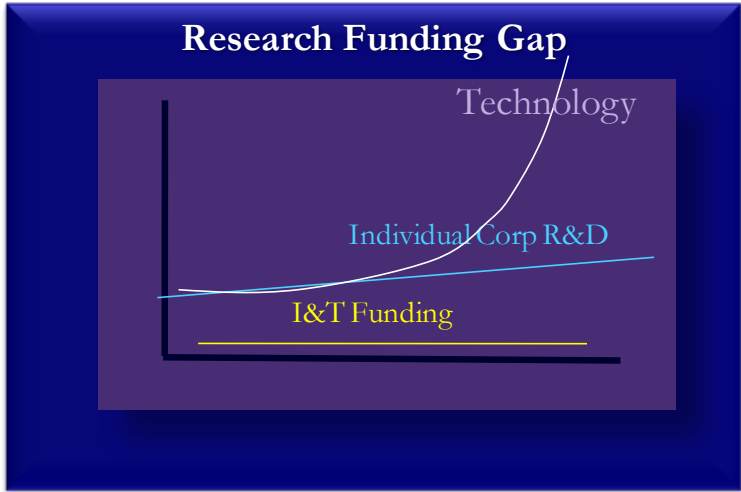
Bottom Line: T&E is not able to keep up with Technology

A Question

- Is all this complexity necessary?

    – Absolutely, it makes the Warfighters more effective, efficient and safer

- So what can we do as Test and Evaluation engineers?

T&E must become more Effective and Affordable

- Need more T&E Research in Government, Industry and Academia
  - Ensure Research is coordinated whenever possible (i.e. between Services, initiated / coordinated by Government, etc)
- Review the Technical Readiness Level processes to see if possible to add official T&E deliverables with TRL's at specific levels, especially in the range of TRL 4 & 5.

T&E must become more Effective and Affordable

- Much more automation should be in use today
  - Training and investment must be done and this will have a big return on investment

- Ensure the use of Scientific (or Analytical) Test Design methods and tools

- Ensure T&E is actively involved with the research and related activities in the Model-Based Development/Engineering arena

Q & A

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Thomas L Wissinks Biography

Tom Wissink is the Lockheed Martin Corporate Engineering & Technology Director of Integration, Test & Evaluation and a Corporate Senior Fellow. He has worked in system/software integration and test, software development, configuration management, and several levels of management for more than 35 years, 30 of them with Lockheed Martin. He has worked on programs like the Space Shuttle and several Satellite Command and Control systems including the Global Positioning System and the Hubble Telescope Project. Tom has also been a teacher and mentor primarily in the area of integration and test.

Tom is also a corporate member of the National Defense Industrial Association (NDIA) co-chairing the DT&E Committee. He has been a presenter at the Aerospace Testing Seminar (ATS) and is a member of the ATS Advisory Board. He has also been a speaker at the NDIA SE Division Conference as well as a Keynote Speaker at STAREAST and at STARWESTs Leadership Session.

Tom grew up in Florida developing a desire to work in engineering watching the Space program. He has a Bachelors degree in Computer Science from Florida Atlantic University. Tom has been married for 37 years, has three boys and three grand kids.