Rational. software

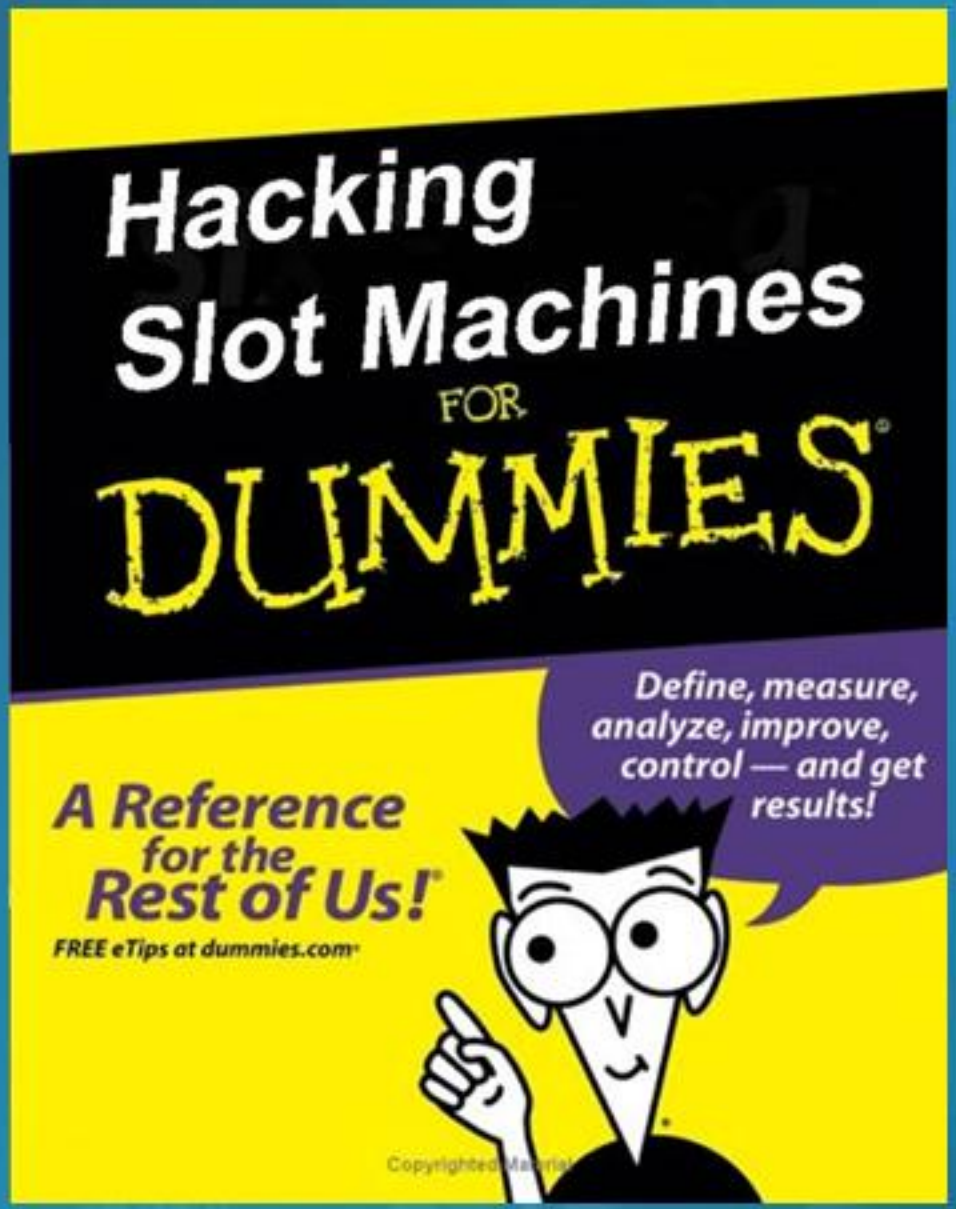
IBM Rational Software Development Conference 2005

IBM.

Rational. software

Advancing Software Engineering

Grady Booch
IBM Fellow


Hacking
Slot Machines
FOR
DUMMIES
Define, measure, analyze, improve, control — and get results!
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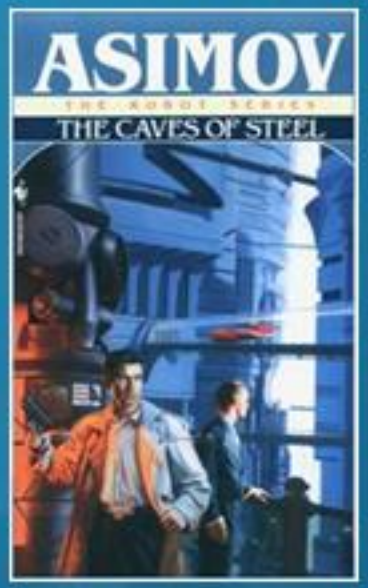
THE DAY THE EARTH STOOD STILL

THIS ISLAND EARTH

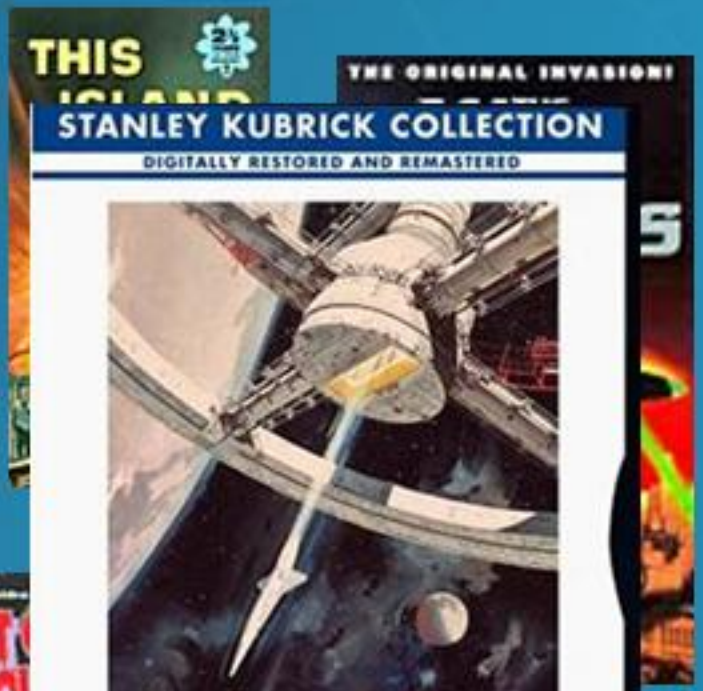
THE ORIGINAL INVASION!
THE WAR OF THE WORLDS

PLAN 9 OUTER SPACE

IT CAME FROM OUTER SPACE

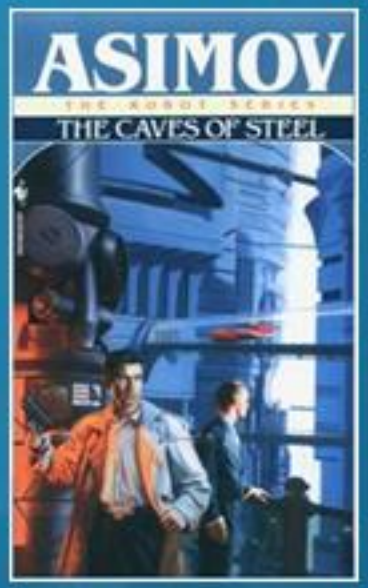

ASIMOV
THE CAVES OF STEEL

THE DAY THE EARTH STOOD STILL


THIS
THE ORIGINAL INVASION!

STANLEY KUBRICK COLLECTION
DIGITALLY RESTORED AND REMASTERED
STANLEY KUBRICK'S
2001:
a space odyssey
DVD

PLAN 9
OUTER SPACE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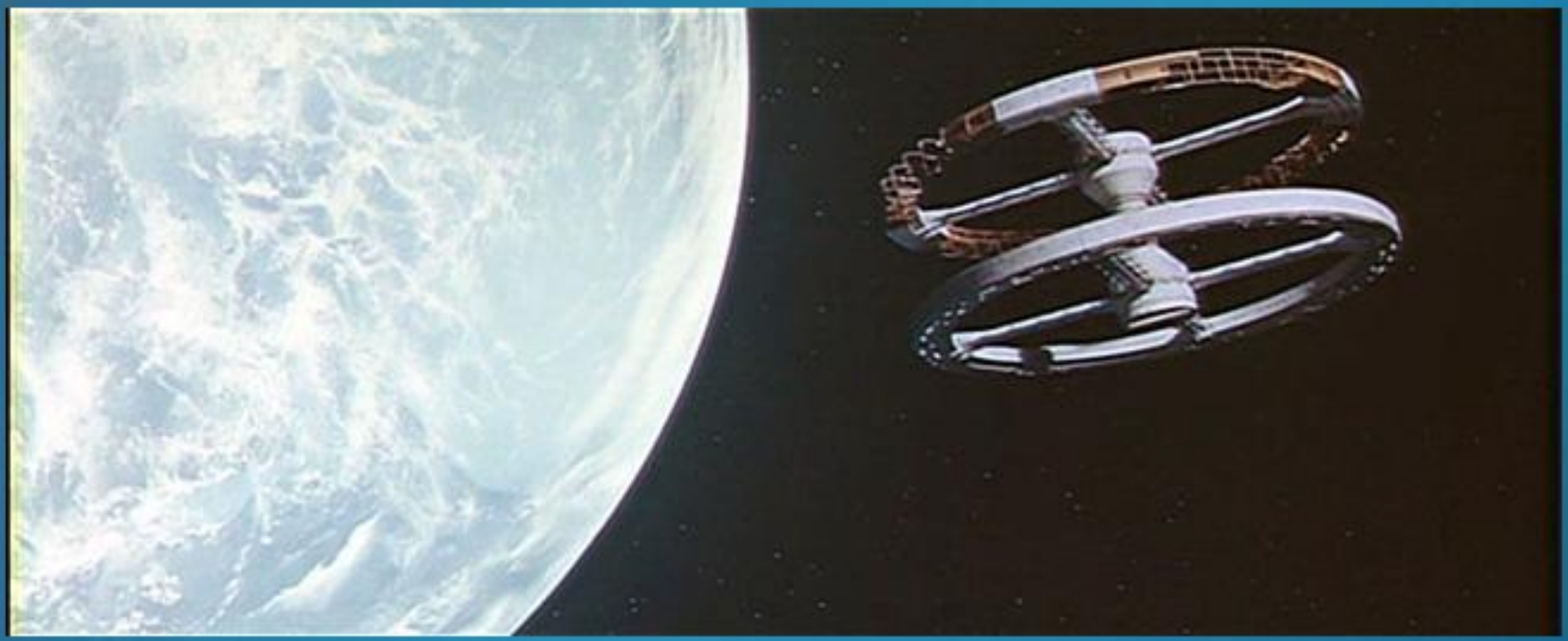
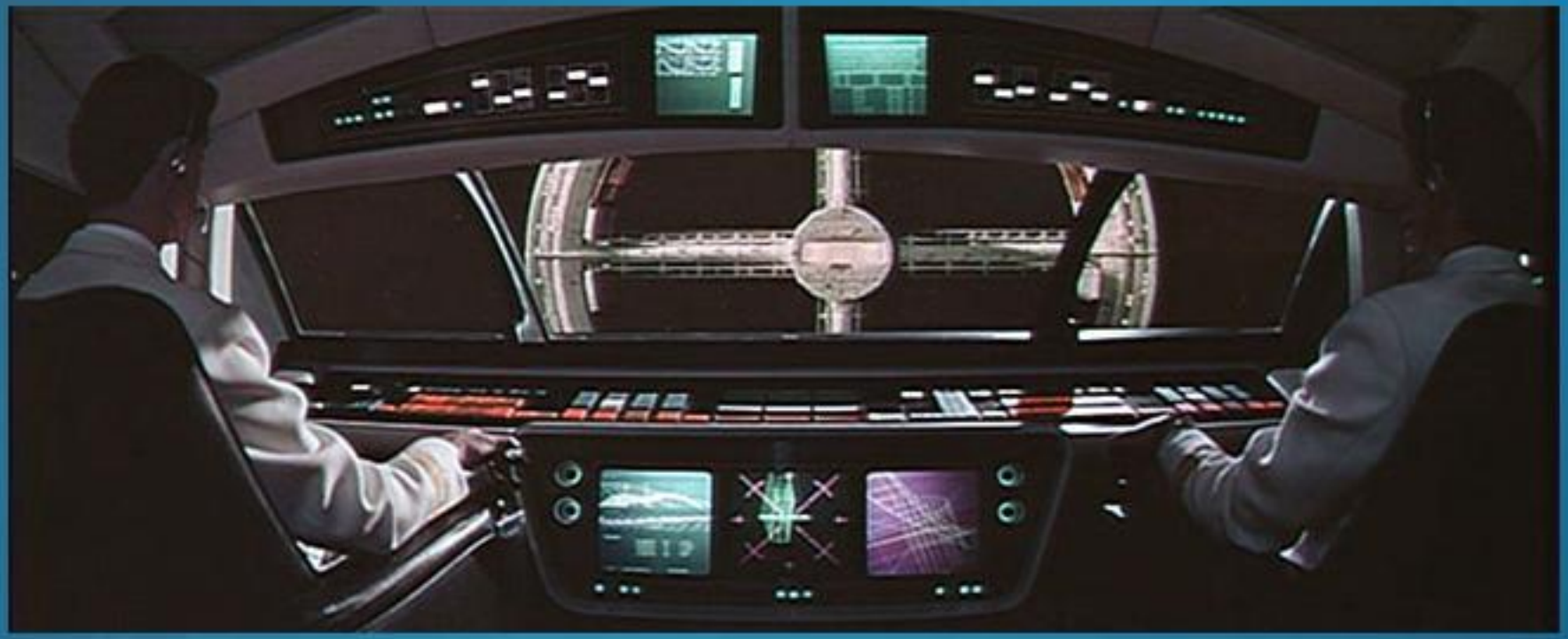
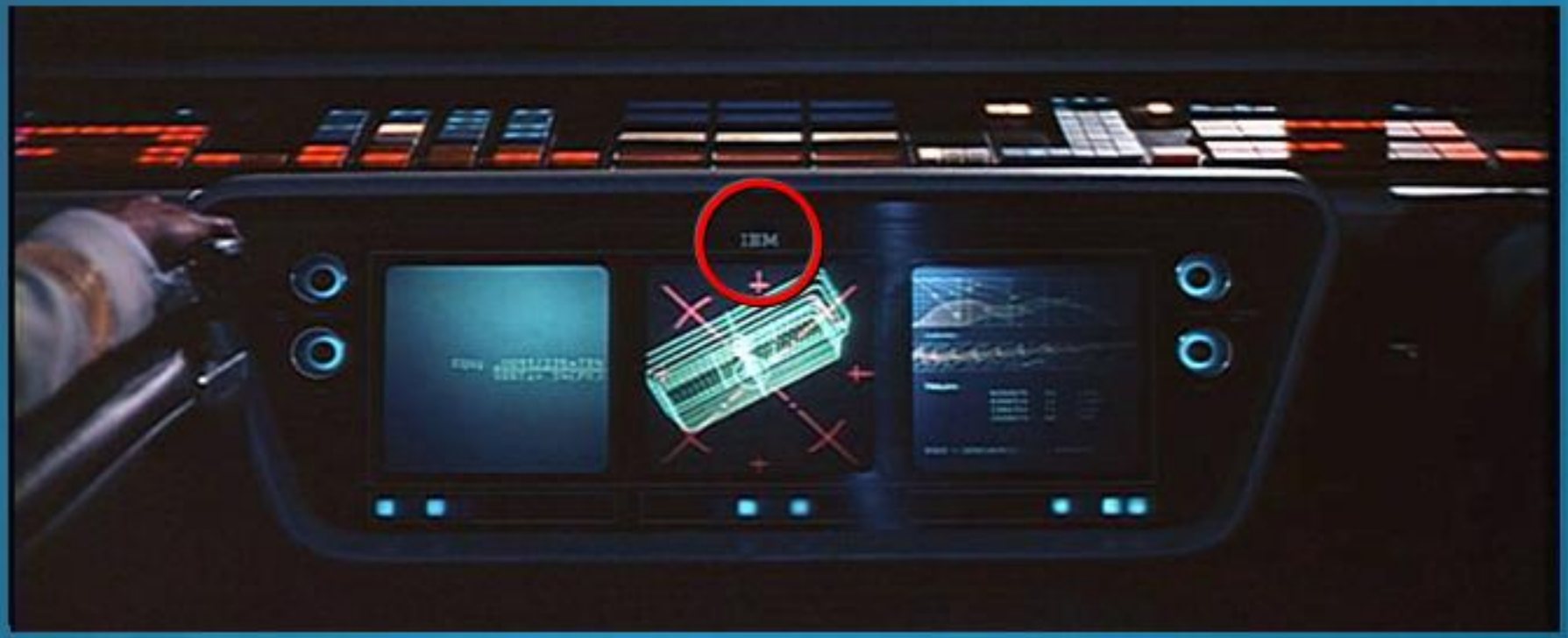


http://www.palantir.net/2001/index.html



http://www.palantir.net/2001/index.html



http://www.palantir.net/2001/index.html

A Midlife Crisis (Personal)

$$\frac{time_alive}{time_remaining} \rightarrow \infty$$

A Midlife Crisis (Personal)

A Midlife Crisis (Personal)

A Midlife Crisis (Personal

http://www.montypythonspamalot.com

A Midlife Crisis (Computers)

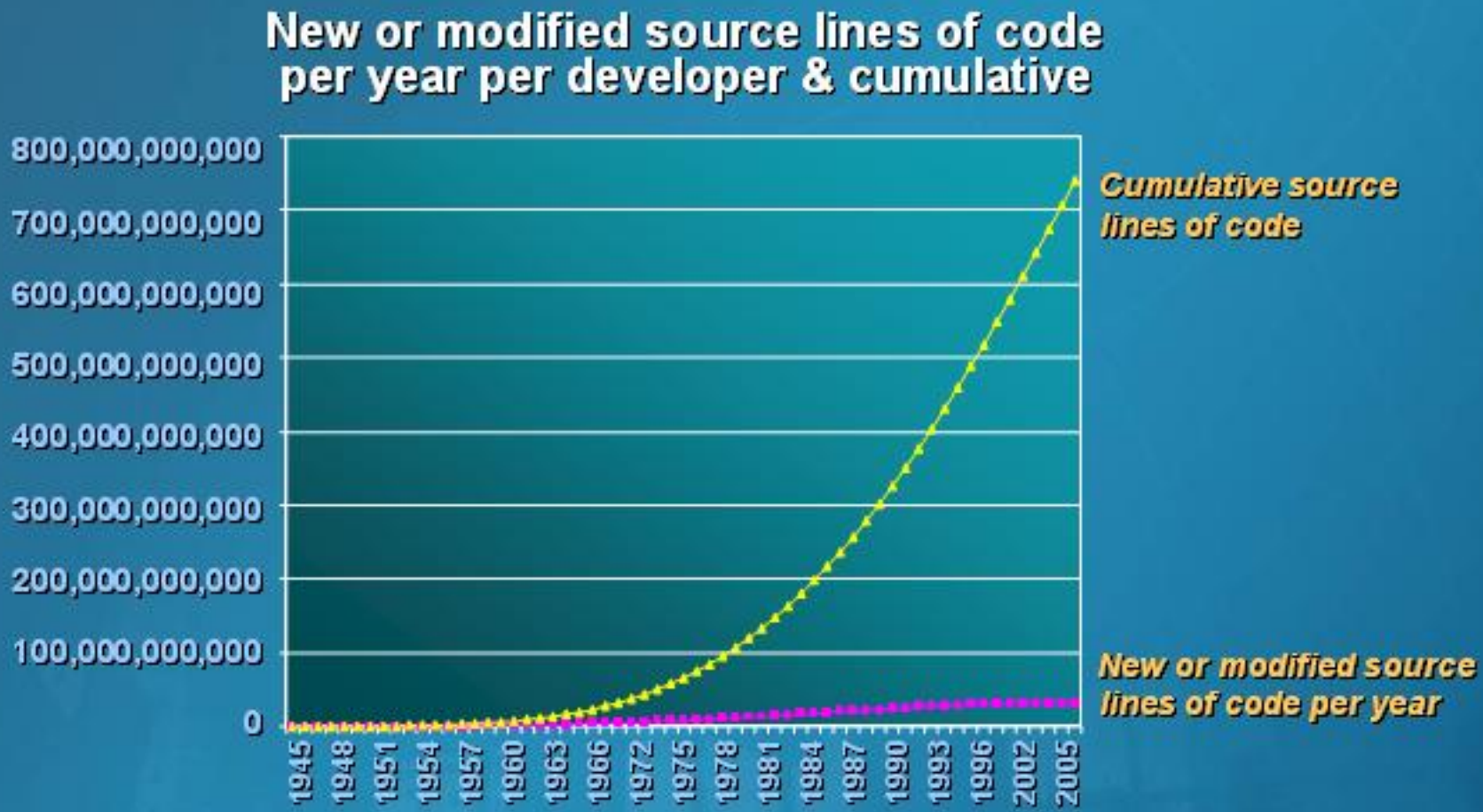
1910s beginning of automation
1920s beginning of expansion
1930s beginning of dependence
1940s beginning of von Neumann machines
1950s rise of the machines
1960s rise of the languages and methods
1970s death of the mainframe
1980s age of the personal computer
1990s age of the Internet and new methods
2000s retrenchment

Software development
has been, is, and remains hard

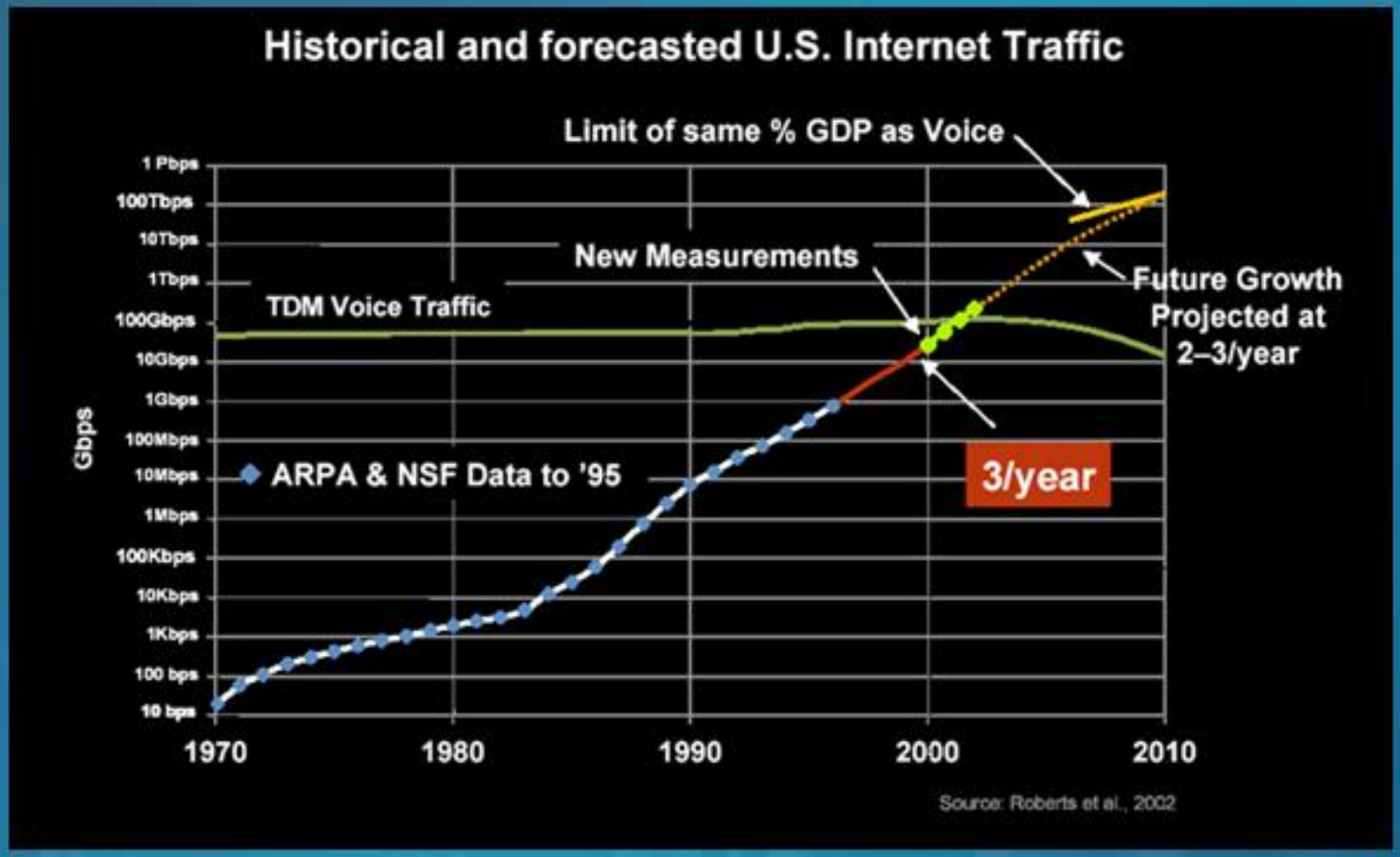
The entire history of software engineering is characterized by rising levels of abstraction

Languages:	Assembly -> Fortran/COBOL -> Simula -> C++ -> Java
Platforms:	Naked HW -> BIOS -> OS -> Middleware -> Domain-specific
Processes:	Waterfall -> Spiral -> Iterative -> Agile
Architecture:	Procedural -> Object Oriented -> Service Oriented
Tools:	Early tools -> CLE -> IDE -> XDE -> CDE
Enablement:	Individual -> Workgroup -> Organization
Solutions:	Proprietary -> Open Source

Growth of SLOC



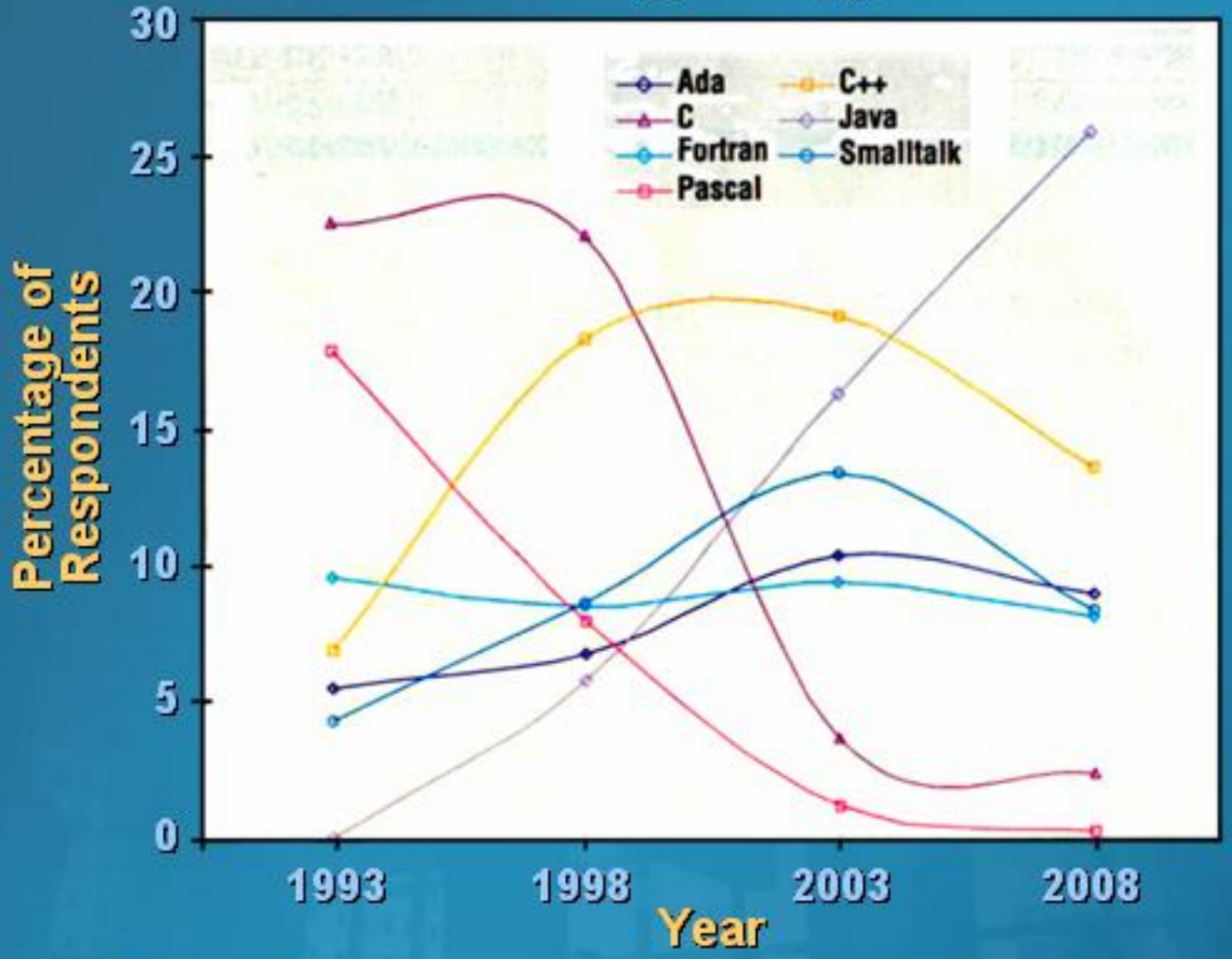
Growth of Network Traffic



Growth of Data

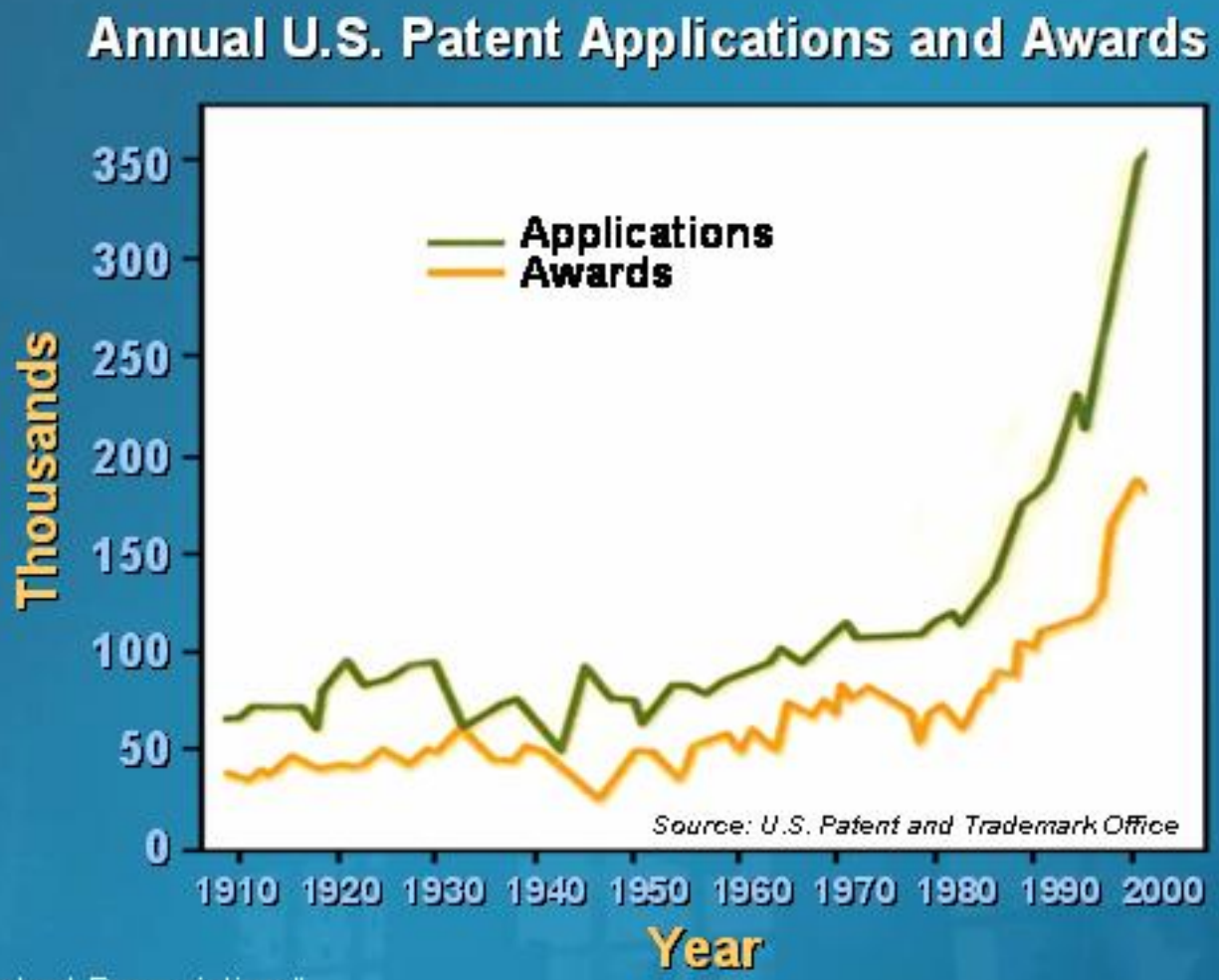
- Increase of ~2 exabytes of data/year
  - ~93% stored digitally
  - ~50% is stored in the last mile and generated by individuals
- Home storage of media reaching .09 exabytes

Growth of Languages



Chen, et al. "An Empirical Study of Programming Language Trends," *IEEE Computer*, May/June 2005

Growth of Patents



Jaffe et al, "Patent Prescription,"
IEEE Spectrum, December 2004

IBM Patent Leadership

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
1	IBM	IBM	IBM	IBM	IBM	IBM	IBM	IBM	IBM	IBM	IBM	IBM
2	Toshiba	Canon	Canon	Canon	Canon	Canon	NEC	NEC	NEC	Canon	Canon	Matsushita
3	Canon	Hitachi	Motorola	Motorola	NEC	NEC	Canon	Canon	Canon	NEC	Hitachi	Canon
4	Kodak	Mitsubishi	NEC	NEC	Motorola	Motorola	Samsung	Samsung	Micron	Hitachi	Matsushita	HP
5	Mitsubishi	Toshiba	Mitsubishi	Hitachi	Hitachi	Sony	Sony	Lucent	Samsung	Toshiba	HP	Micron
6	Hitachi	GE	Toshiba	Mitsubishi	Fujitsu	Samsung	Toshiba	Sony	Matsushita	Sony	Micron	Samsung
7	GE	NEC	Hitachi	Toshiba	Mitsubishi	Fujitsu	Fujitsu	Micron	Sony	Mitsubishi	Intel	Intel
8	Motorola	Kodak	Matsushita	Fujitsu	Toshiba	Toshiba	Motorola	Toshiba	Hitachi	Matsushita	Philips	Hitachi
9	Matsushita	Motorola	Kodak	Sony	Sony	Kodak	Lucent	Motorola	Mitsubishi	Motorola	Samsung	Toshiba
10	Fuji Photo	Matsushita	GE	Matsushita	Kodak	Hitachi	Mitsubishi	Fujitsu	Fujitsu	Samsung	Sony	Sony

Fundamentals
never go out of style

Fundamentals

- Craft crisp and resilient abstractions
- Maintain a good separation of concerns
- Create a balance distribution of responsibilities

Innovation occurs at the intersection of invention and insight

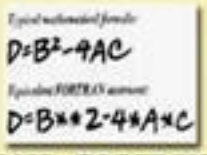
Sam Palmisano, http://www.ibm.com/gio

History of Innovations

1944: Mark 1

1948: SSEC

1956: RAMAC



1957: FORTRAN

1966: One-Device Memory Cell

1967: Fractals

1970: Relational Database

1971: Speech Recognition

1973: Winchester Disk

1979: Thin Film Recording Heads

1980: RISC

Nobel Prizes

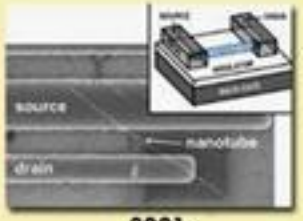
1994: SiGe

1993: RS/6000 SP
1996,97: Deep Blue

1997: Copper Interconnect Wiring

1998: Silicon-on-Insulator

1998: Microdrive



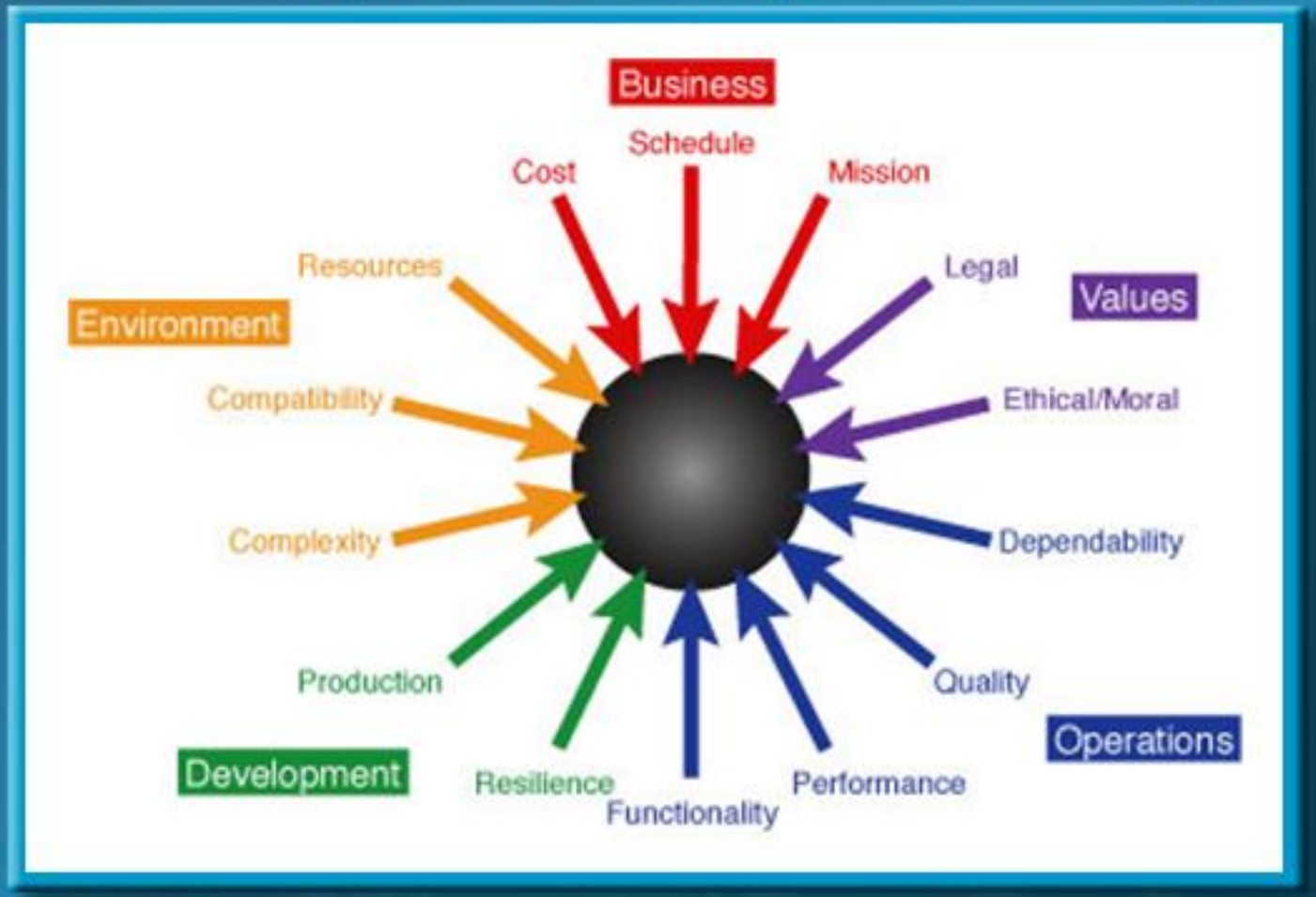
2001: Nanotube Transistor

2002: Millipede

2002: Molecule Cascade Logic Circuit

2004: Blue Gene/L
The fastest supercomputer in the world

Software Development as an Engineering Activity

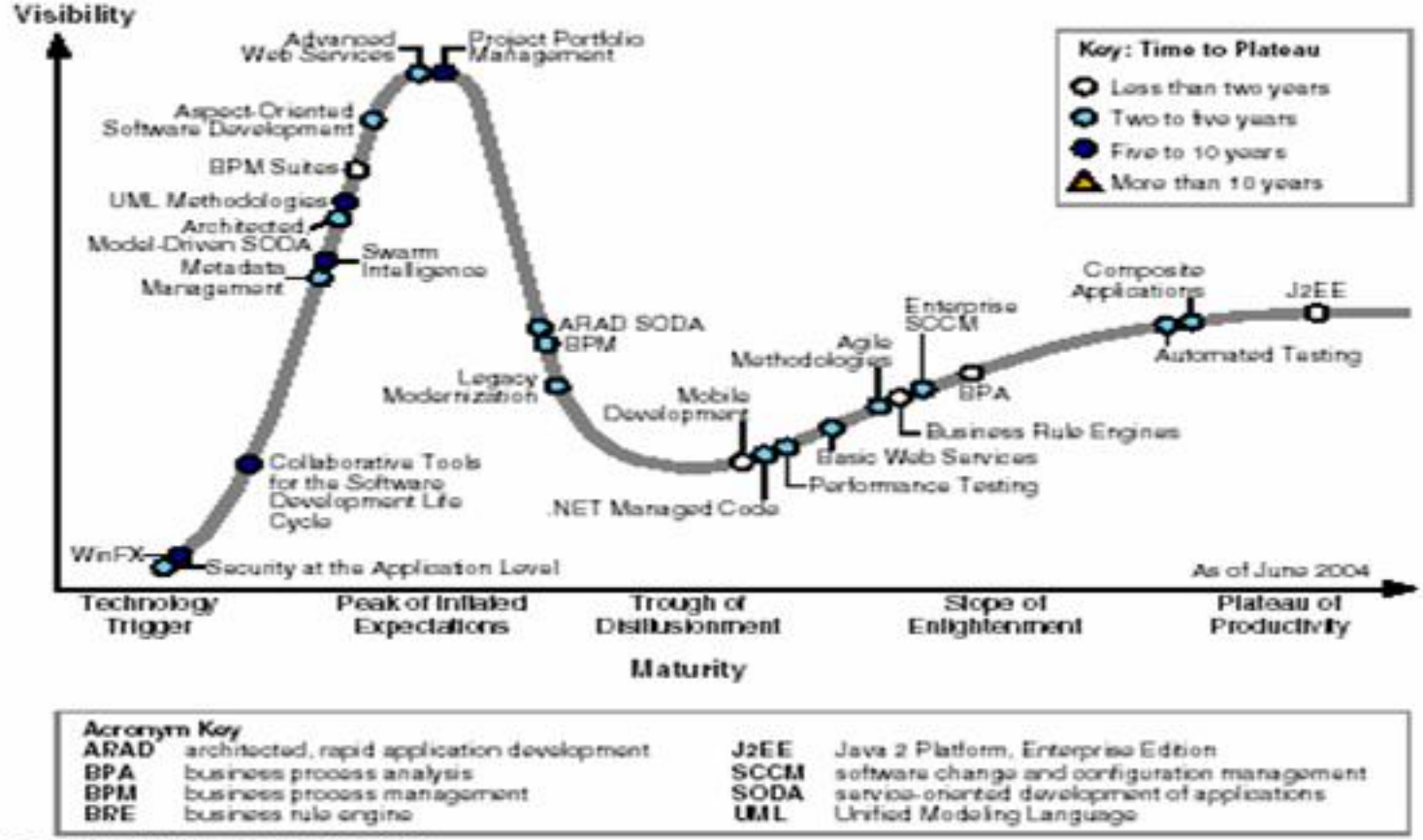


http://www.booch.com/architecture

Software Engineering Trends

- Open source/open standards
- Patterns
- Metadata
- Searching
- Services
- Simplification

Hype Cycle



Source: Gartner Research (June 2004)

Figure 1. Hype Cycle for Application Development, 2004

Pipeline of Innovation

Pipeline of Innovation

Adaptation
Skunk Works
Research

Inception

Elaboration

Construction

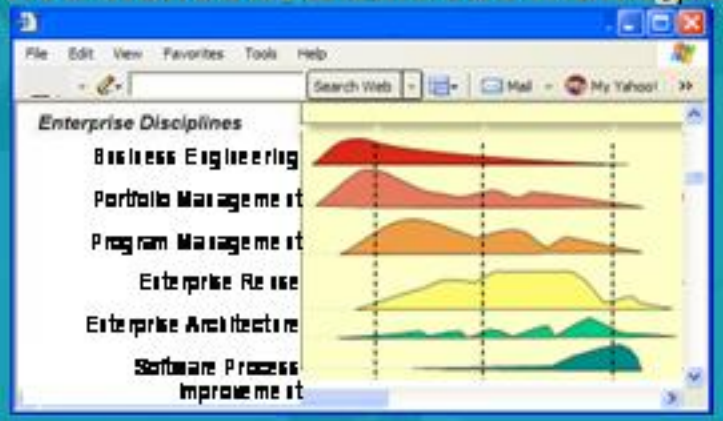
Adaptation
Rational Unified Process

- Scaling the process to the enterprise
- From process to action
- Drinking our own champagne
- Unifying business, software and systems engineering

Scaling To The Enterprise

Scaling To The Enterprise

Governance & Business Management

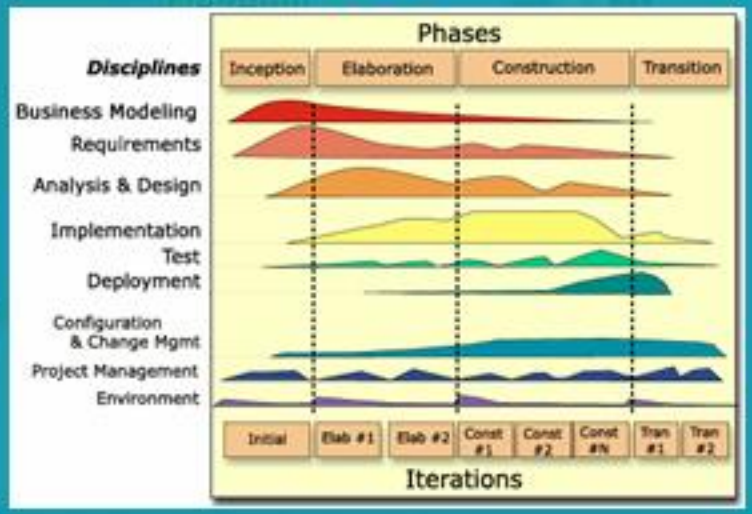


ITUP

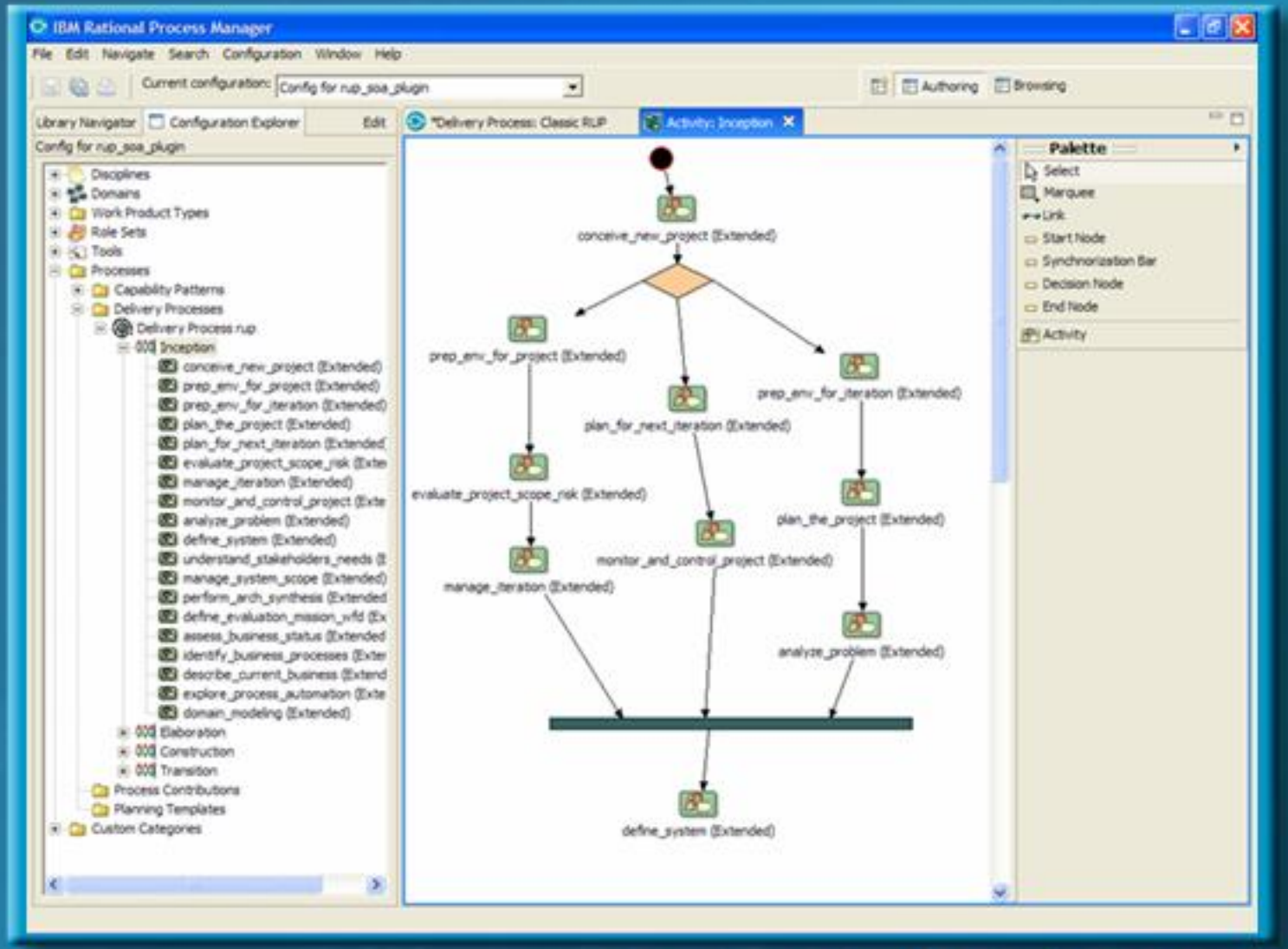
Govern

Deploy

RUP

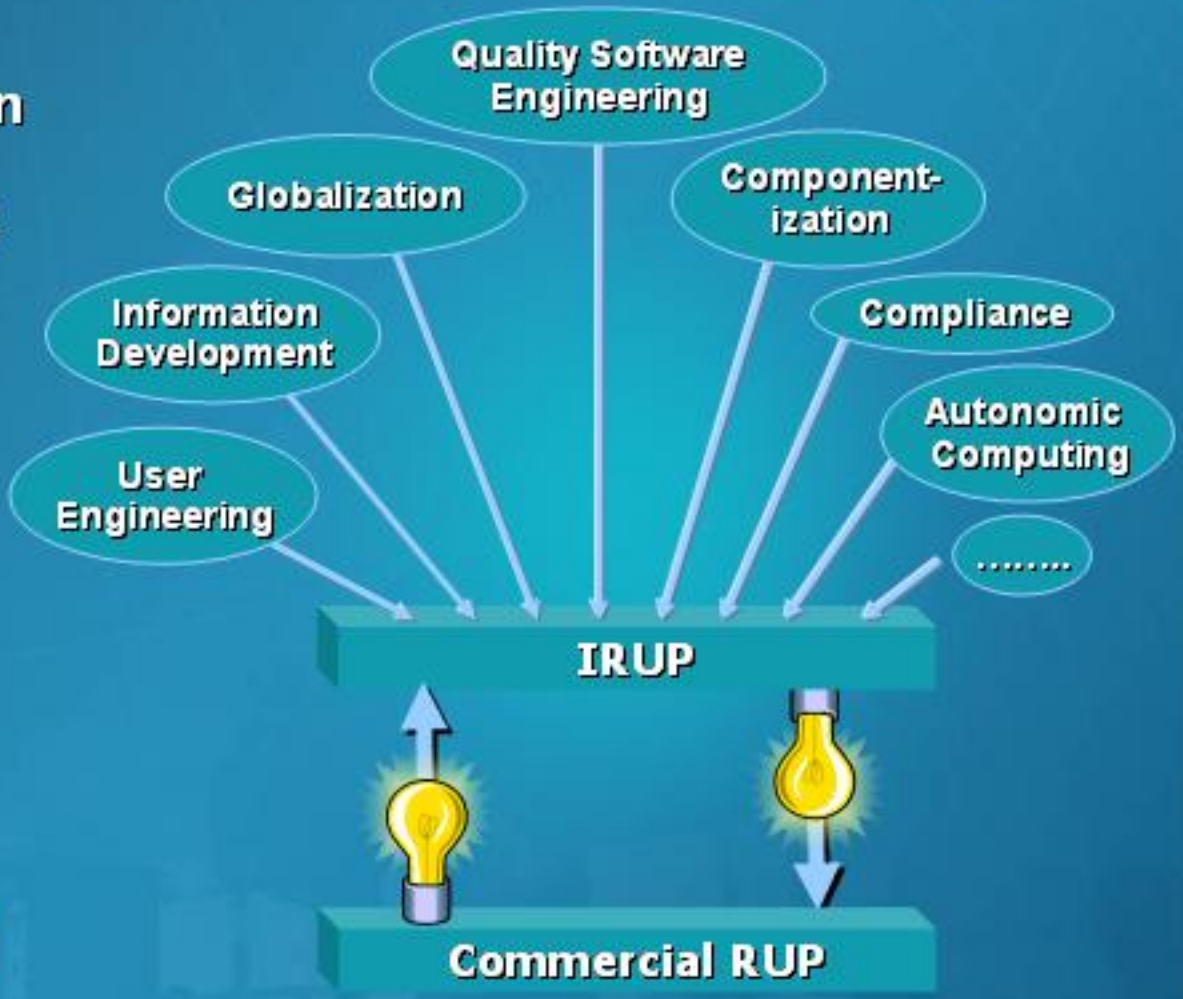


From Process To Action



Drinking Our Own Champagne

- A customized version of RUP addressing IBM's specific needs
- Evolved with know-how from many corporate groups
- To be rolled out to IBM's internal +40,000 developers
- IRUP guidance will help improve also commercial product

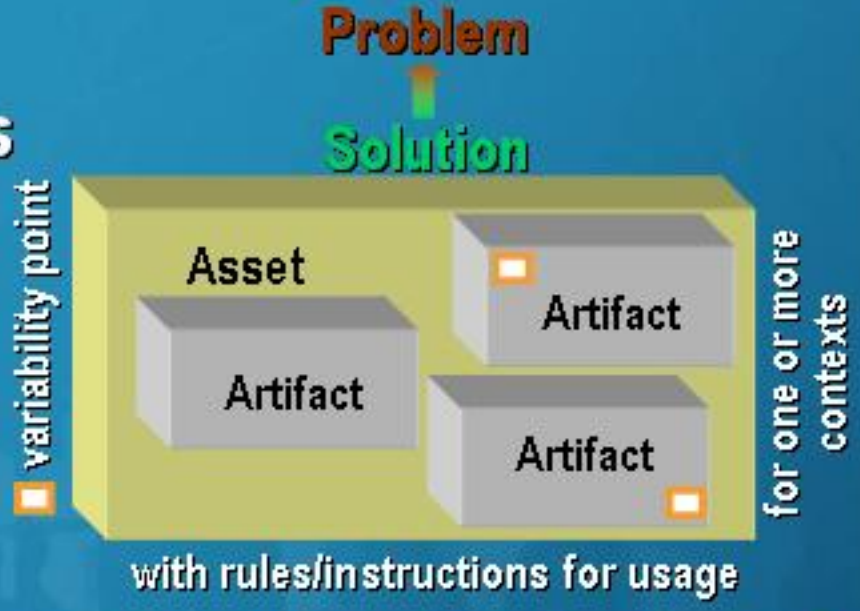


Unifying Business, Software, & Systems Engineering

- Today - Different approaches are applied to:
  - Business Engineering
  - Software Engineering
  - Systems Engineering
- Our solution: Use a common approach to develop any system, no matter if that system is a business, an application, or a system of people, hardware, and software
- The approach allows:
  - Breaking down a system into smaller subsystems
  - Deriving subsystem requirements from system requirements (requirements flowdown)
  - Usage of the view points applicable to your specific system (not a "one size fits all")

Skunk Works
Asset-Based Development

- The best way to reduce the risk of software development is to not develop any software at all
- An asset
  - Collection of artifacts
  - Provide a solution
  - A given context
  - Rules for usage
  - Variability points



Skunk Works
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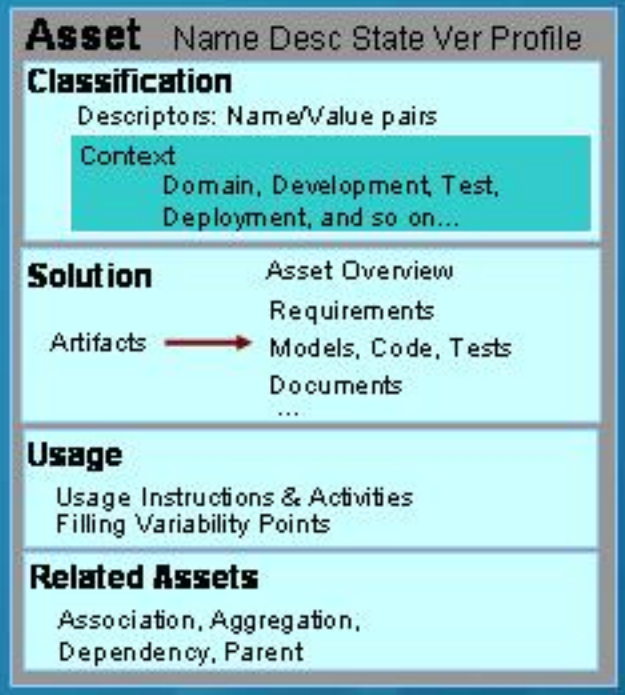


Service-Oriented Architecture

Business Process

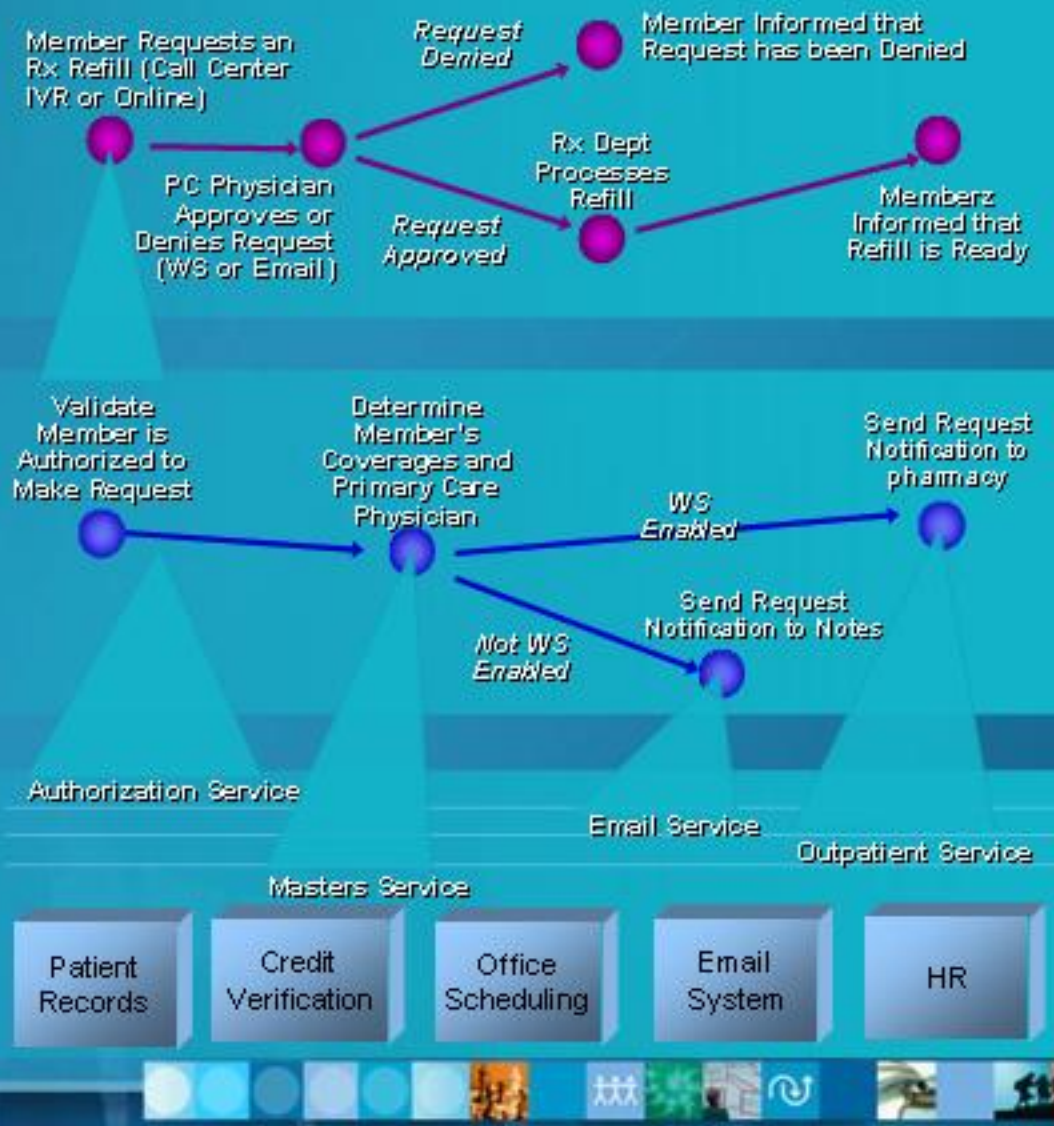
- long running
- one or more persons interacting
- multiple valid business process states
- alternative workflows for non-normal conditions

Services

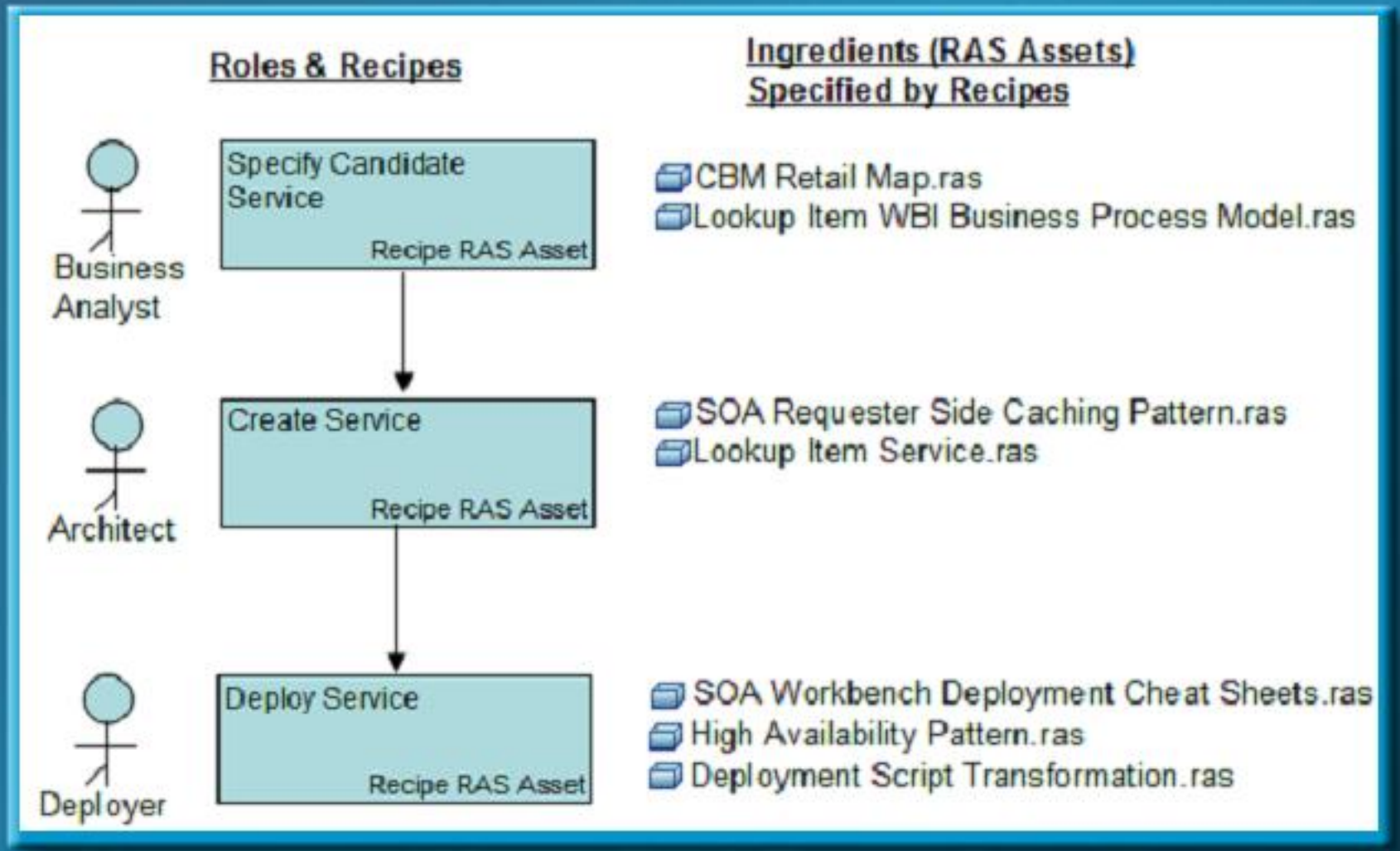
- short term, non-interactive
- one change of business state
- consumes one or more enterprise service
- targeted level of service reuse
- loose coupling important
- may require compensating transactions

Components

- collaborations to implement a single Web Service
- collaborating apps encapsulated via Web Services
- Performance favored over loose coupling



Demo


Roles & Recipes
Ingredients (RAS Assets) Specified by Recipes
Business Analyst
Specify Candidate Service
Recipe RAS Asset
CBM Retail Map.ras
Lookup Item WBI Business Process Model.ras
Architect
Create Service
Recipe RAS Asset
SOA Requester Side Caching Pattern.ras
Lookup Item Service.ras
Deployer
Deploy Service
Recipe RAS Asset
SOA Workbench Deployment Cheat Sheets.ras
High Availability Pattern.ras
Deployment Script Transformation.ras

Research
Joint Programs

- Intentional directed research
  - Addressing points of pain
  - Investigating wicked problems
- Serious investment
  - Several million from Rational
  - Partial matching from Research
  - Several Research-funded big plays
  - ~30 researchers engaged worldwide

Research

Watson
Yorktown Heights, NY

Zurich
Rüschlikon, Switzerland

China
Beijing, China

Almaden
San Jose, California

Austin
Austin, Texas

Haifa
Haifa, Israel

India
Delhi, India

Tokyo
Yamato, Japan

Research's Strategic Thrusts

Rational/Research Joint Program Projects

- Eclipse
- Model-driven development
- Automated software quality
- Enterprise change management

Experimental Collaborative Development Environment

- 1945: Early tools
- 1960: Command Line Environments (CLE)
- 1980: Integrated Development Environments (IDE)
- 2000: eXtended Development Environments (XDE)
- Future: Collaborative Development Environments (CDE)

Activity Spaces

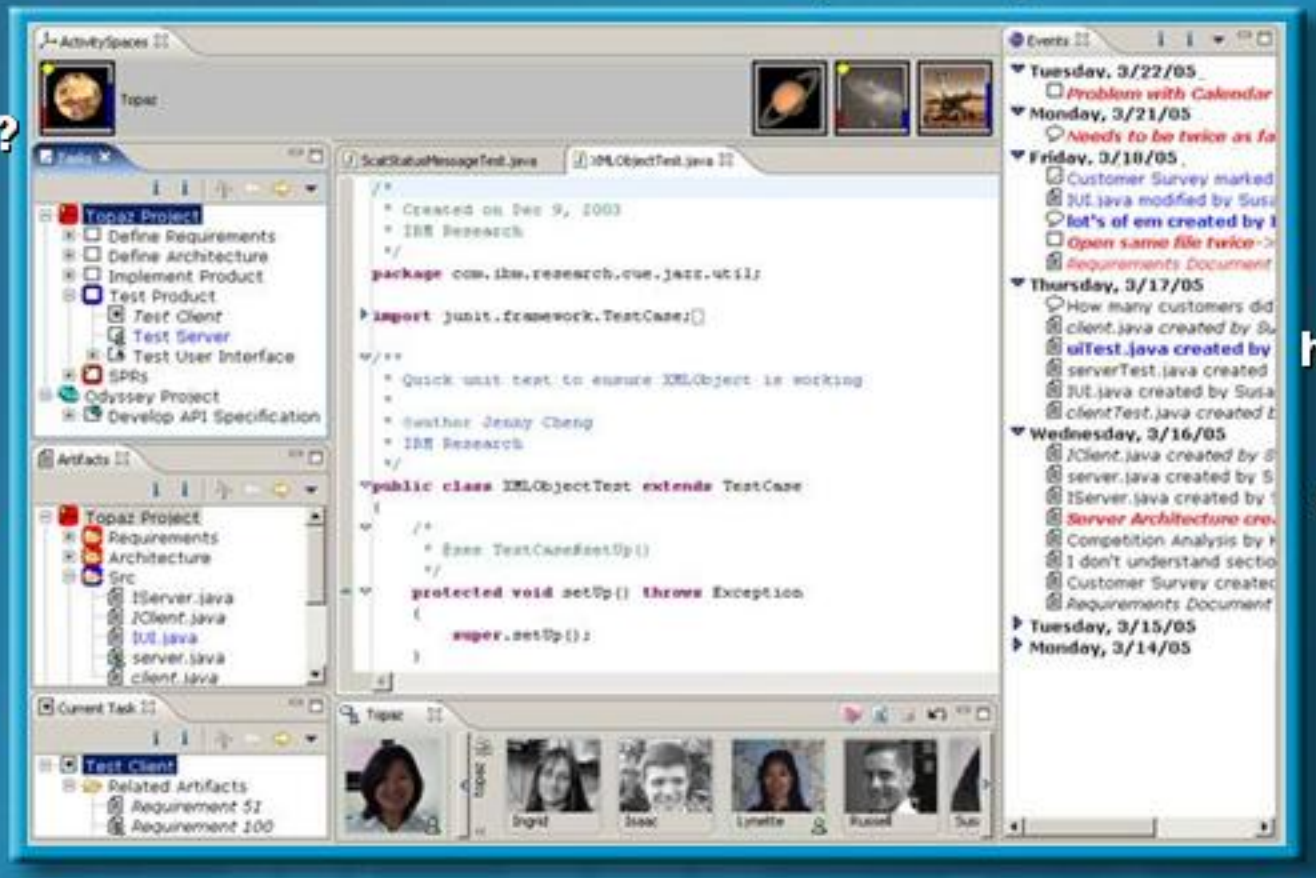
What's changed in my other spaces?

What's happening? What's done?

What's new? What's changed?

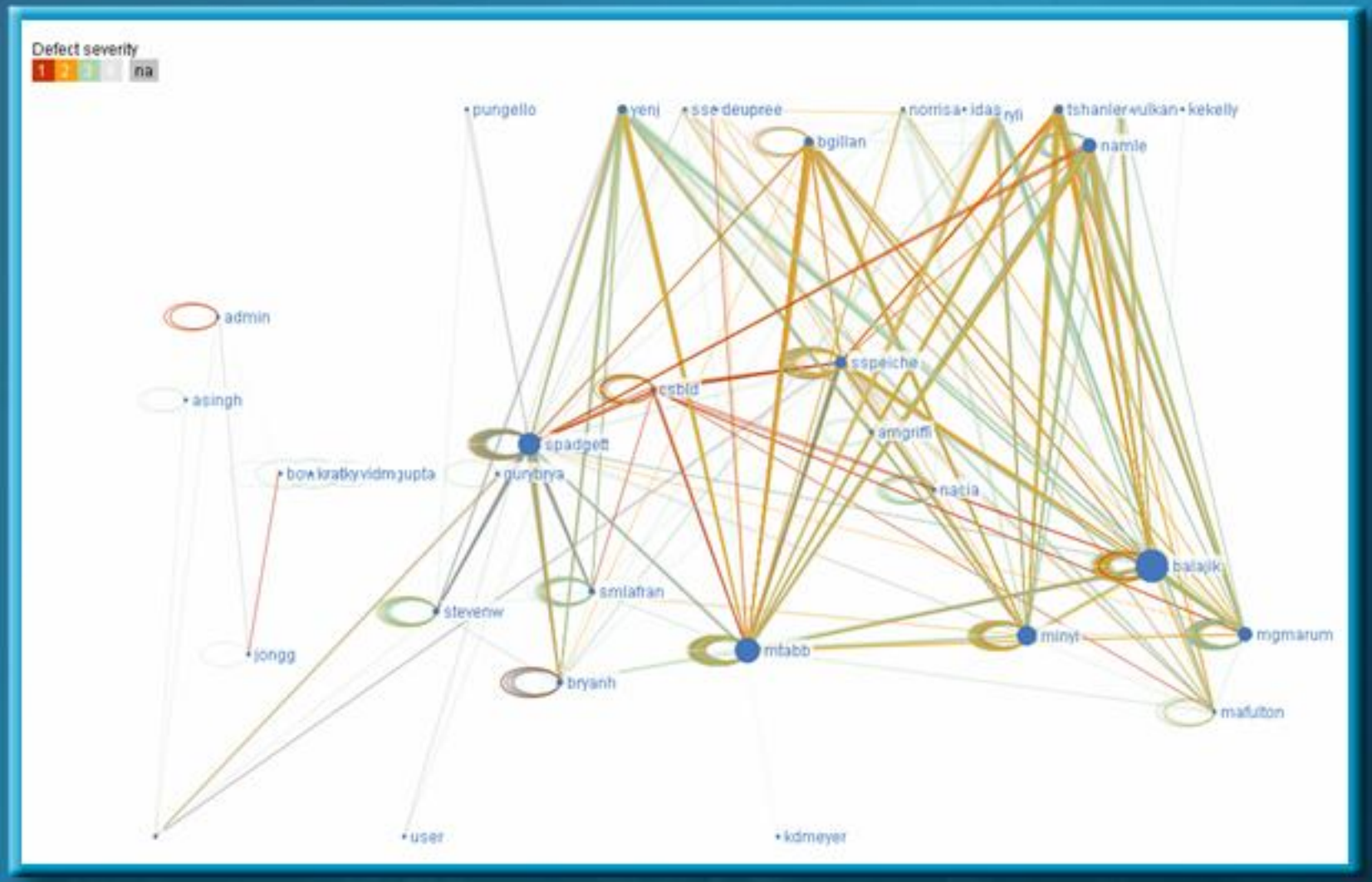
What am I doing?

What's happened lately in my spaces?

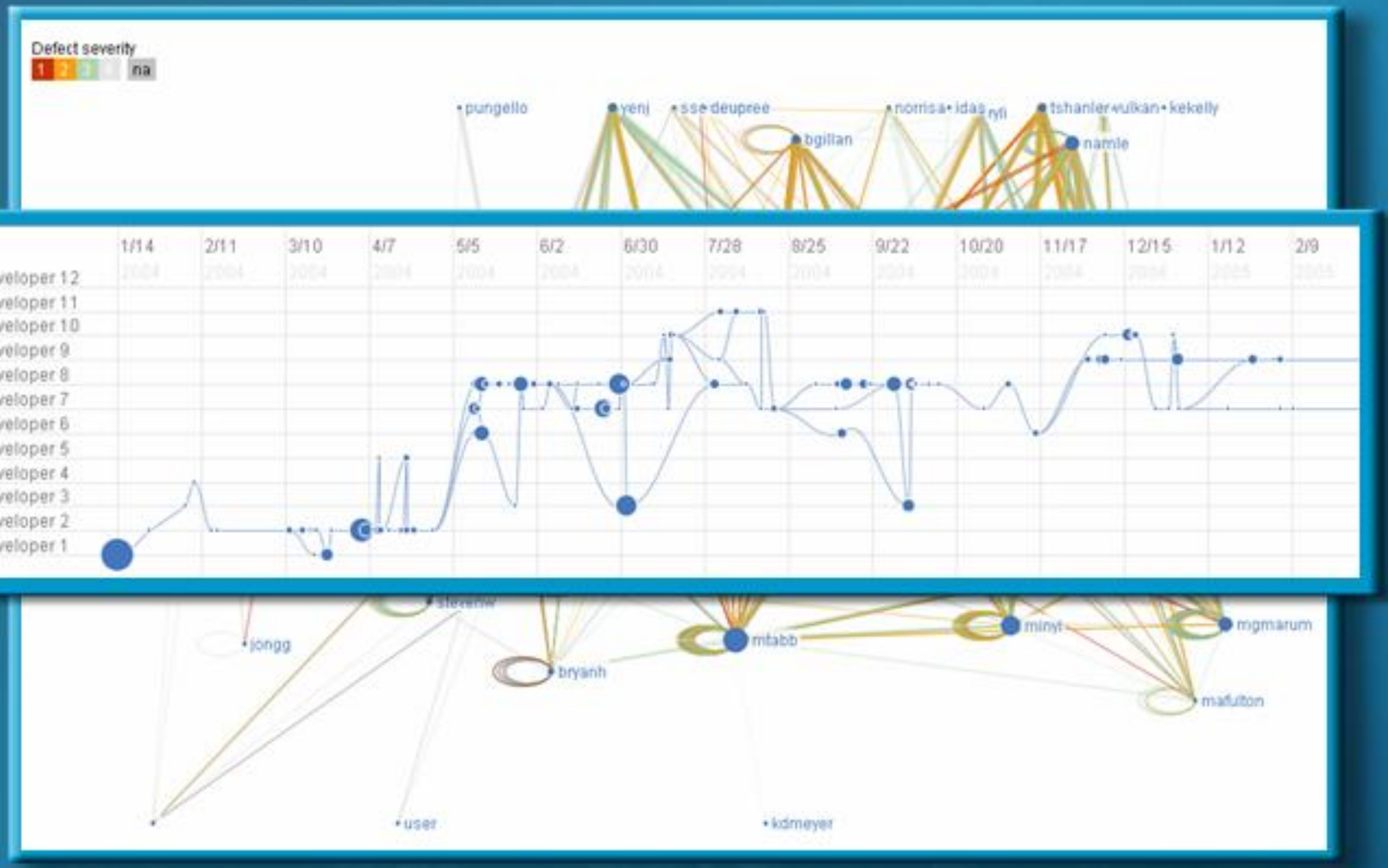


Who's here? What are they doing?

Advanced Visualizations



Advanced Visualizations



Keeping the Pipeline Full

- Software engineering research
- Applications research
- Systems research
- Materials research
- Fundamental research

ibm.com/alphaWorks

Visit the alphaWorks Booth in the Solution Center to see these technologies in action

Emerging technology downloads

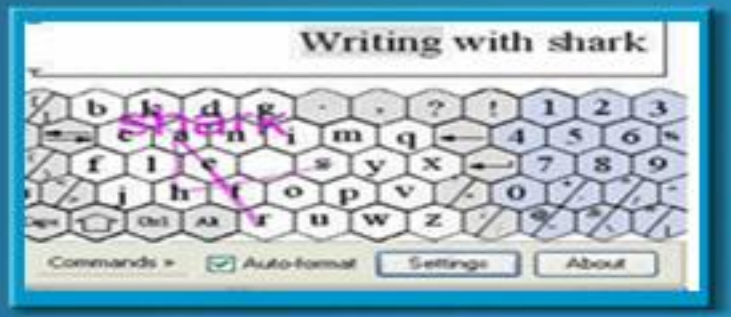
Research topics

Interactive demos

Source: http://www.ibm.com/alphaworks, http://www.ibm.com/developerworks

Shorthand Aided Rapid Keyboarding

- SHARK is an advanced pen-based text input method for mobile devices. A new user may trace the letters on the keyboard to enter a word. SHARK uses novel pattern recognition methods to match the user's input to a large lexicon of words. Over time one may remember some or parts of the patterns and speed up the text writing.



- Special algorithms, feedback mechanisms, and interface techniques are developed to support users' gradual transition from visually-guided tracing on keyboard to recall-driven gesturing.

Multilingual Automatic Speech-to-Speech Translator

- MASTOR is a new, integrated approach to machine translation technology. This approach focuses on meaning preservation (rather than exact translation) and natural language understanding

- Similar in function to the "Universal Translator" concept from Star Trek series, MASTOR brings us one step closer by easing collaboration across language barriers

MARVEL

- Multimedia Analysis and Retrieval Engine (MARVEL) is an image search tool, that addresses the problem of indexing, categorizing, and searching large volumes of images.

- MARVEL was awarded the Wall Street Journal's 2004 Technology Innovation Award in the Multimedia Category.

- MARVEL technology is unique in its approach to analyzing and fusing audio, visual, and text information to automatically annotate multimedia data.

IBM's Smart Surveillance System

- The IBM smart surveillance system is an advanced surveillance system which provides the capability to automatically monitor a scene
- Smart Surveillance has the capability to:
  - Manage surveillance data
  - Perform event based retrieval
  - Receive real time event alerts through standard web infrastructure
  - Extract long term statistical patterns of activity

Veggie Vision

- Veggie Vision shortens and automates checkout time by automatically recognizing objects, such as fruits and vegetables, at the point of sale.

- Additional benefits are improved inventory control and improved consumer satisfaction. Under laboratory conditions the system achieves a 90% recognition rate which is comparable to human performance.

Everywhere Displays

Embedding displays on objects as a way to realize ubiquitous computing

- Virtual "touch screens" on any surface
  - Projection steered by a pan/tilt mirror to create displays on any surface
  - Imagery generated by computer vision algorithms that detect user gestures
- Applications
  - Public spaces: a better way to flexibly provide information without risks of theft or vandalism
  - Augmented reality: projecting information about objects and processes without requiring users to wear goggles

Meta Pad Modular Computer

In seconds, Meta Pad transforms into a handheld, desktop, laptop, tablet or wearable computer, without rebooting

- 9-ounce PC core unit with processor, memory & storage
- Pocket-sized: ¾ inch thick stack of 3x5 index cards
- 800 MHz; 128 MB RAM; 10 GB hard drive
- Maximum MHz/Watt/cc/kg for Windows OS
- Portable apps, registry & core hardware
- Thermal dock for heat dissipation
- Single docking connector

Linux Watch

A “concept car” for the post-desktop and mobile PCs era

- Up-to-date instant info device
  - 640x480 hi-res OLED
  - Simple touch-screen interface
  - Phone directory, calendar
  - Pager and IrDA communication channels
  - Wireless information services
- Innovation at multiple levels
  - Systems
  - Hardware
  - Displays
  - Packaging
  - User interfaces
  - Communication technology
  - Operating systems
  - Application software

Blue Gene/L

System
(64 cabinets, 64x32x32)
First 16 shown

180/360 TF/s
32 TB DDR

Cabinet
32 Node Cards, 8x8x16
in 2 midplanes

2.8/5.6 TF/s
512 GB DDR

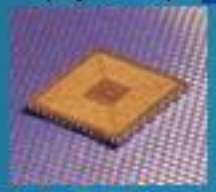
Node Card
(32 chips, 4x4x2)
16 Compute Cards
(up to 2 IO cards)

90/180 GF/s
16 GB DDR

Compute Card
(2 chips, 1x2x1)

5.6/11.2 GF/s
1.0 GB DDR

Chip
(2 procs.)

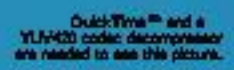


2.8/5.6 GF/s
4 MB

Note: Clock Speed 700 MHz

Deep Thunder

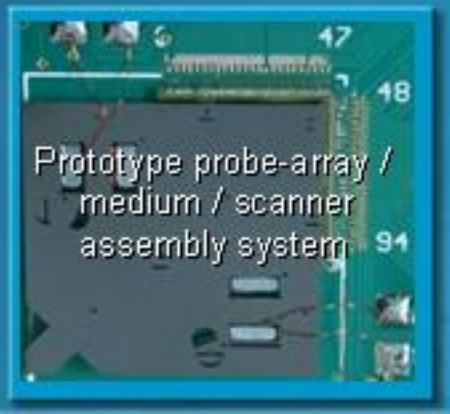
- Local, high-resolution, short-term weather forecasting



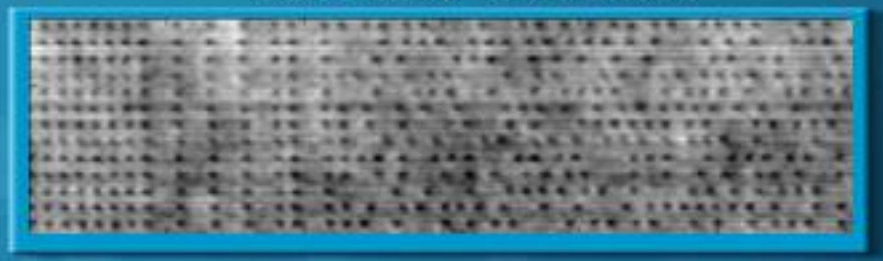
Millipede: Nanotechnology Data Storage

"Thermomechanical probe-storage using thousands of nano-size tips that punch indentations representing individual bits into a thin polymer film"

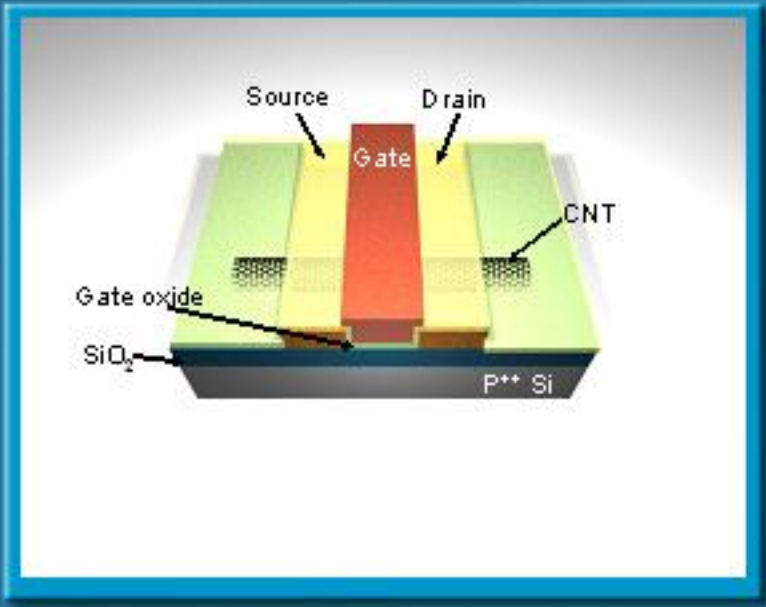
- Erasable and rewritable technology
- Storage densities of a trillion bits (1 Terabit) per square inch or higher
- Tracking of multiple probes at nanometer resolution

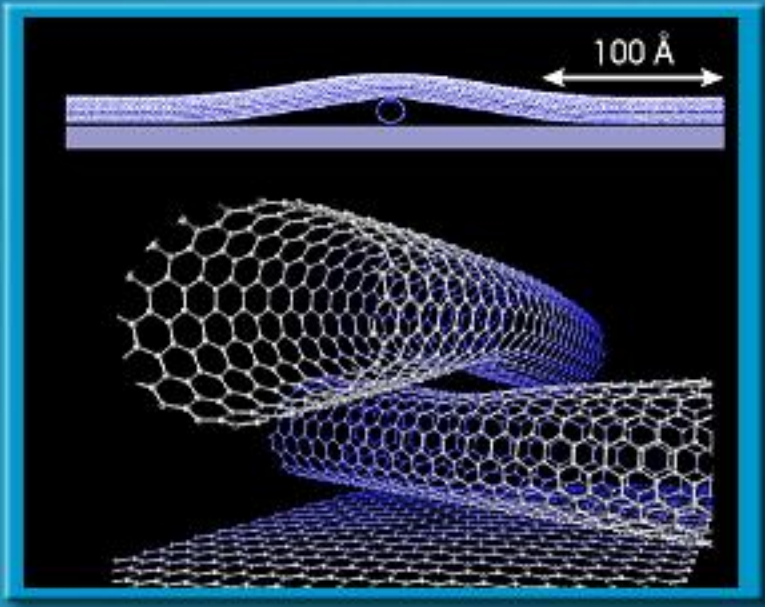


Bit-pitch = 13 nm Trackpitch = 27 nm
Areal Density 1.140 Tbits/in.^{2}



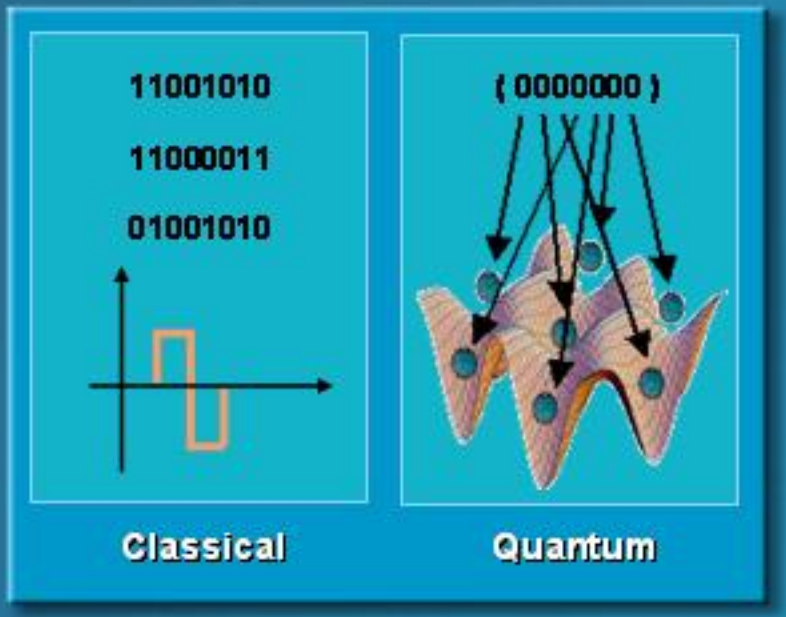
Carbon Nanotube FET





- Discovering and understanding the scientific foundations of nanotechnology
- Devising new atomic- and molecular-scale structures and devices for enhancing information technologies

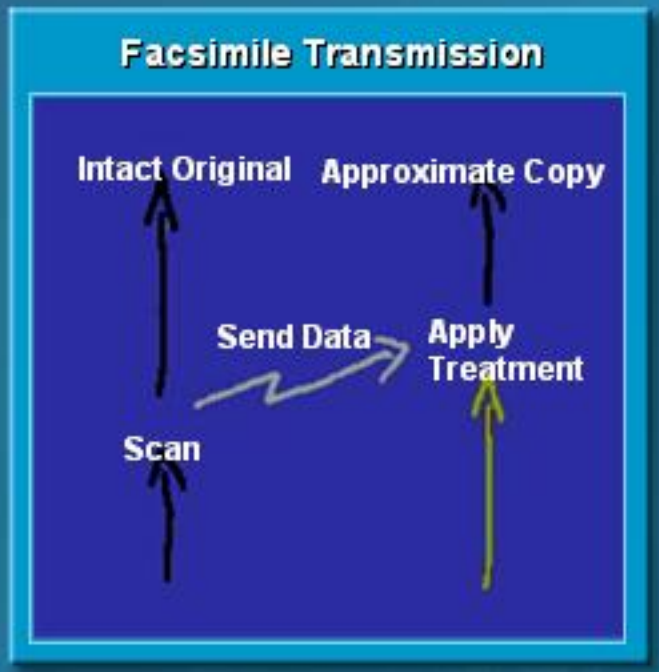
Quantum Information Processing

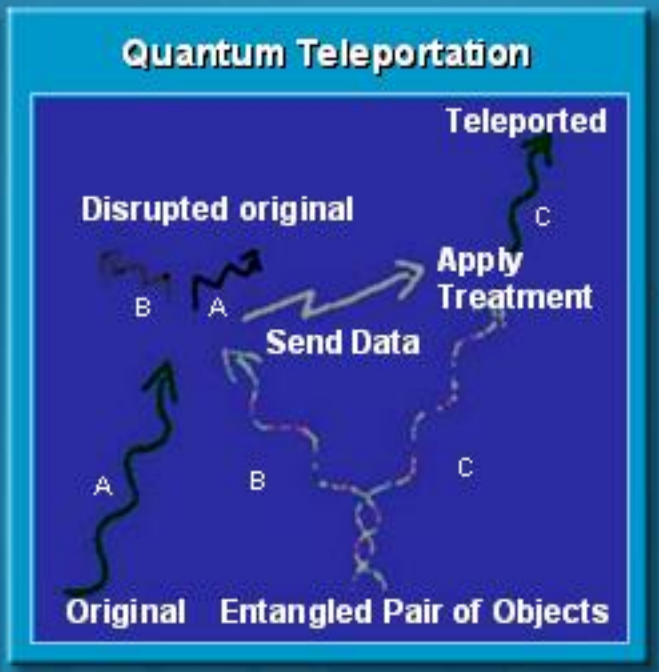


- When information is recorded in the exact quantum state and allowed to evolve according to the laws of quantum mechanics, novel kinds of information transmission and processing become possible:
  - quantum cryptography
  - quantum computing
  - quantum teleportation
  - quantum data hiding
  - ... ? ...

Quantum Teleportation

A group of scientists, including IBM Fellow Charles H. Bennett, confirmed that perfect teleportation is possible in principle, but only if the original is destroyed





Innovation occurs at the intersection of invention and insight

Sam Palmisano, http://www.ibm.com/gio

Thank
You