



Overview of DoD S&T Networking and IT Research Priorities, Programs and Funding

Federal Networking and IT Research Opportunities FY 2004
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Dr. André van Tilborg

andre.vantilborg@osd.mil

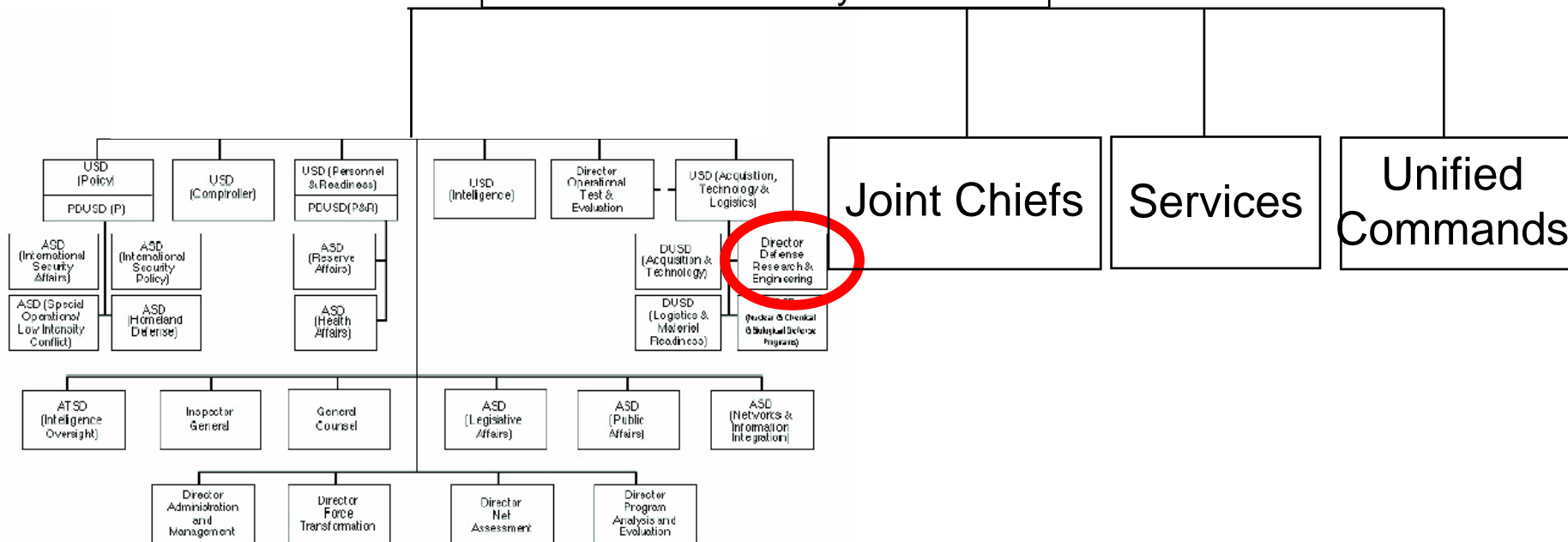
Director, Information Systems Directorate
Office of Deputy Under Secretary of Defense (Science & Technology)



Secretary of Defense

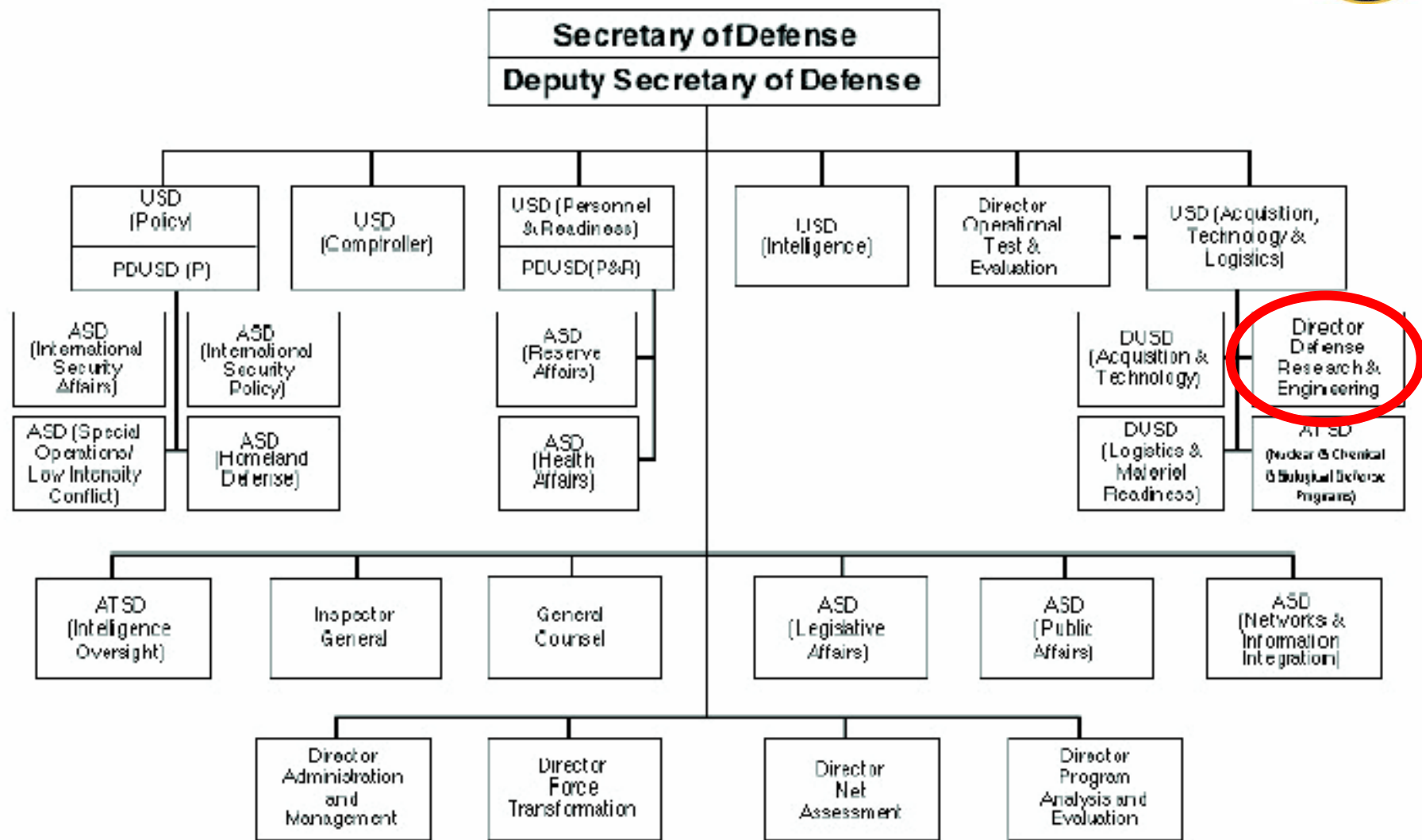
Deputy Secretary of Defense

Office of the Secretary of Defense

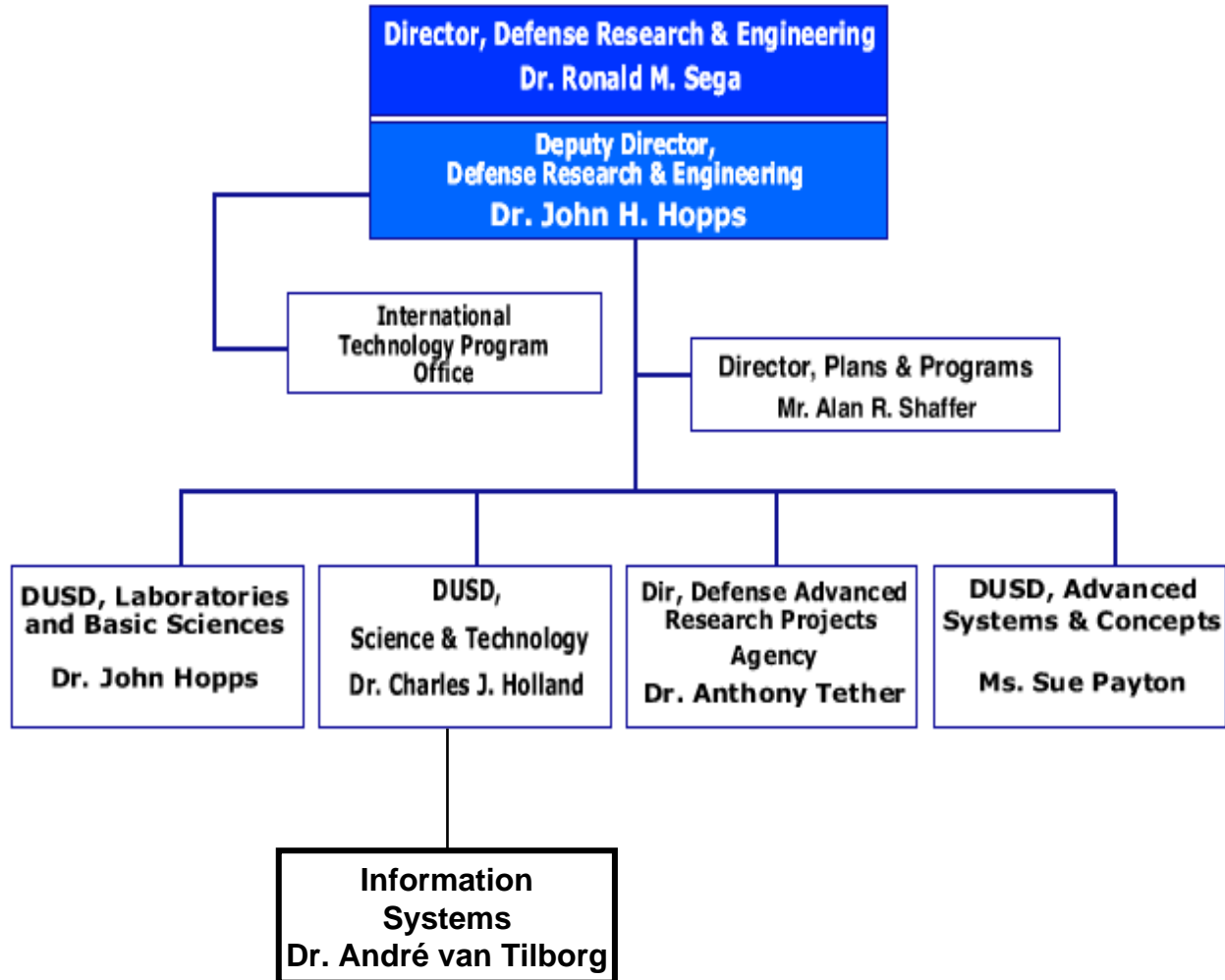




Office of the Secretary of Defense



DDR&E Organization



DoD Science & Technology Mission

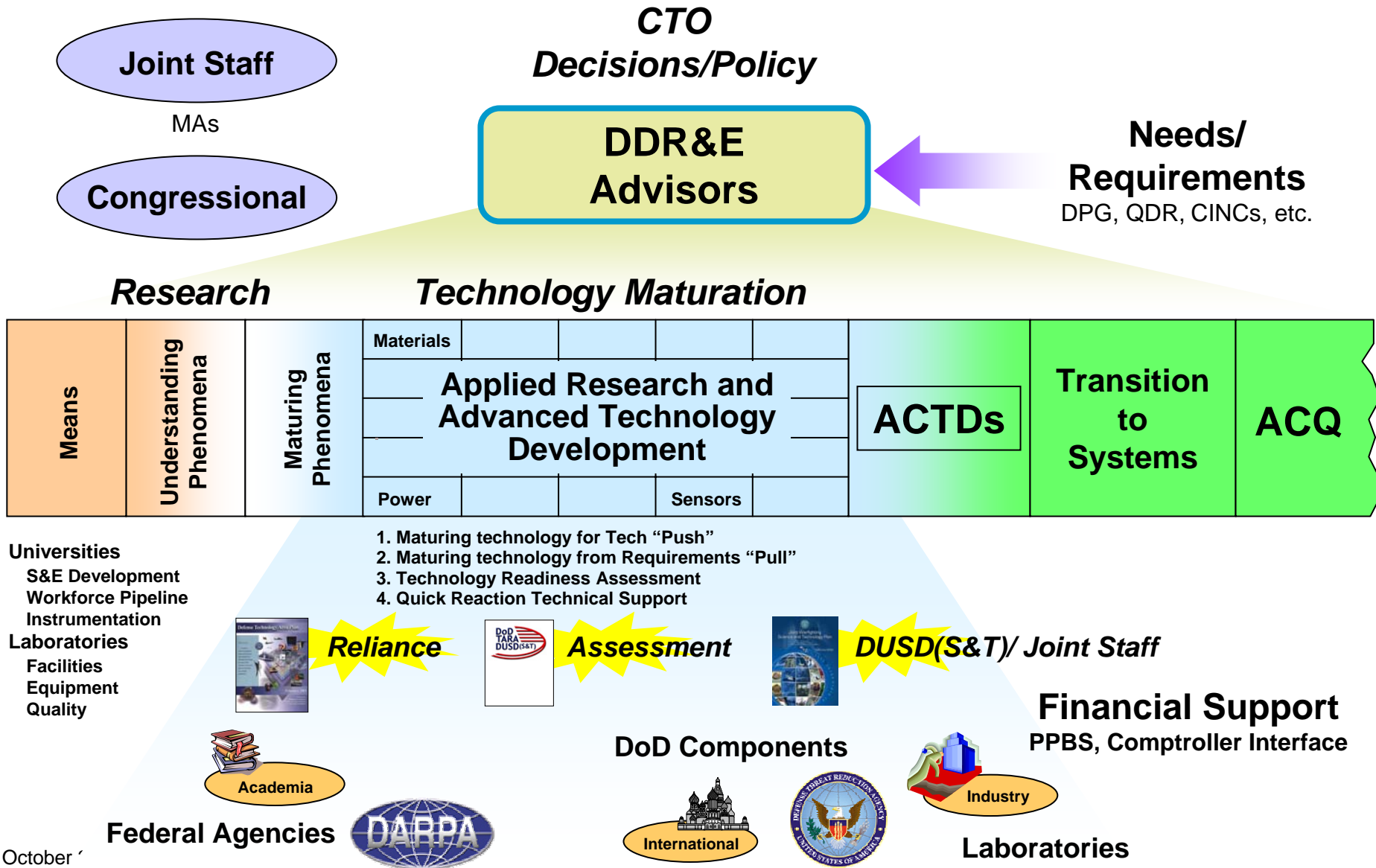


To ensure that the warfighters today and tomorrow have superior and affordable technology to support their missions, and to give them revolutionary war-winning capabilities.





Spectrum of S&T





FY04 RDT&E Budget Request

(PBR2004 data source)

**FY04 RDT&E = \$61.8B
requested
(6.1 thru 6.7)**

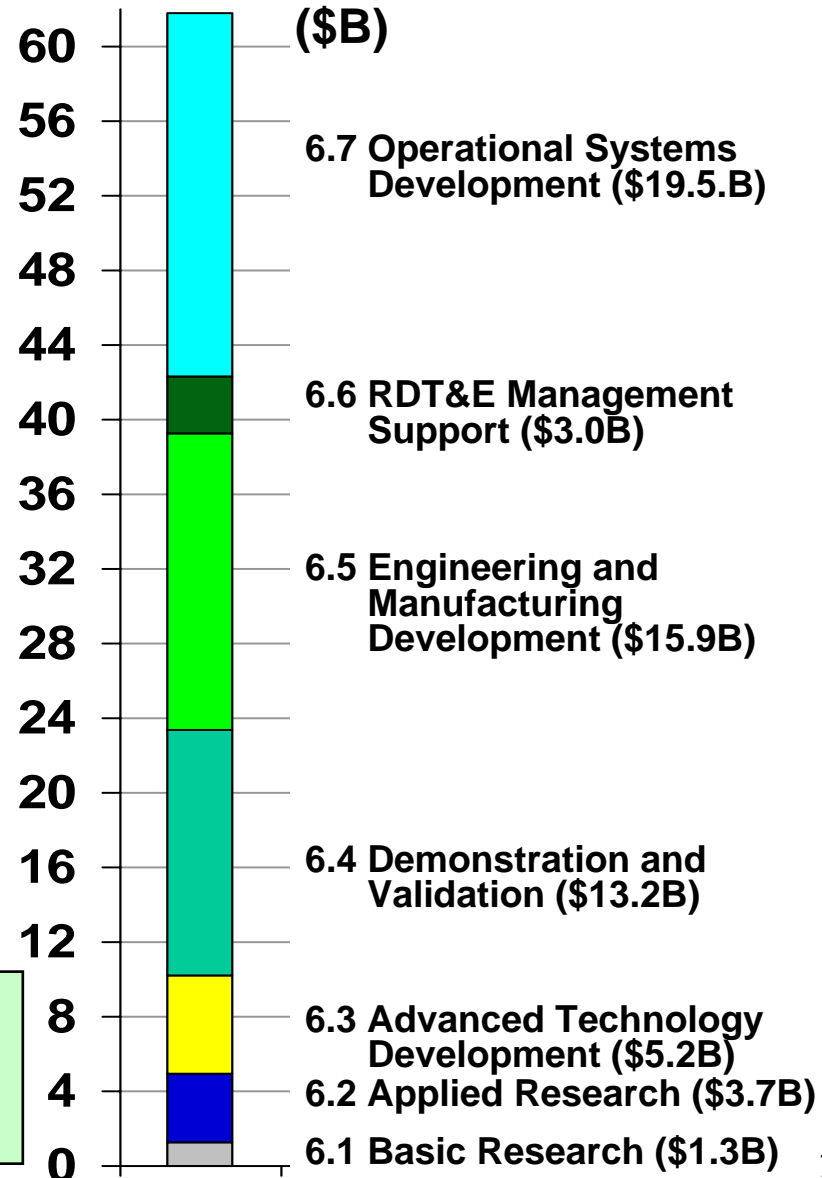
(6.6 + 6.7 = \$22.5B)

**Development
(6.4 + 6.5 = \$29.1B)**

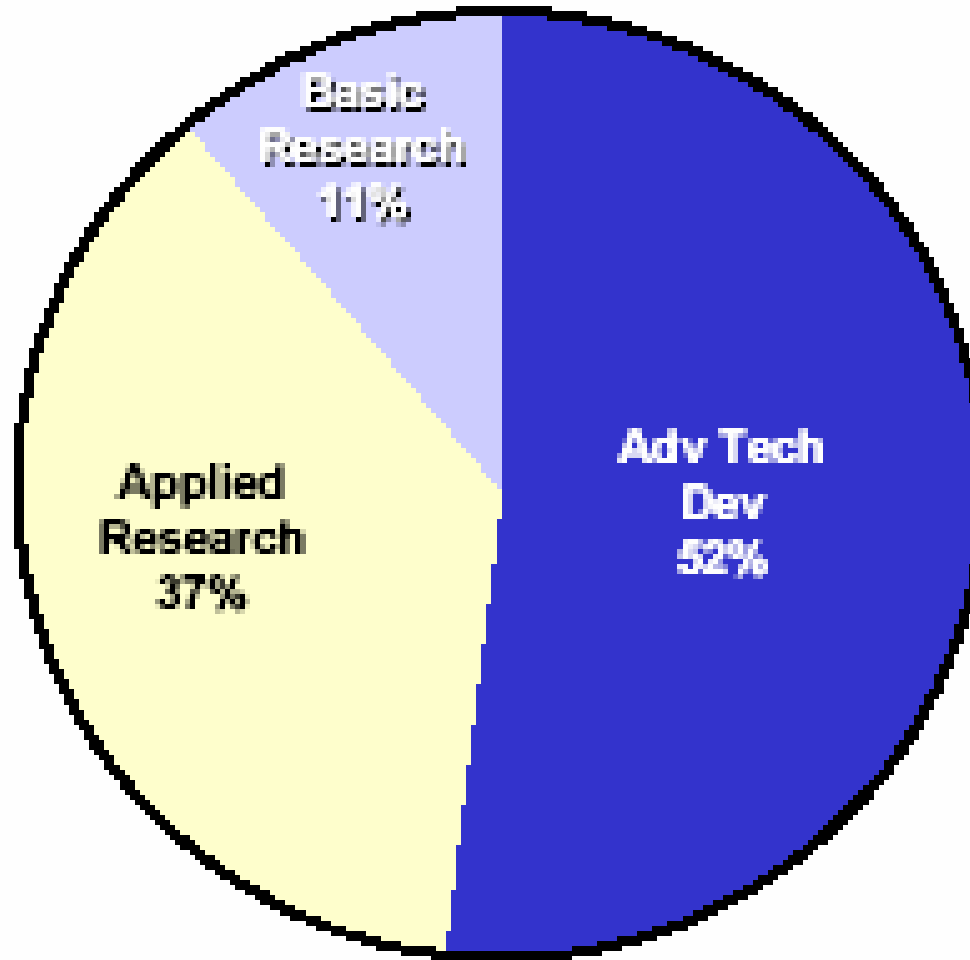
**Technology Base
(6.1 + 6.2 = \$5.0B)**

**Science and Technology
(6.1 + 6.2 + 6.3 = \$10.2B)**

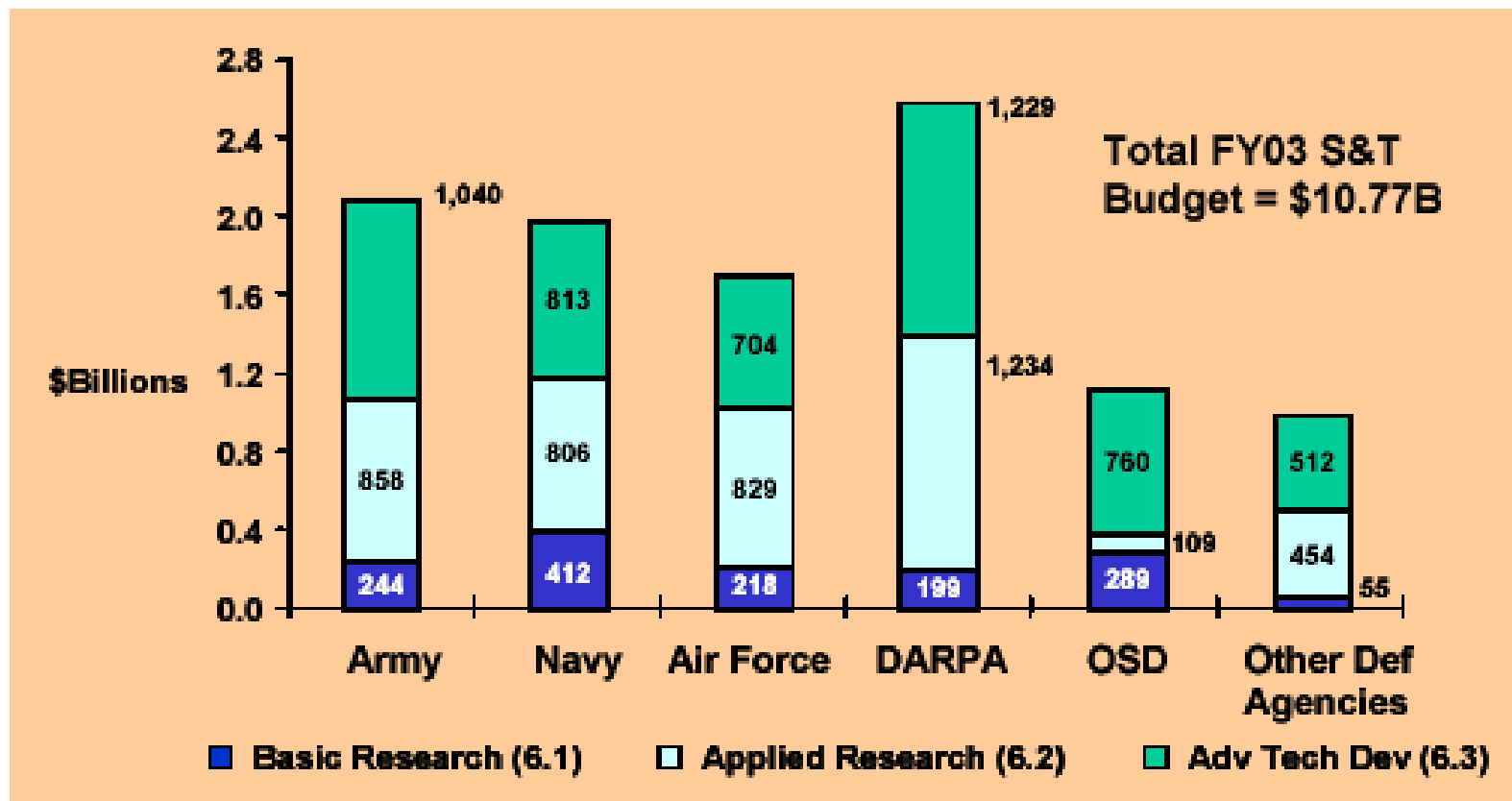
16% of RDT&E



Allocation of DoD FY03 S&T Funds

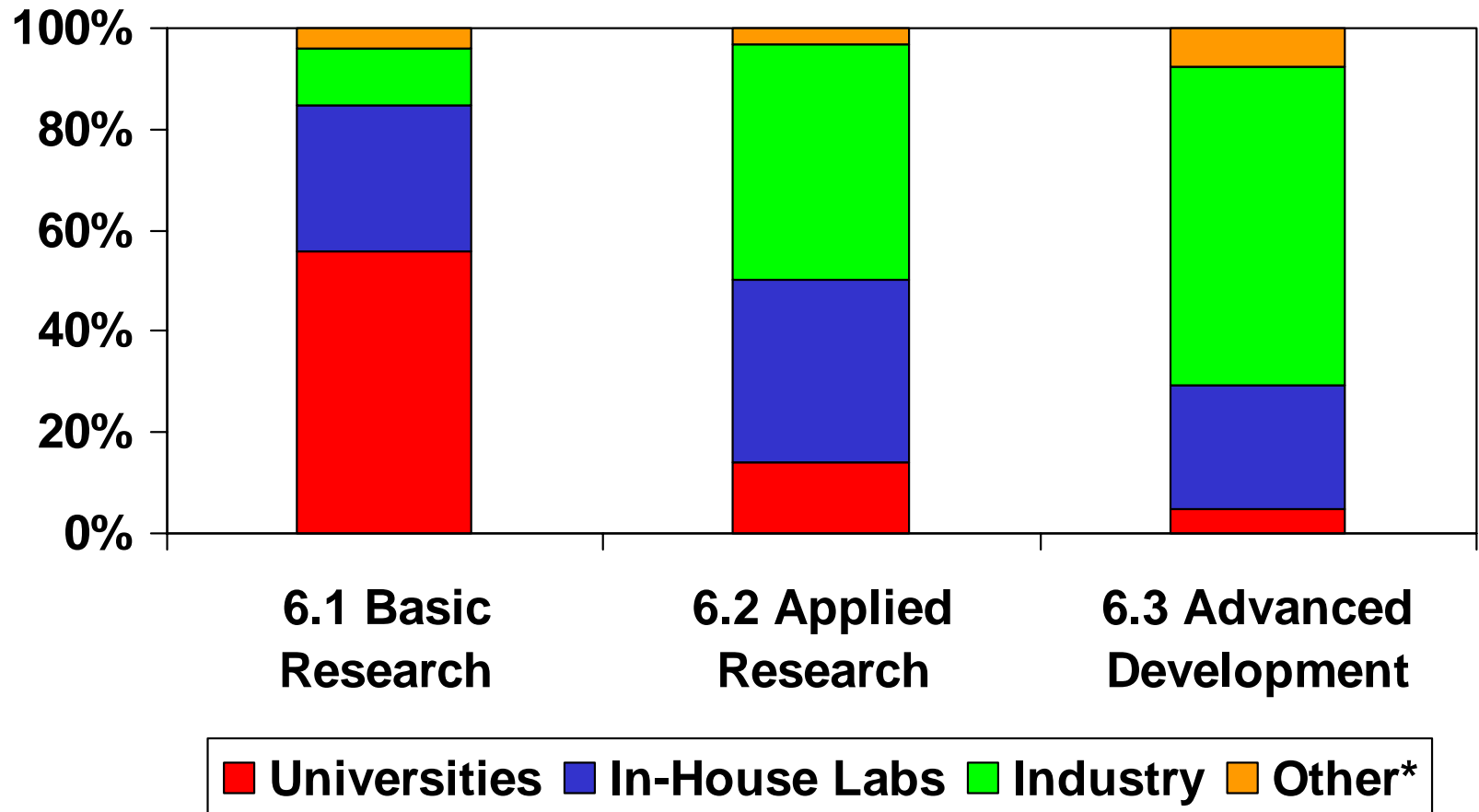


Distribution of FY03 S&T Funds

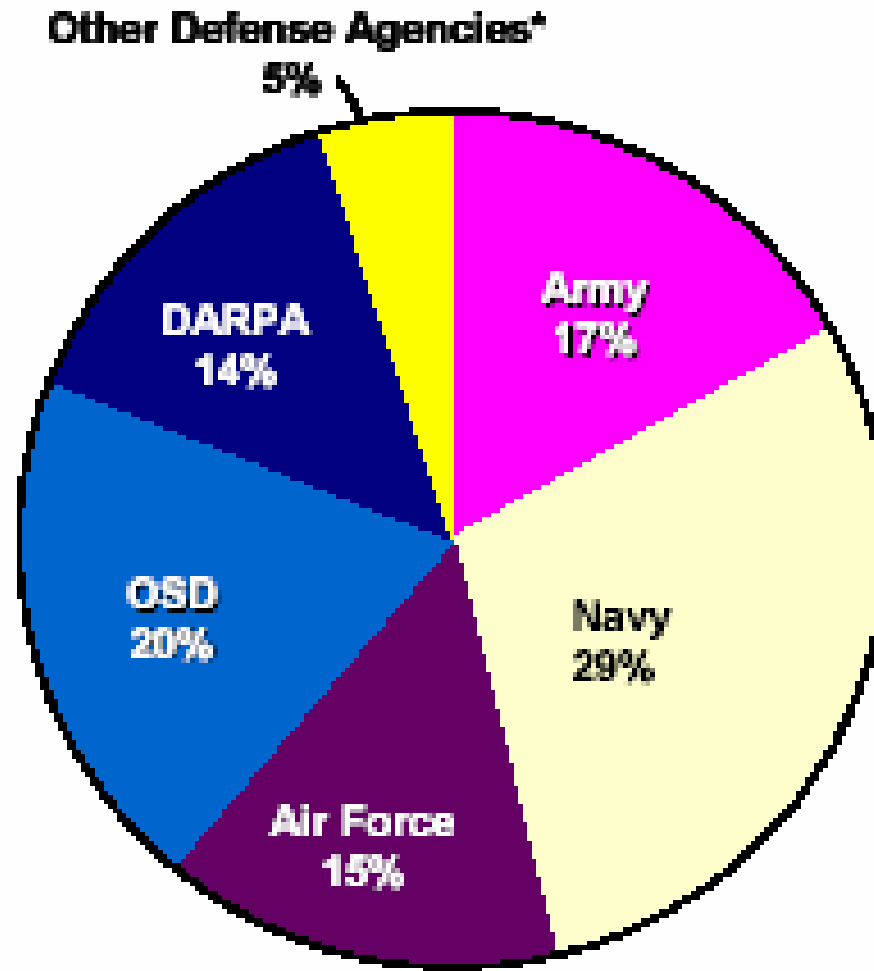




From Which DoD Accounts do Universities Receive Support?



DoD FY03 Basic Research Funds

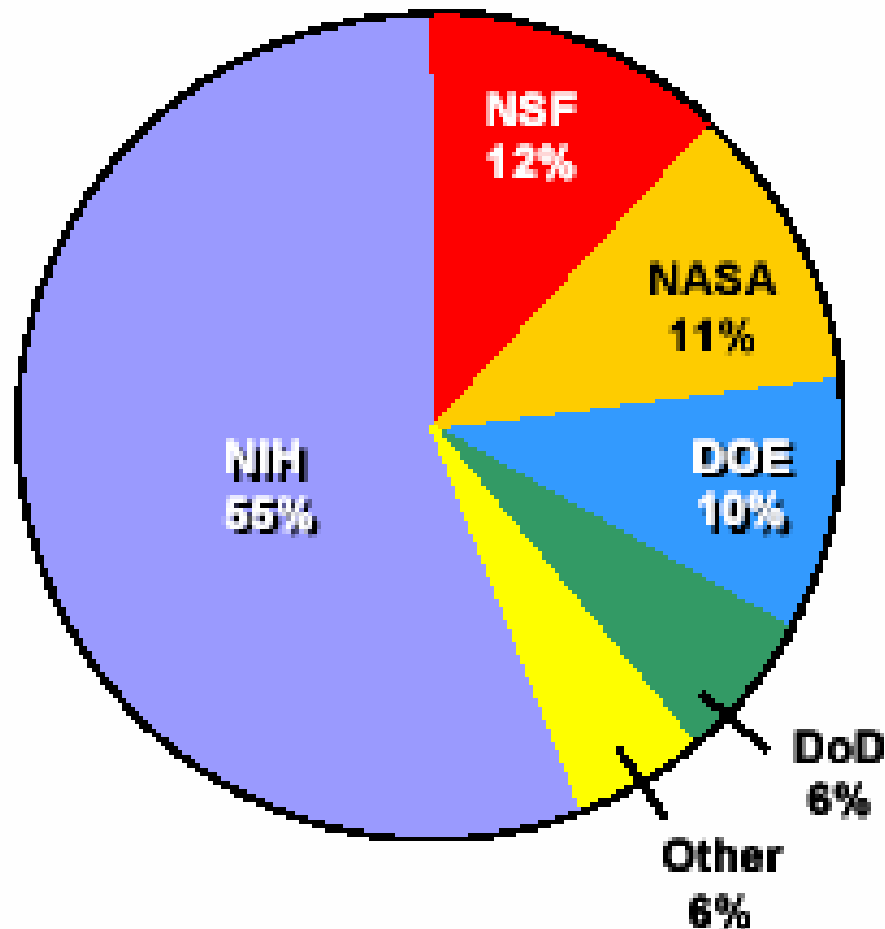


* Other Defense agencies include the Chemical and Biological Defense Program

Comparison of Basic Research Funding

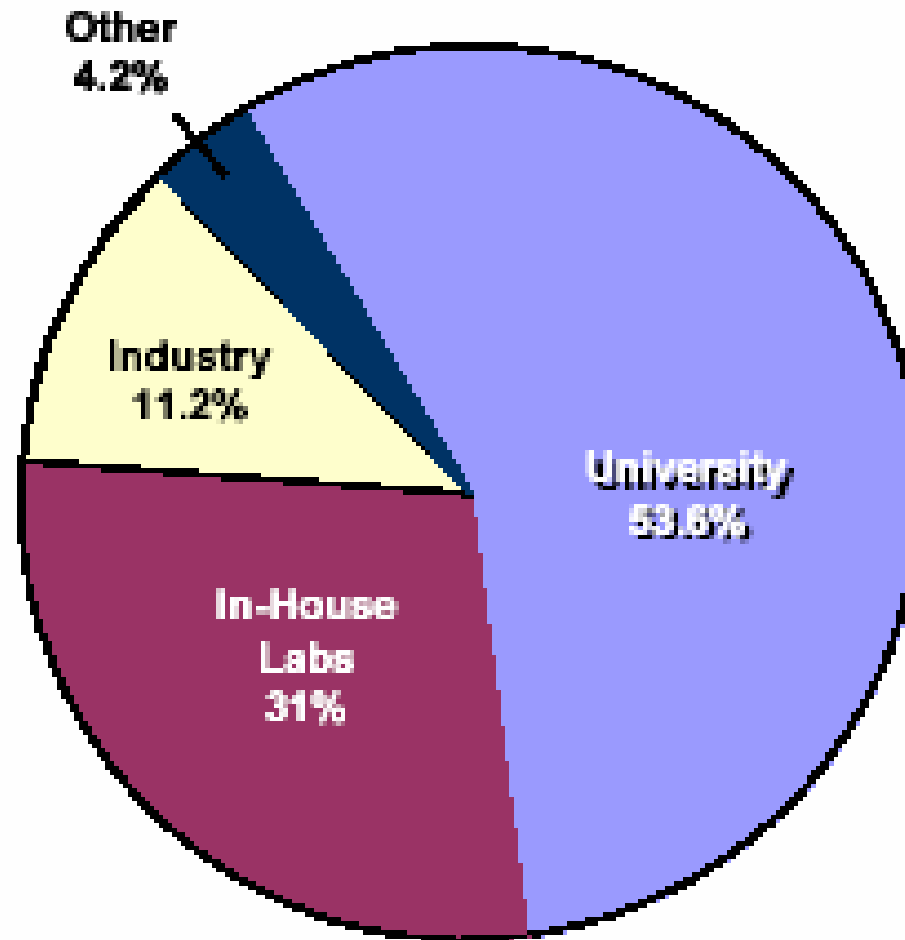


FY02 Funding Total = \$23.4B



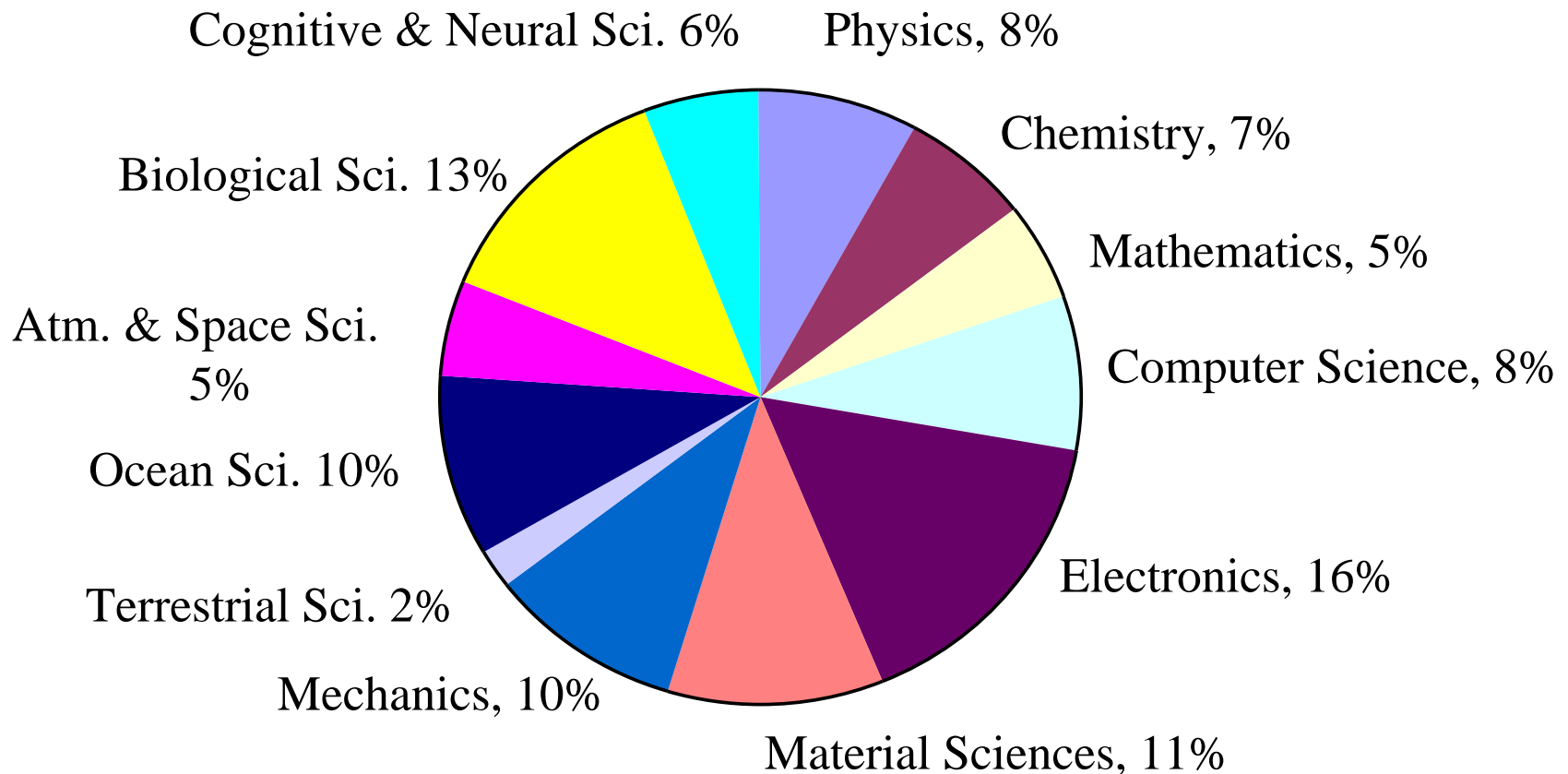
Source: National Science Foundation (Reference 13)

Performers of DoD Basic Research in FY03



Source: National Science Foundation (Reference 14)

DoD Basic Research Funding by Discipline (varies slightly yearly)



DoD's Major Funders of IT & Networks External Research



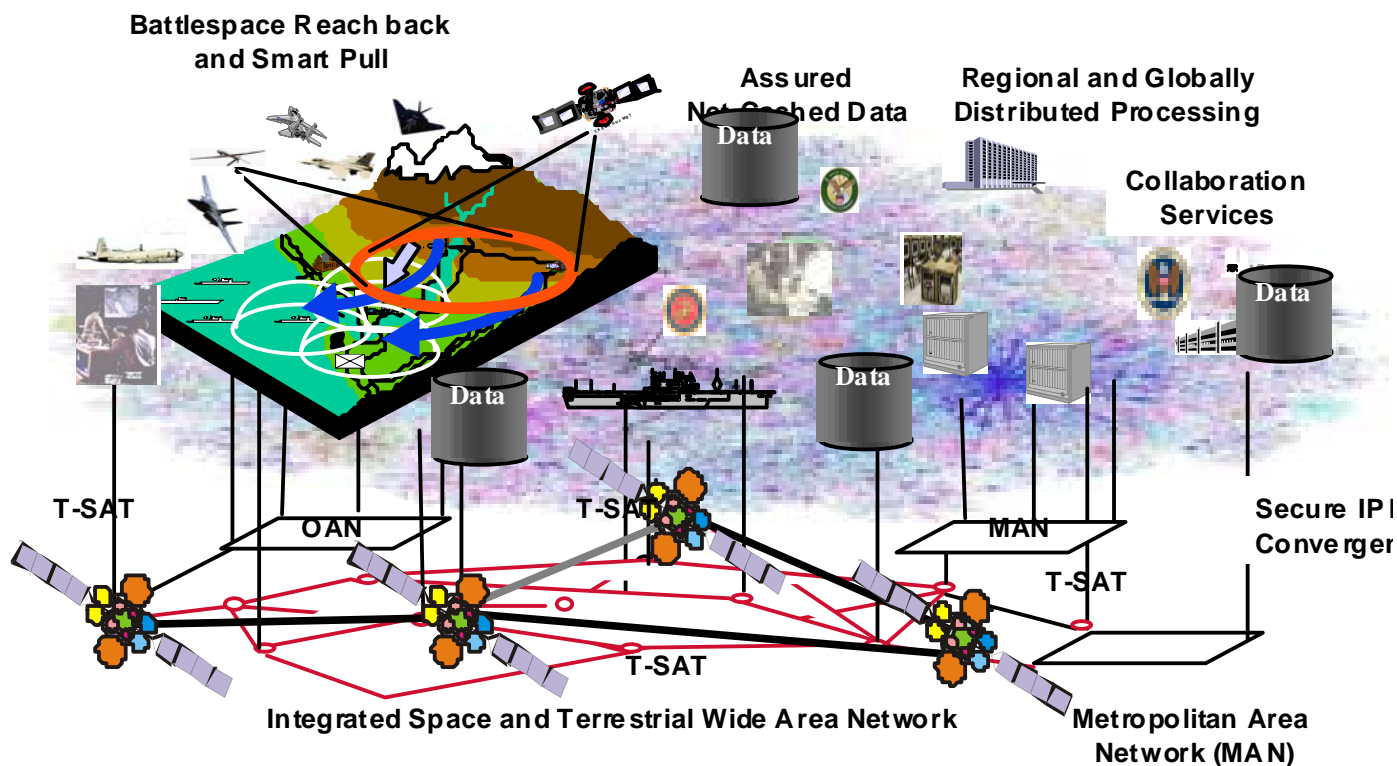
- **Defense Advanced Research Projects Agency**
 - Information Processing Technology Office
 - Information Exploitation Office
 - Advanced Technology Office
- **Office of Naval Research**
 - Information, Electronics, & Surveillance Dept.
 - Mathematics, Computer, and Information Sciences Division
- **Air Force Research Laboratory**
 - Office of Scientific Research
 - Directorate of Mathematics and Space Sciences
 - Information Directorate
- **Army RDECOM**
 - Communications-Electronics Research, Development & Engg Ctr.
 - Army Research Laboratory
 - Computational & Information Sciences Directorate
 - Computing and Communications Sciences Division
 - Army Research Office
 - Computing & Information Sciences Division

DoD IT & Networking Key POCs



- Mr James Barbarello – CERDEC: james.barbarello@us.army.mil
- Dr Theodore Bially – DARPA IXO: tbially@darpa.mil
- Dr Ron Brachman – DARPA IPTO: rbrachman@darpa.mil
- Dr Northrup Fowler – AFRL/IF: northrup.fowler@afrl.af.mil
- Dr James Gantt – ARL: jgantt@arl.army.mil
- Dr David Honey – DARPA ATO: honeyd@darpa.mil
- Dr Bobby Junker – ONR: junkerb@onr.navy.mil
- Dr Wen Masters – ONR: masterw@onr.navy.mil
- Dr Cliff Rhoades – AFOSR: clifford.rhoades@afosr.af.mil
- Dr Bill Sander – ARO: sander@aro.arl.army.mil
- Mr Charles Strimpler: CERDEC: charles.strimpler@us.army.mil
- Mr Gary Yerace – ARL: gyerace@arl.army.mil

Notional Battle Space Information Grid



DoD Reliance: Guidance Regarding DoD Research Directions



<https://www.dtic.mil>

DDR&E S&T Initiatives

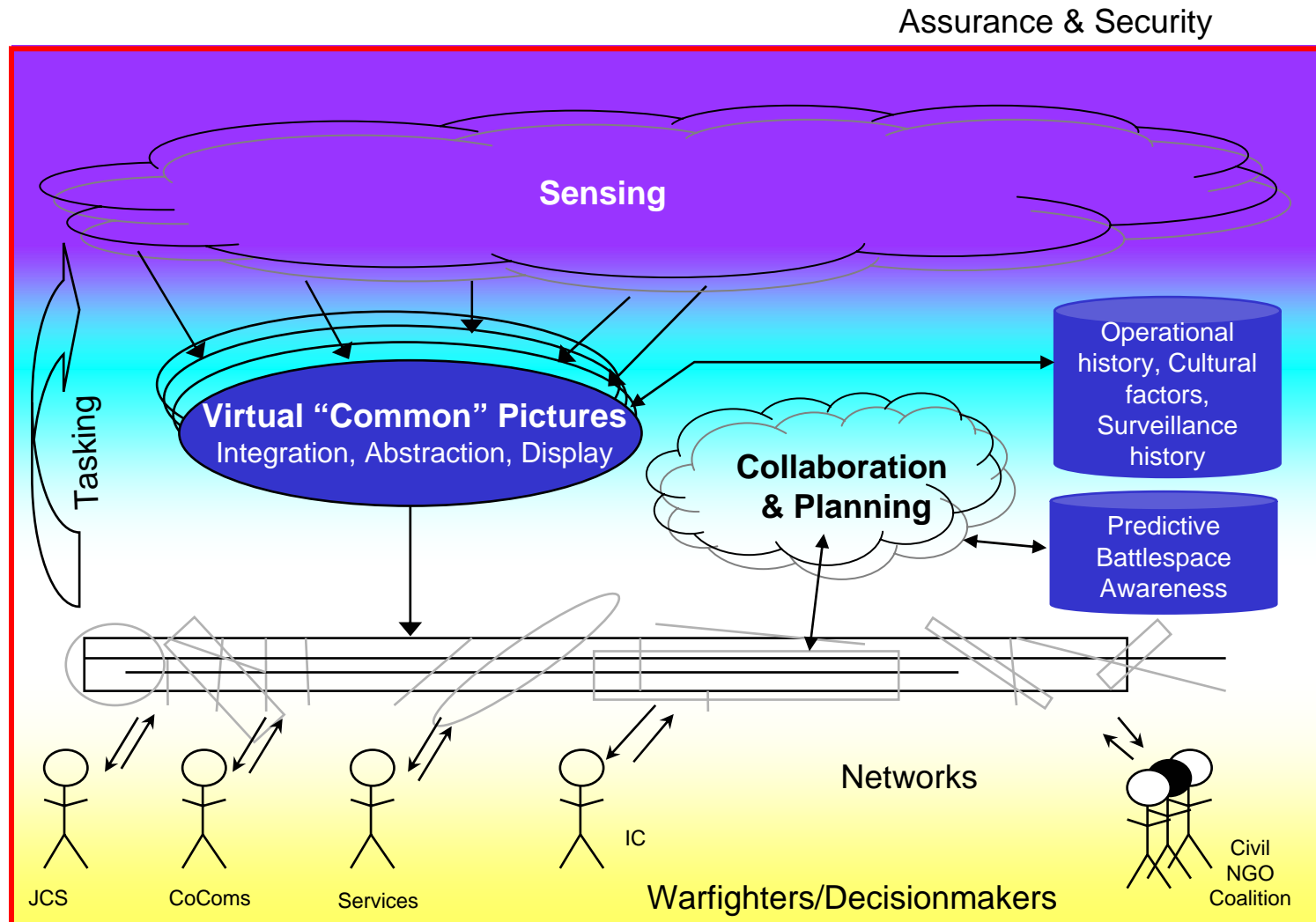


- **National Aerospace Initiative**
- **Energy and Power Technology Initiative**
- **Surveillance and Knowledge Systems (SKS) Initiative**
 - Focuses on research in C4ISR to enable network-centric ops

Future Objective C4ISR Operational Environment:



- Persistent
- Adaptive
- Flexible
- Agile
- Pervasive
- Integrated
- Interoperable
- Joint
- Intelligent
- Autonomous
- Connected
- Robust
- Assured
- Trusted
- Timely
- Optimal
- Accurate
- Seamless
- Operator-Centered
- Operationally-tailored
- Coalition
- Plug & Play
- Distributed





Surveillance & Knowledge Systems

Information and Decision Dominance achieved through integrated C4ISR technologies that enable seamless, interoperable, knowledge-based, and assured Joint & Coalition Network-Centric Operations & Warfare.

- **Sensing:**

Management and tasking of pervasive, persistent sensors for enhancing battlespace knowledge

- **Comms & Networking:**

Guaranteed, 365x24x7, mobile, information access and delivery (always-on “internet dial tone”)

- **Knowledge Management:**

Dramatically improved speed of command through integrated Common Picture, Collaboration, and Planning

- **Information Security (Cyber Ops):**

Network protection, information assurance; offensive disruption

SKS Pursues C4ISR S&T Objectives in Six Key Dimensions



- **Sensing, Detection, & Tracking Effectiveness**
 - Detection of partially obscured and low observable targets
 - Rapidly and remotely detect covert and overt WMD/CBNRE facilities and movement of material
- **Common Picture Quality**
 - Automated multi-intelligence data fusion
 - Information Distribution
- **Decision Quality & Timeliness**
 - Collaboration
 - Accuracy
- **Network Coverage**
 - Mobile ad hoc self organizing networks
 - End-to-end Quality of Service (QoS)
- **Interoperability & Flexibility**
 - Information Exchange Richness
 - On Demand Interoperability
- **Information Security, Survivability, and Response**
 - Cyber attack impact assessment & recovery Course of Action (COA)
 - Synchronize information operations planning and execution to kinetic campaign objectives



High-Priority Technology Gaps

- **Sensing:**
 - Self re-configuring sensor networks
 - Multi-source sensor automatic/aided target identification
 - On-board and Off board multi-source fusion, automated collaborative platform target identification
- **Communications & Networking:**
 - Seamless, highly scaleable, mobile networking developments and demonstrations across multiple tiers (surface to space)
 - On-the-move networking antennas
- **Knowledge Management:**
 - Cognitive science-based tools, models, computational methods, and human-computer interfaces
 - Future state prediction models
 - Real-time consistent level 2 & 3 data fusion
 - Automated planning & assessment tools
 - Software for verification and validation analyses
 - Authoritative data with known confidence
 - Reliable, controllable mechanisms for integrating and managing loosely-coupled systems in a dynamic global enterprise
- **Information Security, Survivability, & Response:**
 - Robust, covert cyber-surveillance tools and techniques
 - Autonomic security management and defense postures for wired and wireless networks
 - Active network defense



Example: How One Service Views Networking and IT Research for its Mission



Dynamic Command & Control



**24 Hours a Day -- 24 Time Zones
(Foreign and Homeland)**

Key Information Capabilities

- **Build & maintain a Dynamic Execution Order, covering:**
 - Air & Space
 - Cyber
 - Government, Military, Civil
- **Distributed configurable centers, adaptable to mission, resources, guidance, & command style**
- **Minimal forward deployed footprint**
- **Optimal use of bandwidth, secure assured communication among units**



Information Operations



Key Information Drivers

- Integration of defensive & offensive information warfare
- Computer & network attack protection, detection, and response
- Secure, survivable networks for sensitive & classified traffic for Joint/Coalition operations
- Information Assurance for embedded systems
- Integration of IO with conventional operations





Integrated Space, Air, Sea & Ground Operations



***Information Technology is the
fabric that Integrates Air, Space,
Ground and Sea Operations***

Key Information Capabilities

- Seamless C2 information systems
- Control and integration of:
 - Ground
 - Sea
 - Air
 - Space

Cyber
Civil Defense
State/Local
FEMA, CDC
- Global information services with assured availability and quality
- Interoperability and Integration with Government and Civil organization



Time-Sensitive Targets



Key Information Drivers

- Seamless (Near) Real Time Operation Between Sensors, Decision Makers, Shooters, and Weapons
- Exploit MTI Data to Find, Fix, Track, Engage mobile targets in “hide” and in motion
- No Move Zones vs. No Fly Zones
- Information architectures for real-time information into and out of the cockpit
- Robust terminal guidance



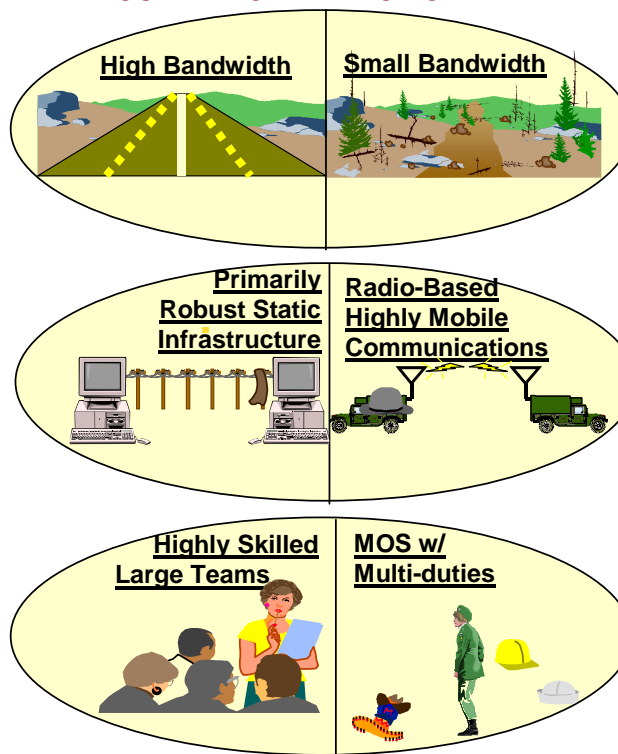
Commercial versus Military Communications Challenges



Commercial

- Mobile Subscriber, Fixed Infrastructure
- Pre-configured Networks
- Tall, Fixed Antenna Towers
- Fiber optic Internodal Connections
- Greater Frequency Spectrum Availability
- Fixed Frequency Assignments
- Protection: None -> Privacy (single level)
- Interference Rejection is Somewhat Important
- Low probability of Detection (LPD) is not an issue

COMMERCIAL TACTICAL



Military

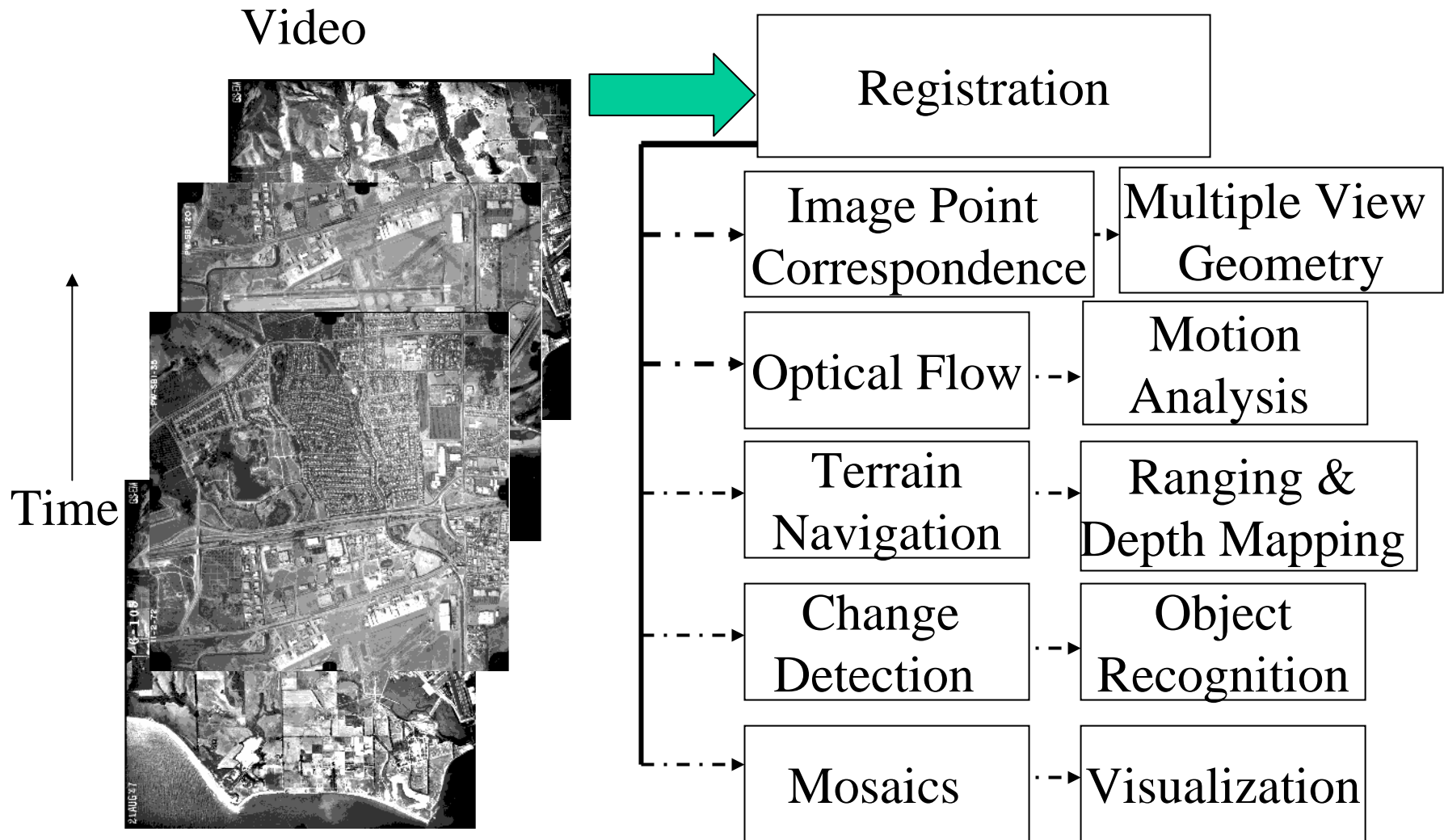
- Mobile Subscriber - Mobile Infrastructure
- Ad Hoc, Self Organizing Networks
- Small, Easily Erectable Masts; Low Profile OTM Antennas
- Mobile, Wireless, Internodal Connections
- Restricted Frequency Assignments; Geographically Impacted
- Protection: None -> Top Secret/SI (Multiple, Simultaneous Levels)
- Interference Rejection and Antijam are Critical
- Low Probability of Detection (LPD) is Critical



Examples of Specific Network & IT Research Being Pursued



Image Registration is Fundamental to Automation/Interpretation



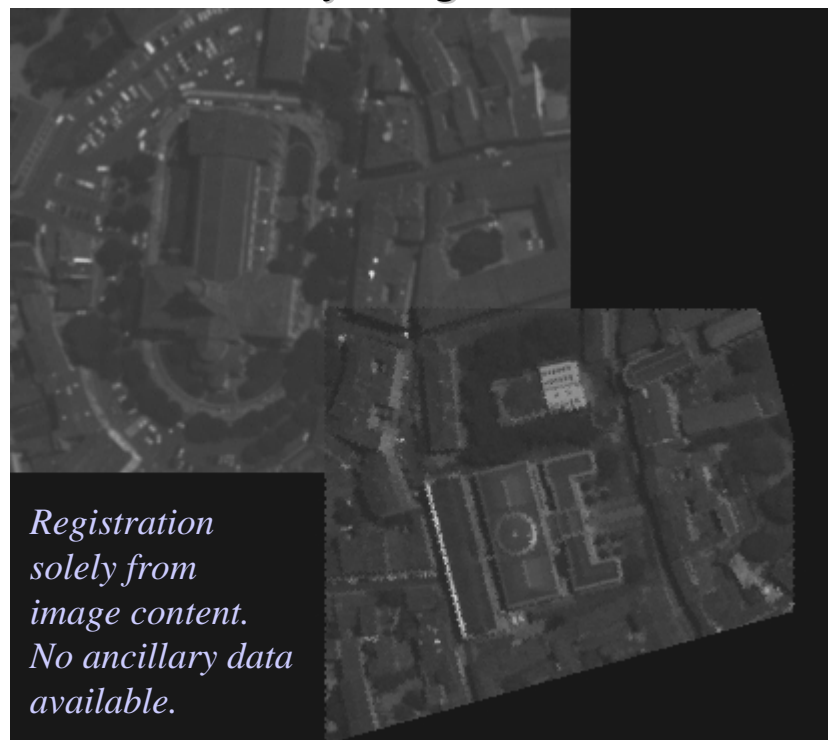
Automatic Registration of Surveillance Imagery



- Images at left share less than 20% common area. Images differ in:
 - Color content (Green vs. Blue Channels)
 - Pose (Perspective change)
 - Severe Occlusion



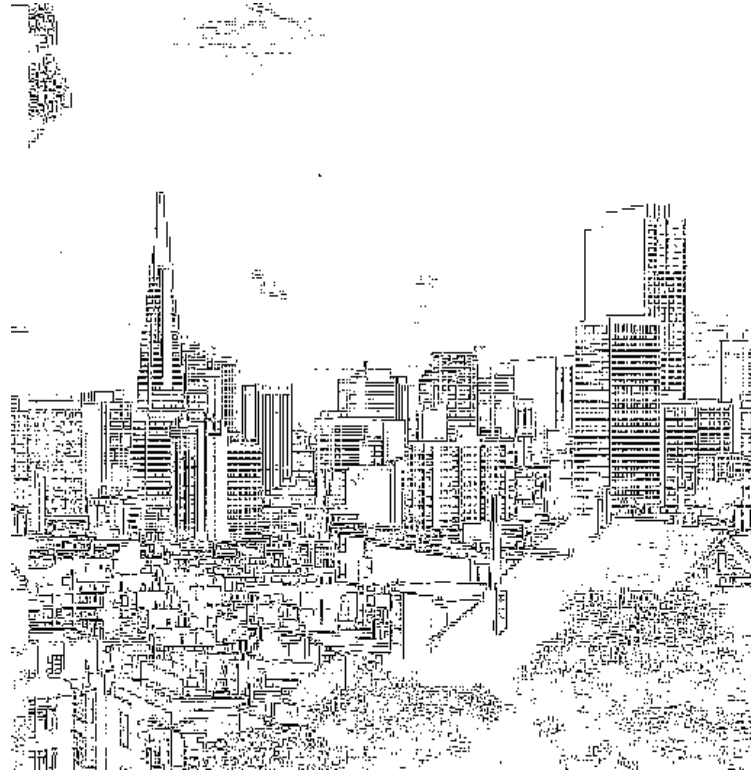
Automatically Registered Mosaic



Automated Generation of Urban Topography Databases

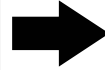


Original

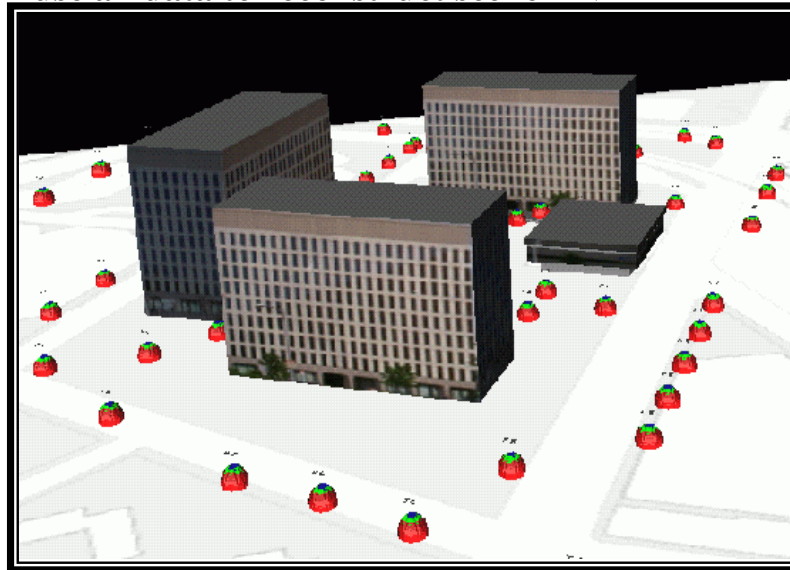


Processed

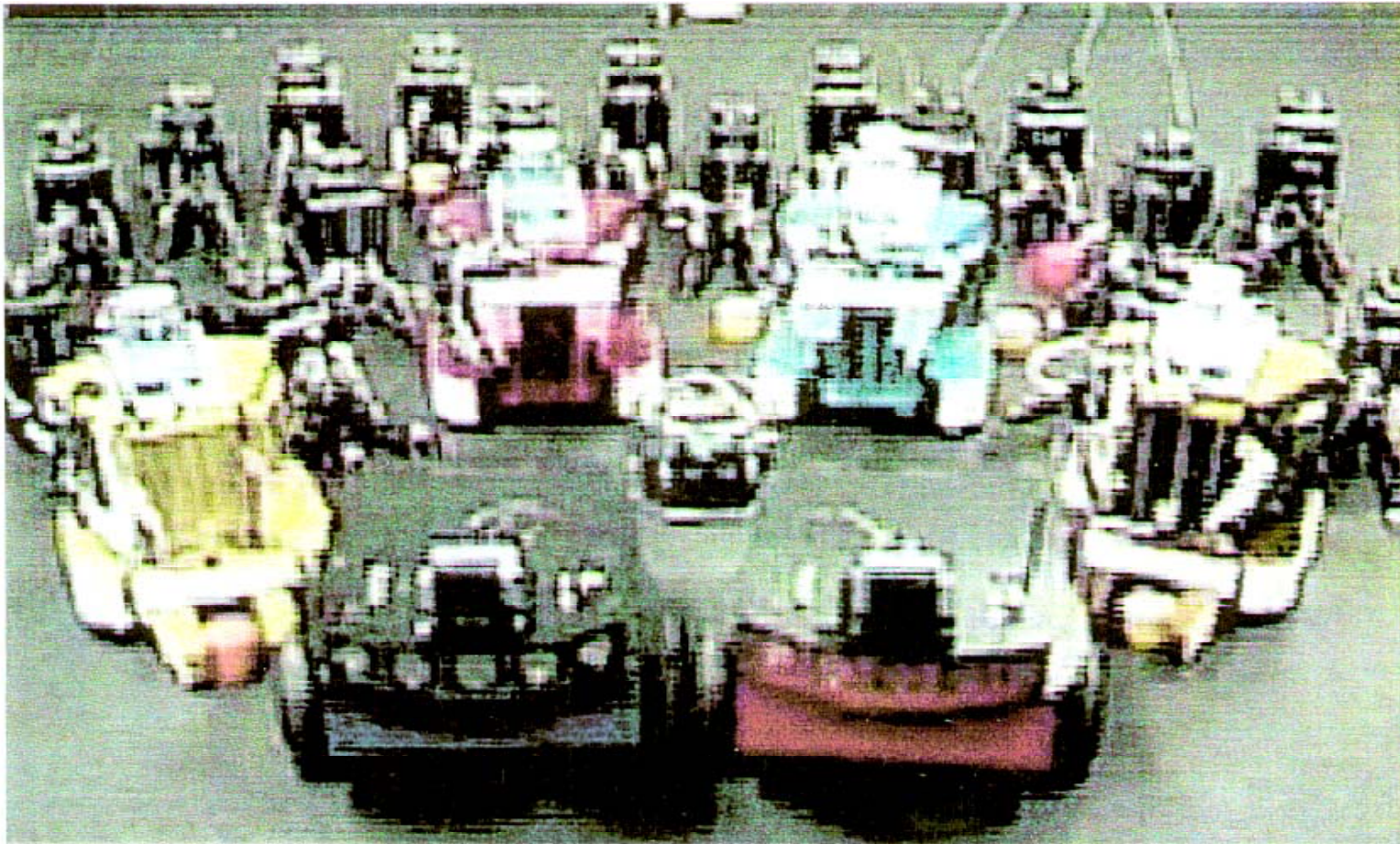
Automated Generation of Digital Models via 3-D Hemispheric Imagery



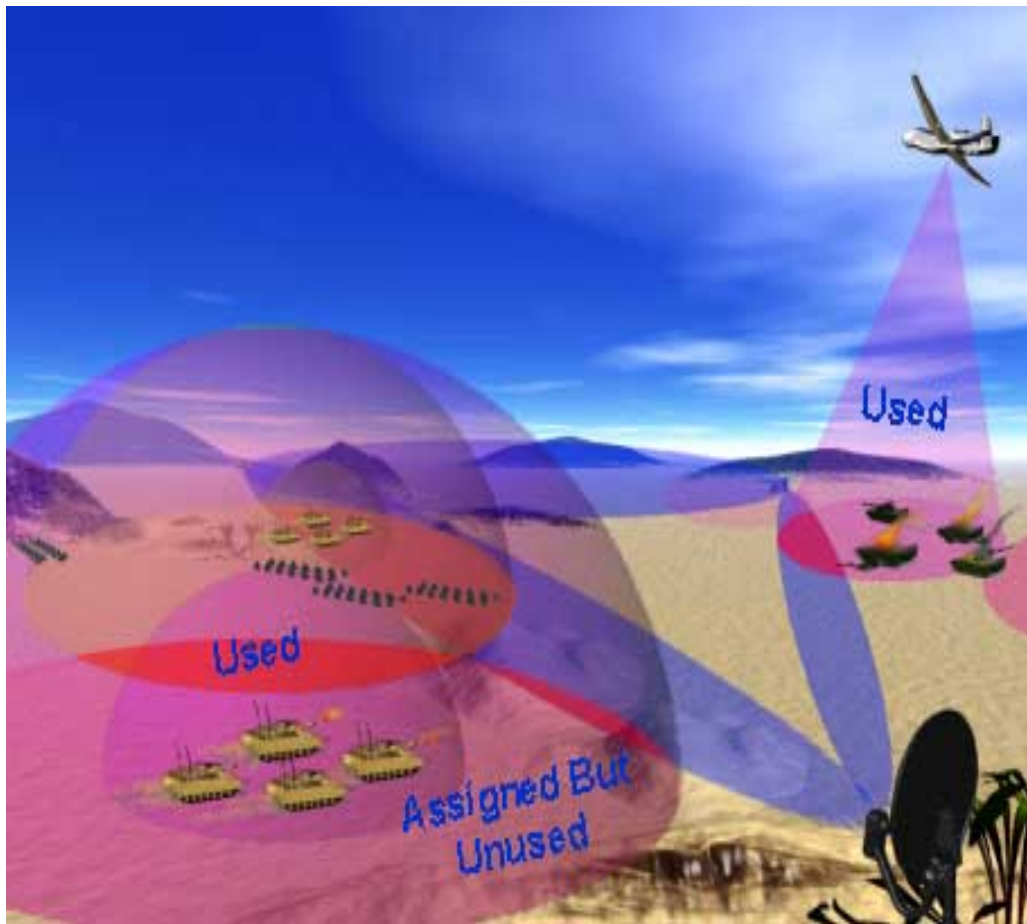
use all data to reconstruct scene



Surveillance by Swarms of Autonomous Mobile Platforms

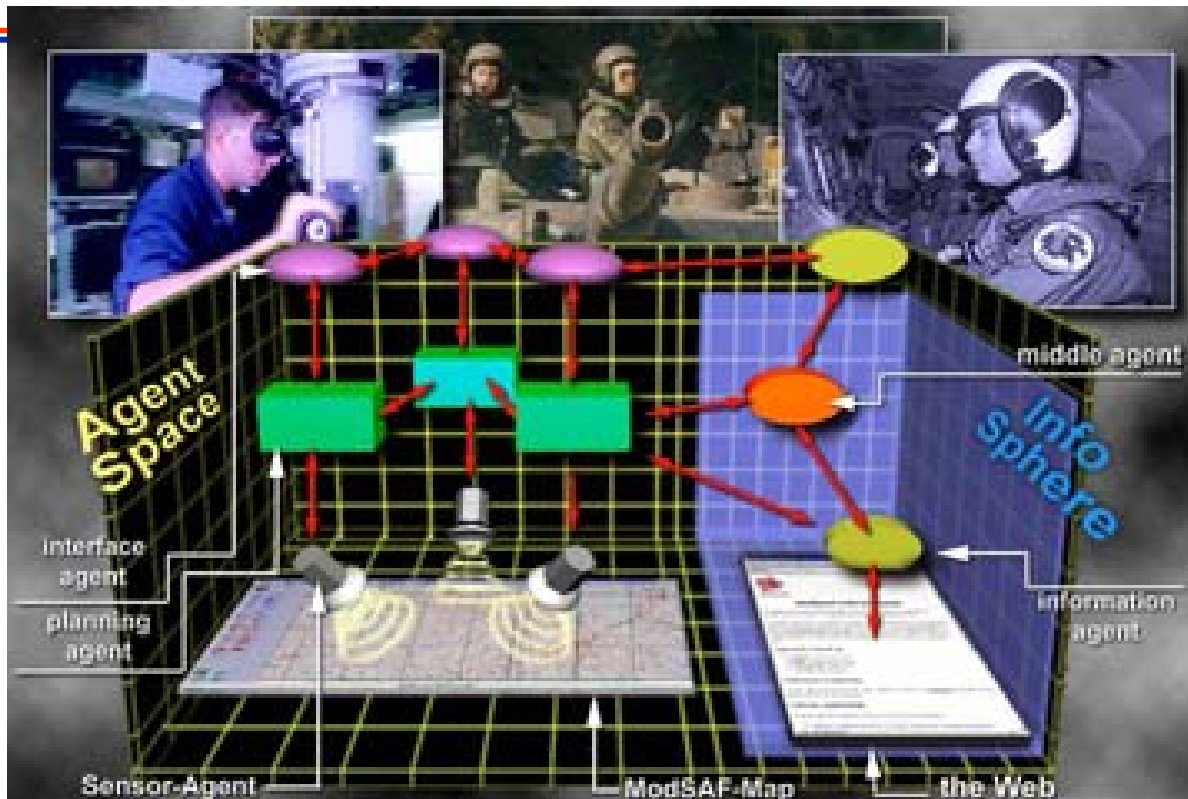


Maximize Efficiency of RF Spectrum Usage



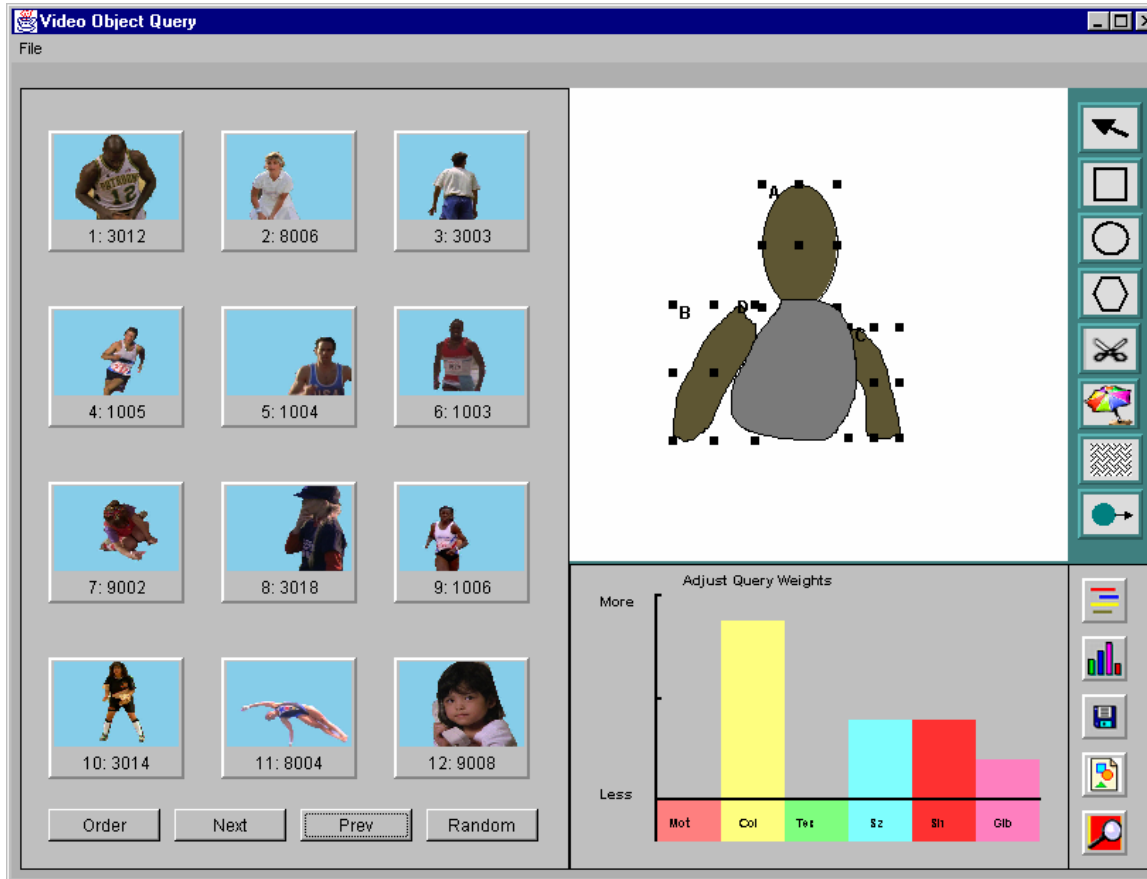
- Develop Both the Enabling Technology and the System Concepts to Dynamically Use Spectrum
- Autonomous Dynamic Spectrum Utilization
 - Sense, create waveforms, & minimize interference to existing users
- Develop Open XG Protocol Set
- Evolve Spectrum Policy Based Controls

Integrating Intelligent Assistants into Human Teams



- Increase the effectiveness of joint Command and Control Teams through the incorporation of Agent Technology in environments that are: distributed, time stressed, uncertain, and open

Semantic Video Object Segmentation and Matching



Ability to relate semantic object specifications to visual appearance is crucial in content-based info indexing and retrieval

Summary



- **DoD is a big organization with many IT and Networks research components.**
- **There is an overarching vision for DoD's IT and Networks research: Network-Centric Operations.**
- **DoD's IT and Networks research activity is executed in a decentralized and distributed fashion, coordinated through the S&T Reliance process.**
- **Potential participants in DoD-sponsored IT and Networks research will find it helpful to familiarize themselves with documented research needs, and with the objectives of the specific program officers responsible for advancing key technologies.**