

# Spectrum of Academic Research Computing

- Electromagnetic Analogical Description -

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# Acknowledgement

By Google's technology

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Google™



# Paradigm

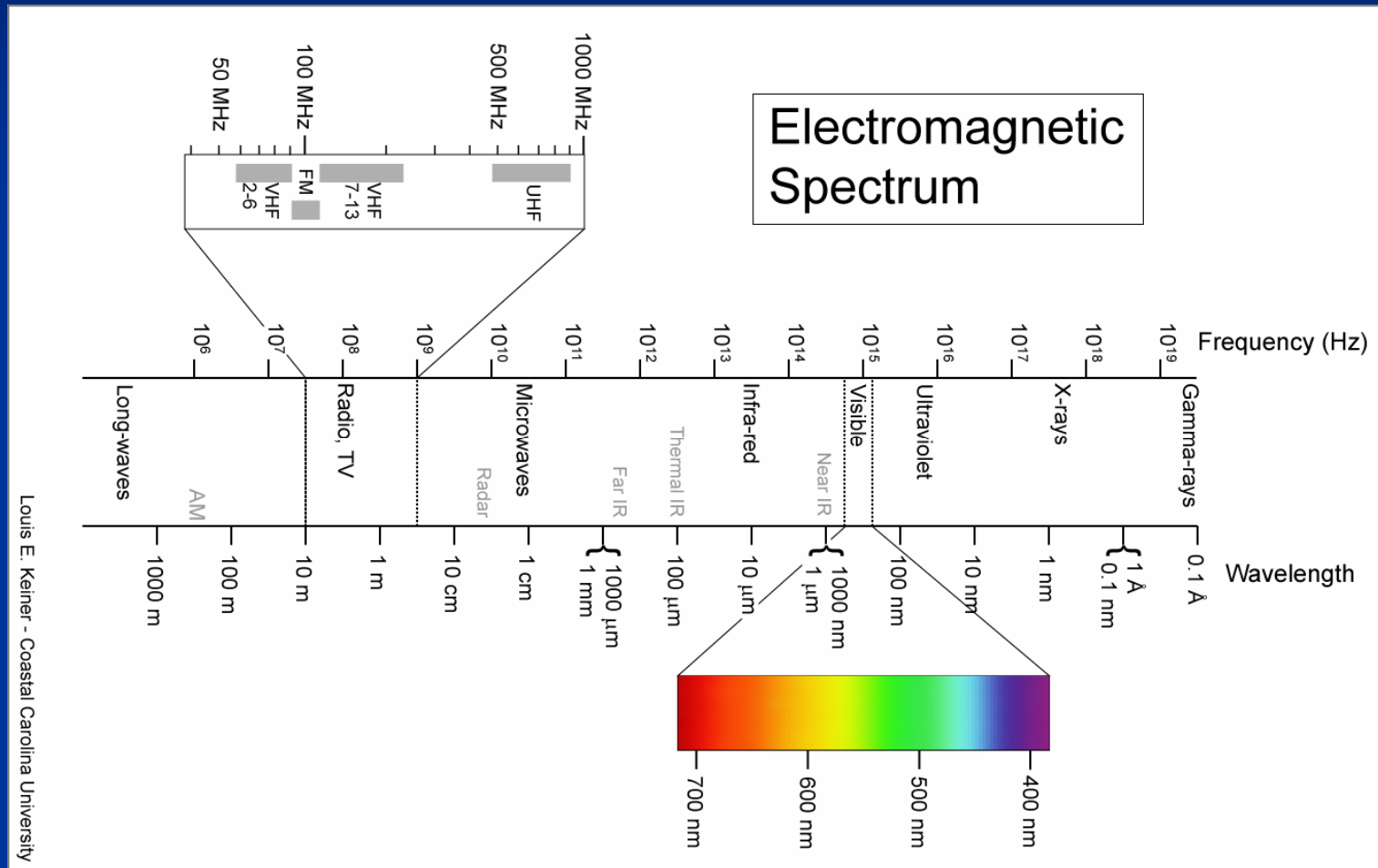
Sharing

Learning

Crossing

Creation

# Electromagnetic (EM) Spectrum



# EM Spectrum Description

## ■ Relationship

- 2 constants
- 3 variables

$$\lambda = \frac{c}{f}$$

Speed of Light  
299,792,458 m/s  
(constant and static)

Wavelength  
(in vacuum)  
(scope)

Associated frequency  
(temporal, dynamic, and technical)

$$E = h f$$

related to Energy

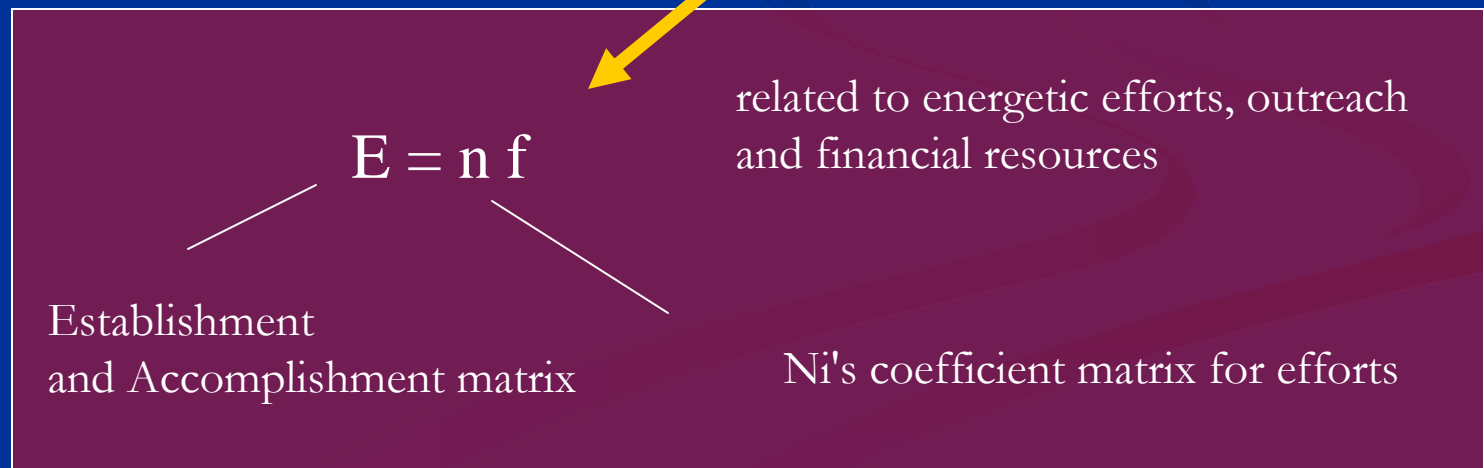
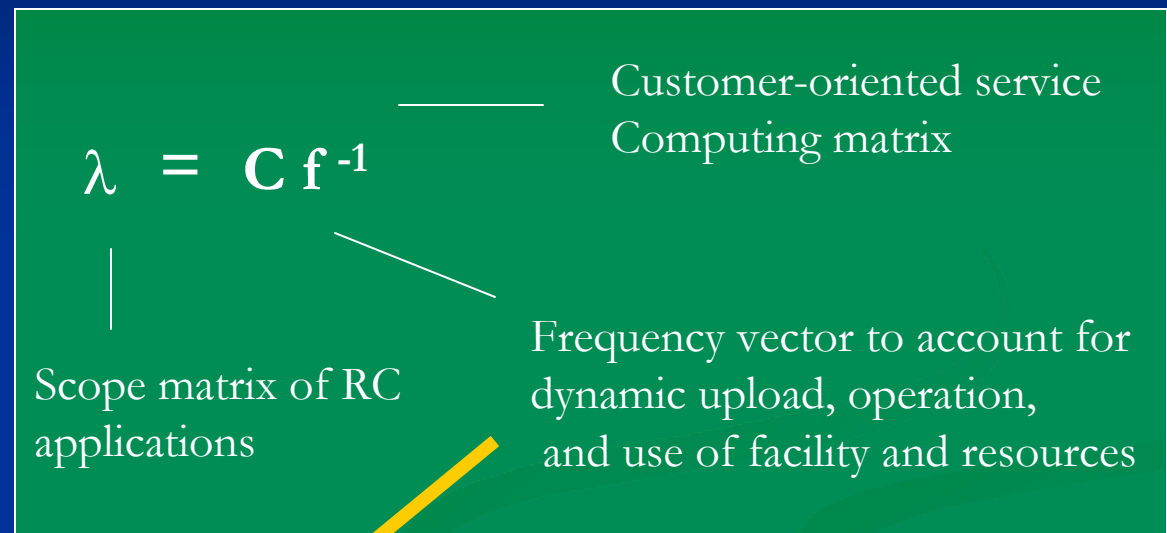
Photon Energy

Planck's constant  
(about  $6.626069 \times 10^{-34} \text{J}\cdot\text{s} = 4.13567 \mu\text{eV}/\text{Ghz}$ )

# Research Computing (RC) Spectrum Description

## ■ Relationship

- 2 constants
- 3 variables



# Spectrum Description

## ■ Classification

$\gamma$  = Gamma rays

HX = Hard X-rays

SX = Soft X-Rays

EUV = Extreme ultraviolet

NUV = Near ultraviolet

Visible light

NIR = Near infrared

MIR = Moderate infrared

FIR = Far infrared

Radio waves

EHF = Extremely high frequency (Microwaves)

SHF = Super high frequency (Microwaves)

UHF = Ultra high frequency

VHF = Very high frequency

HF = High frequency

MF = Medium frequency

LF = Low frequency

VLF = Very low frequency

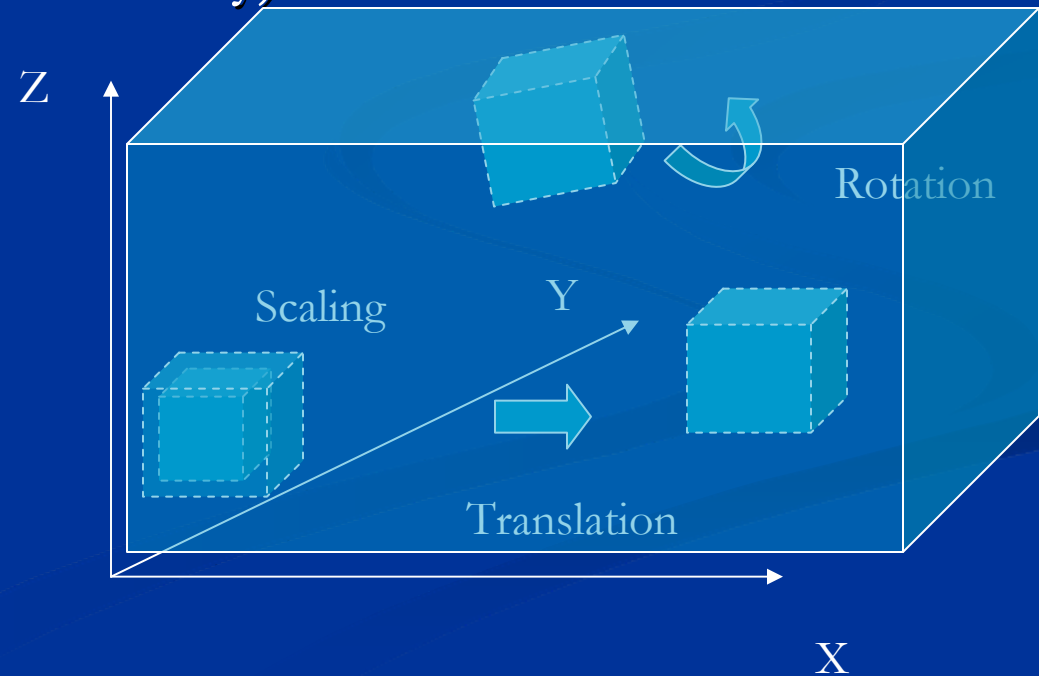
VF = Voice frequency

ELF = Extremely low frequency

CLASS	FREQUENCY	WAVELENGTH	ENERGY
$\gamma$	300 EHz	1 pm	1.24 MeV
HX	30 EHz	10 pm	124 keV
SX	3 EHz	100 pm	12.4 keV
SX	300 PHz	1 nm	1.24 keV
EUV	30 PHz	10 nm	124 eV
NUV	3 PHz	100 nm	12.4 eV
NIR	300 THz	1 $\mu$ m	1.24 eV
MIR	30 THz	10 $\mu$ m	124 meV
FIR	3 THz	100 $\mu$ m	12.4 meV
EHF	300 GHz	1 mm	1.24 meV
SHF	30 GHz	1 cm	124 $\mu$ eV
UHF	3 GHz	1 dm	12.4 $\mu$ eV
VHF	300 MHz	1 m	1.24 $\mu$ eV
HF	30 MHz	1 dam	124 neV
MF	3 MHz	1 hm	12.4 neV
LF	300 kHz	1 km	1.24 neV
VLF	30 kHz	10 km	124 peV
VF	3 kHz	100 km	12.4 peV
ELF	300 Hz	1 Mm	1.24 peV
ELF	30 Hz	10 Mm	124 feV

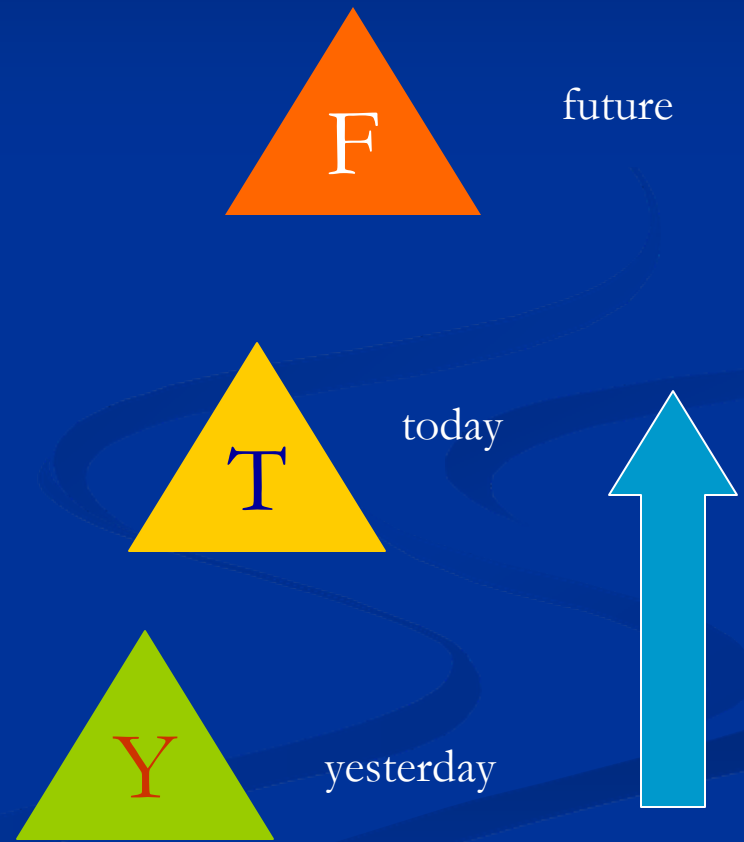
# Research Computing (RC)

- Abstract description
  - Integrity
  - Coordinates (origin, boundary, grid, and unity)
  - Attributes
  - Functions
  - Integration
  - Interface
  - Inheritance



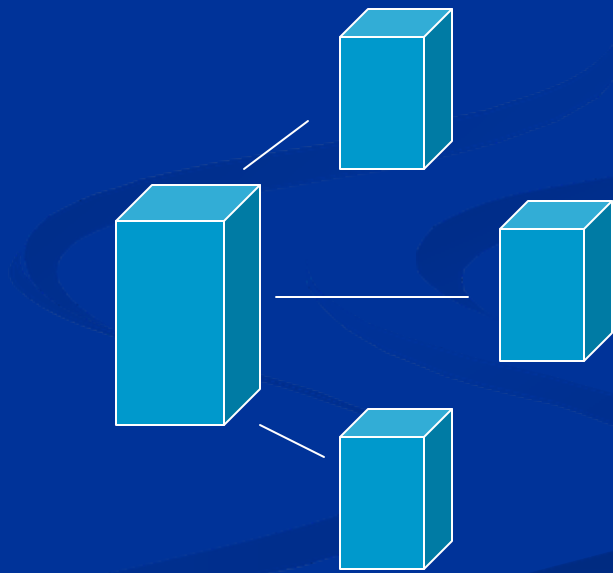
# RC – Integrity and Unification

- Cutting-edge computing technology for research
- Persistent services for research community
- Functional catalyst to research discovery
- Organizational dependency and technical independency



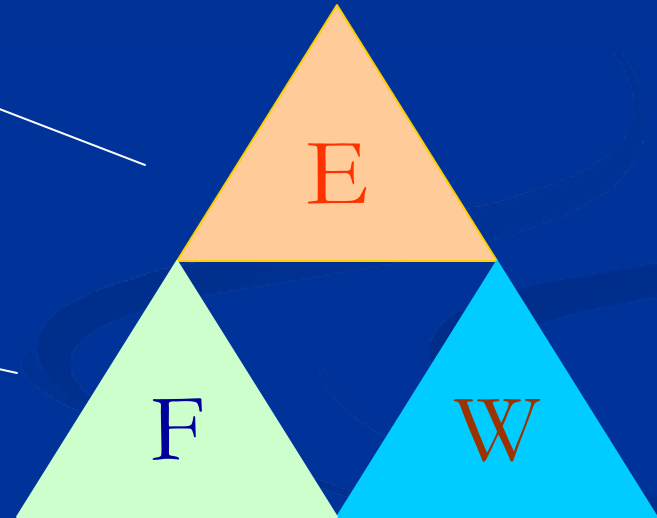
# RC – Coordinates

- Centralized HPC system and service locations
- Departmental units and contacts
- Regional and national resources
- System networking
- System clustering



# RC-Attribute Description

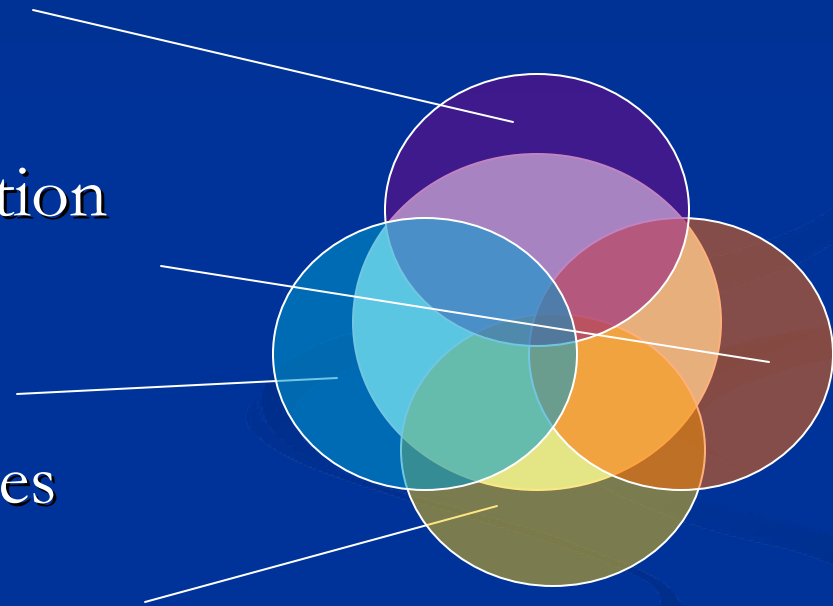
- Environment
  - Culture and management system
  - Vision and mission
  - Infrastructure, strategies and taskforces
- Facility
  - Hardware
  - Software
  - Applications
- Workforce and Expertise
  - People
  - Knowledge
  - Training



# RC-Functions

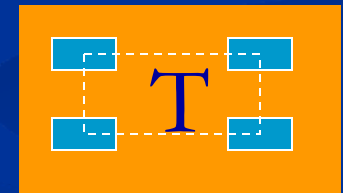
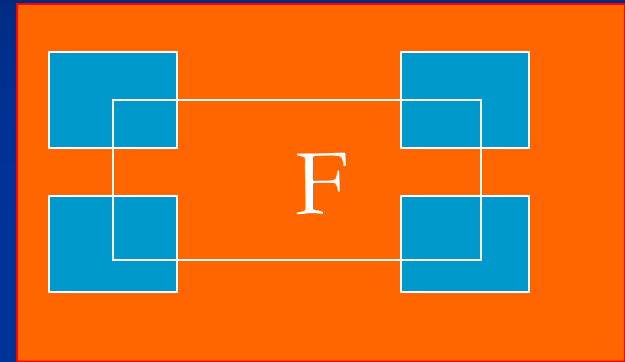
## Technological Challenges

- Based on computer science
- Evolution with the cutting-edge information technology
- Bridging with the computational sciences
- Stimulated by multidisciplinary research



# RC-Functions: Today's RC Demands & Characterizes

- Huge demands
  - Unprecedented HPC power
  - Super DIC capacity
  - Large-scale, cross-domain, cross boundaries, geographically—distributed, multidisciplinary collaboration and cooperation
  - Knowledge-based management system and workforce development
- Scalability (applied to all the attributes)
- Scope expansion in terms of functionality
- Scale increase for each project
- Integration of multiple projects
- Integrity for resource and information sharing
- Urgent requisition, fast processes, high competitiveness



# RC – Functions: Infrastructure

University Mission

National IT Roadmap for HE

IT Infrastructure

RC community

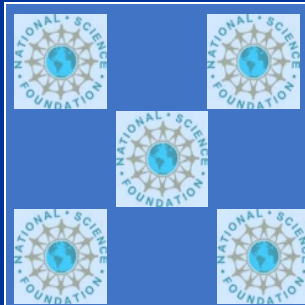
AC Infrastructure

NSF-CI

RC Infrastructure

# RC – Functions: NSF Roadmap & Cyberinfrastructure

- NSF-OCI
- Cyberinfrastructure Vision for 21 Century Discovery
- 4 CI components
- 5 Missions

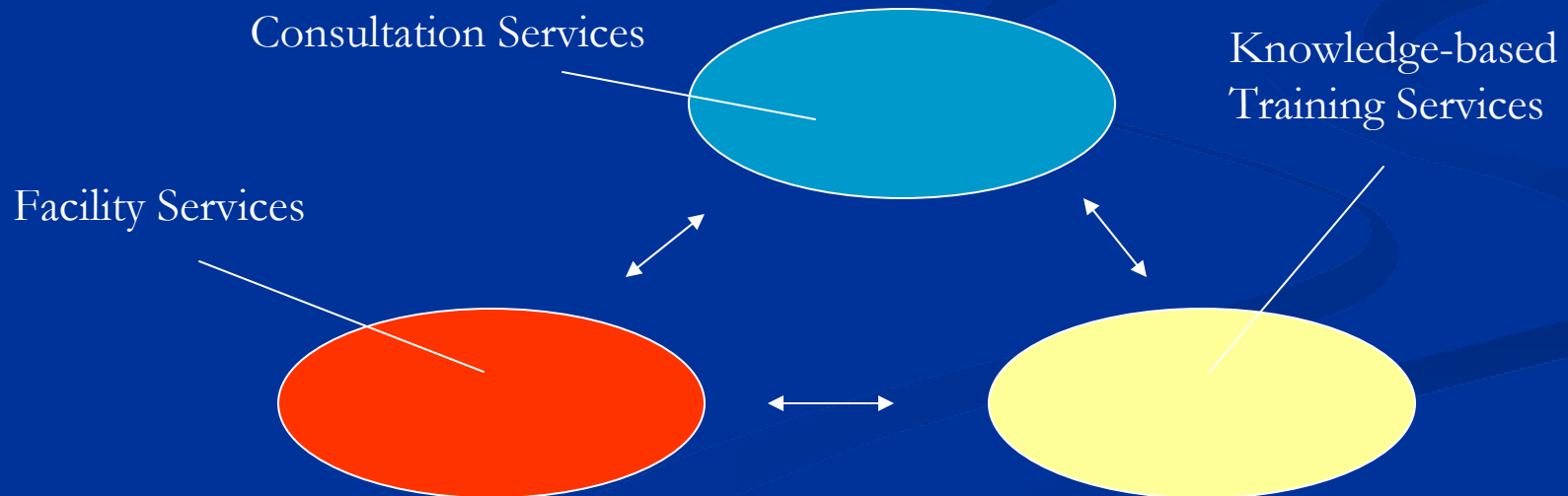


# RC – Functions: NSF Roadmap & Cyberinfrastructure

- Develop a human-centered CI driven by science and engineering research and education
- Promote the access to world-class CI tools and services
- Broadening participation and strengthening the Nation's workforce in all areas of science and engineering
- CI evolves as an essential national infrastructure for conducting science and engineering research and education
- Create a stable CI environment that enables the research and education communities to contribute to the agency's statutory mission

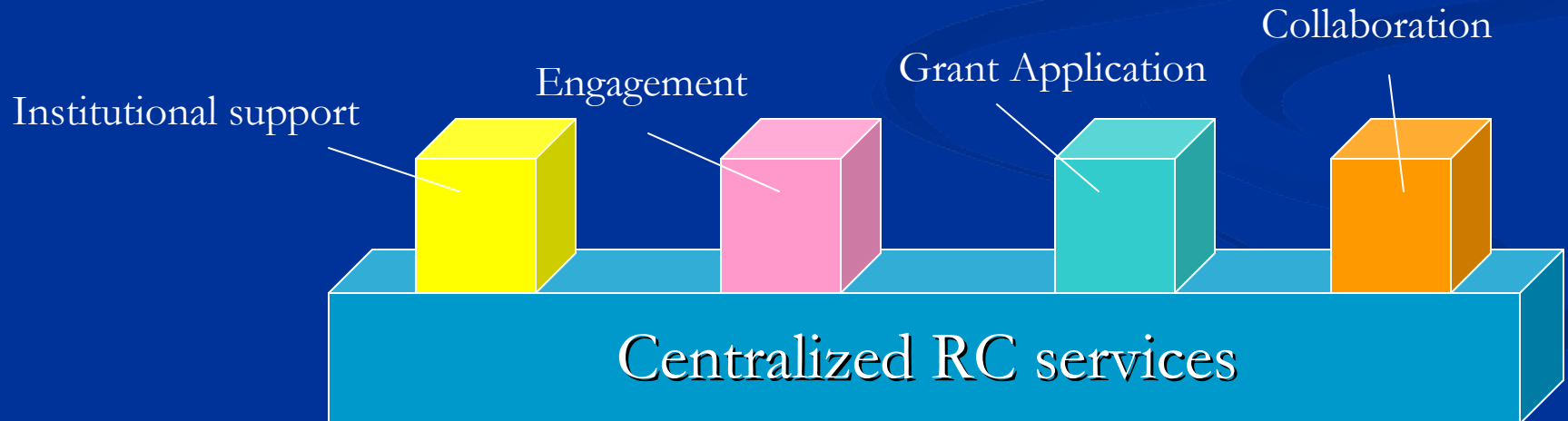
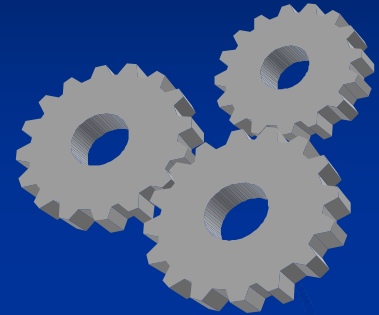
# RC – Functions

- Provide faculty-oriented HPC-IDC service supports
  - Facility services (maintain, sustain, and expand facility and resources)
  - Hands-on training services
  - Consultation services



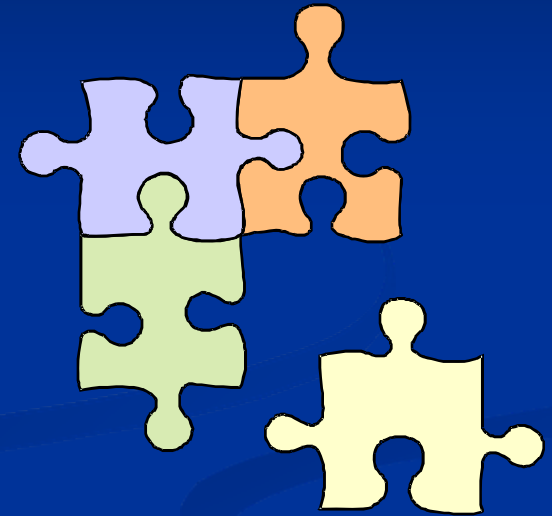
# RC – Functions

- Collaborative engagement
  - Participate in institutional service support
  - Engage faculty's research projects
  - Assist faculty to apply for external grants
  - Promote cross-domain collaborations



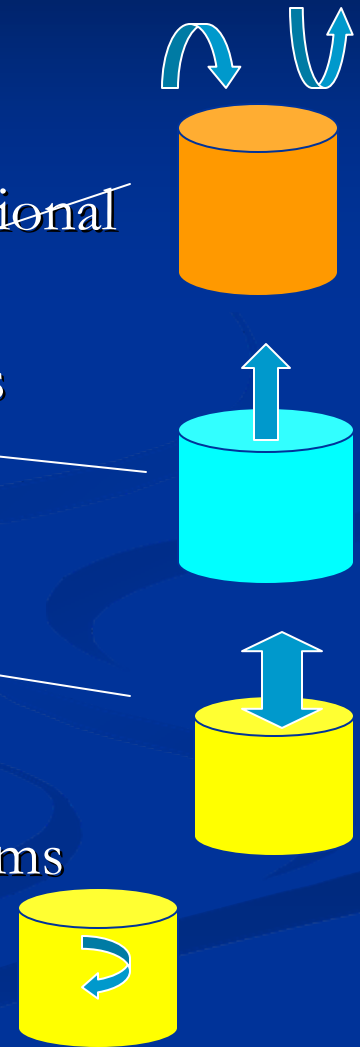
# RC -Integration

- Build easy-to-use RC solution library for faculty
- Sharp the knowledge
- Develop advanced enterprise RC solutions
- Integrate exiting computing technology
- Build RC-knowledge database management system
- Promote large-scale computations in promising domains

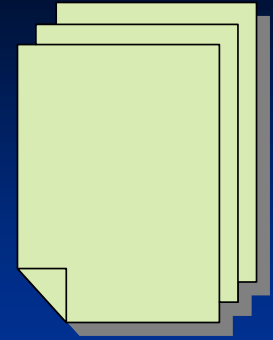


# RC -Interfaces

- Outreach and Communication
  - Involvement in university, national and international level RC activities
  - Exhibition of research computing achievements
  - Technology transfers
- Local communications
  - IT Departmental collaborations
  - IT Departmental knowledge sharing
  - Other campus computation institutes or programs
- Reputation and Visibility

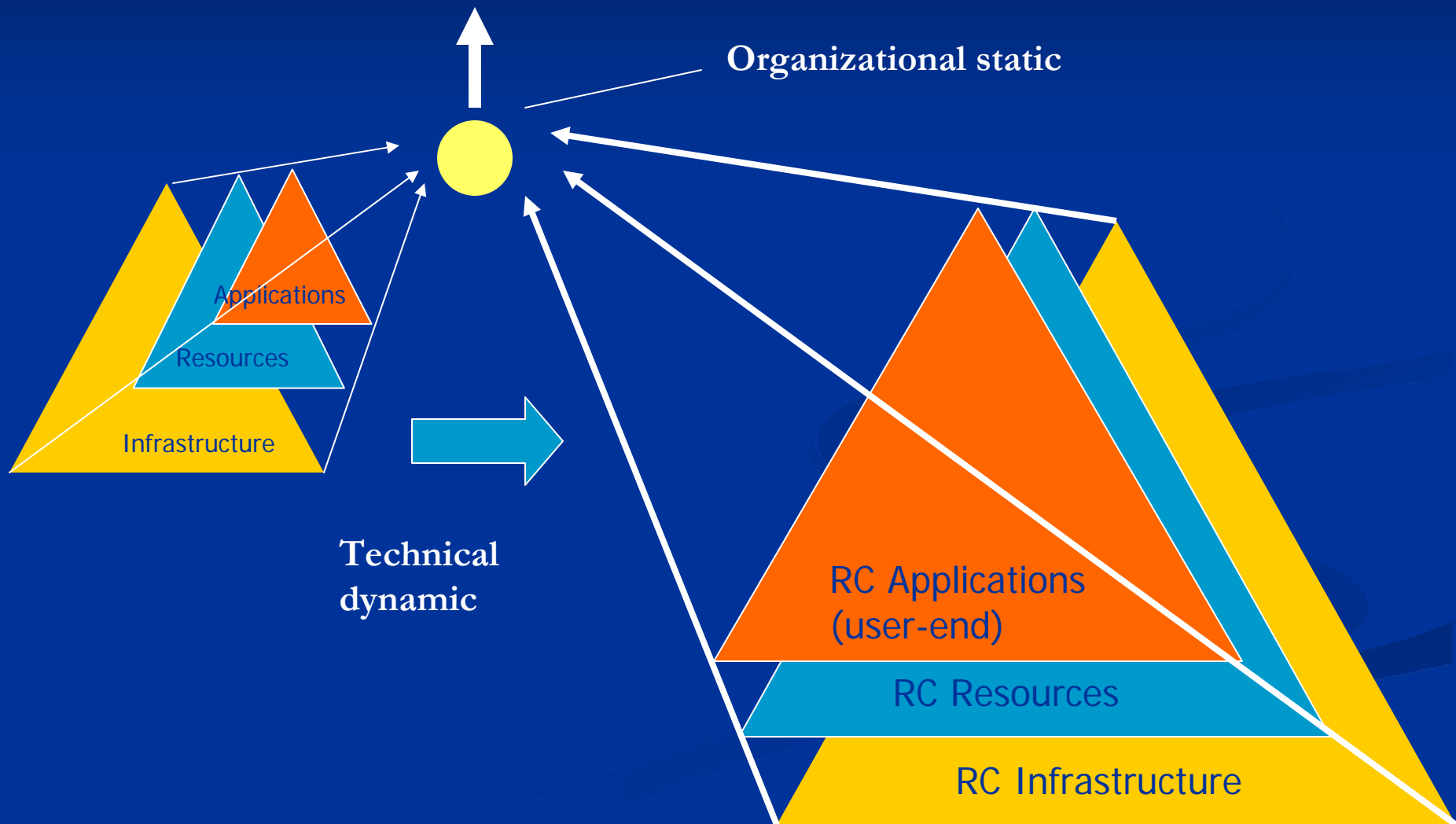


# RC -Inheritance



- Project
  - Initiative
  - Definition and description
  - Operations
  - Assessment and review
  - Report

# RC: dynamic vs. static



# Ultimate

- Establish a low cost/performance, national recognized, CI-powered RC facility which enables the faculty to accomplish their world-level outstanding research achievements.

**Thanks!**

**Q&A?**