Transforming Science in the 21ˢᵗ Century: A Vision for a National Cyberinfrastructure Ecosystem

Manish Parashar

Office Director

Office of Advanced Cyberinfrastructure,

Directorate for Computer & Information Science & Engineering

National Science Foundation

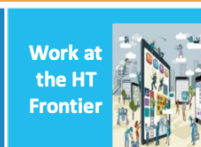Town Hall, PEARC 19, Chicago, IL

August 01, 2019

Cyberinfrastructure is Central NSF's Mission & Priorities

"To promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defense..."

Convergence Accelerators
Accelerating Discovery through Convergence Research

HDR Convergence Accelerator
FW-HTF Convergence Accelerator
Future accelerator(s)

BIO | CISE | EHR | ENG | GEO | MPS | SBE

RESEARCH IDEAS

HARNESSING THE DATA REVOLUTION

Harnessing Data for 21st Century Science and Engineering

Work at the HT Frontier

Windows on the Universe: Multi-messenger Astrophysics

Leading the Next Quantum Revolution

Navigating the New Arctic

Understanding the Rules of Life: Predicting Phenotype

PROCESS IDEAS

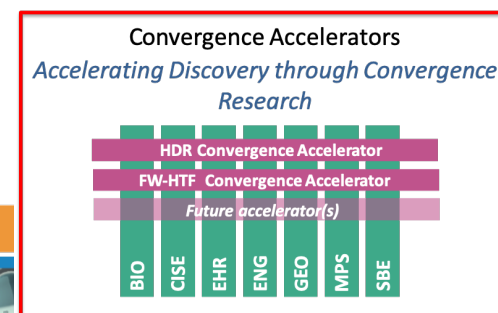Mid-scale Research Infrastructure

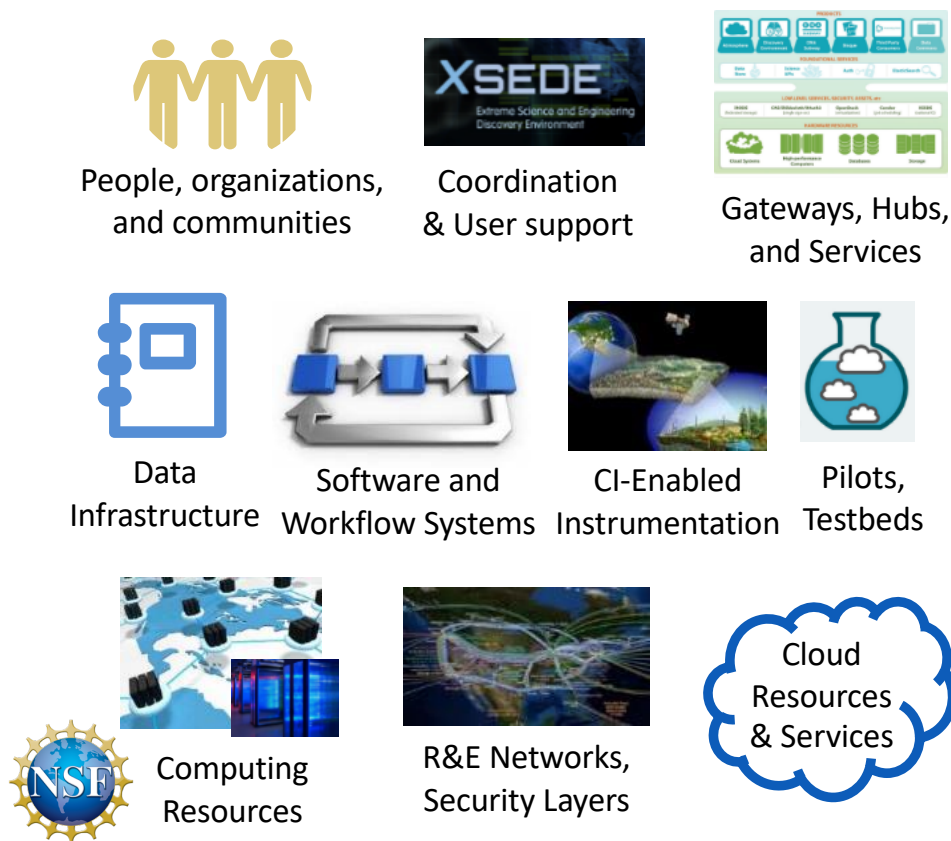NSF 2026

Growing Convergence Research at NSF

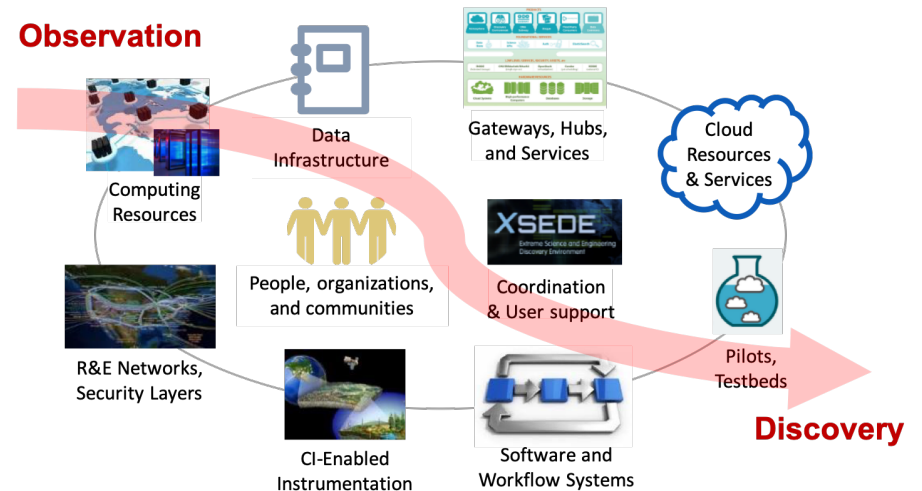NSF INCLUDES: Enhancing STEM through Diversity and Inclusion

NSF Office of Advanced Cyberinfrastructure (OAC)

Foster a cyberinfrastructure ecosystem to transform science and engineering research… through Research CI and CI research

People, organizations, and communities

Coordination & User support

Gateways, Hubs, and Services

Data Infrastructure

Software and Workflow Systems

CI-Enabled Instrumentation

Pilots, Testbeds

Computing Resources

R&E Networks, Security Layers

Cloud Resources & Services

Observation

Discovery

Rapid (disruptive) changes in S&E and CI landscapes → *Our cyberinfrastructure ecosystem must evolve!*

Transforming Science Through Cyberinfrastructure

NSF's Blueprint for a National Cyberinfrastructure Ecosystem for Science and Engineering in the 21st Century

".... an agile, integrated, robust, trustworthy and sustainable CI ecosystem that drives new thinking and transformative discoveries in all areas of S&E research and education"

Community-informed blueprints focused on different elements of the CI ecosystem

http://go.usa.gov/xm8bU

A new vision…

An agile, integrated, robust, trustworthy and sustainable CI ecosystem that drives new thinking and transformative discoveries in all areas of S&E research and education.

Overarching principles:

- View CI more holistically

- Support translational research

- Balance innovation with stability

- Couple discovery and CI innovation cycles

- Improve usability
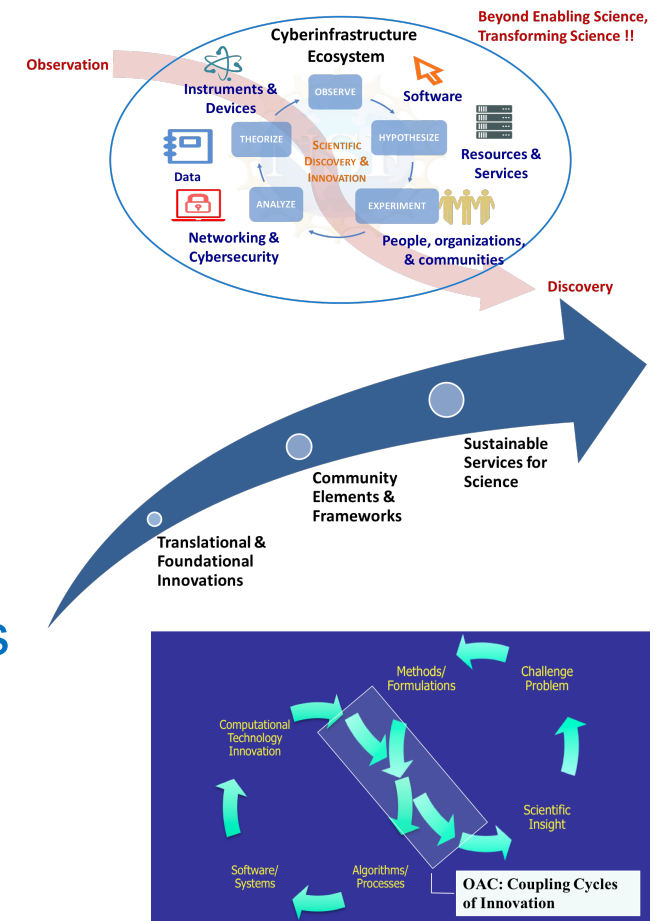
Computational blueprint.

Implement extensions and enhancements to current investments and new programs and opportunities in 2019 and beyond.
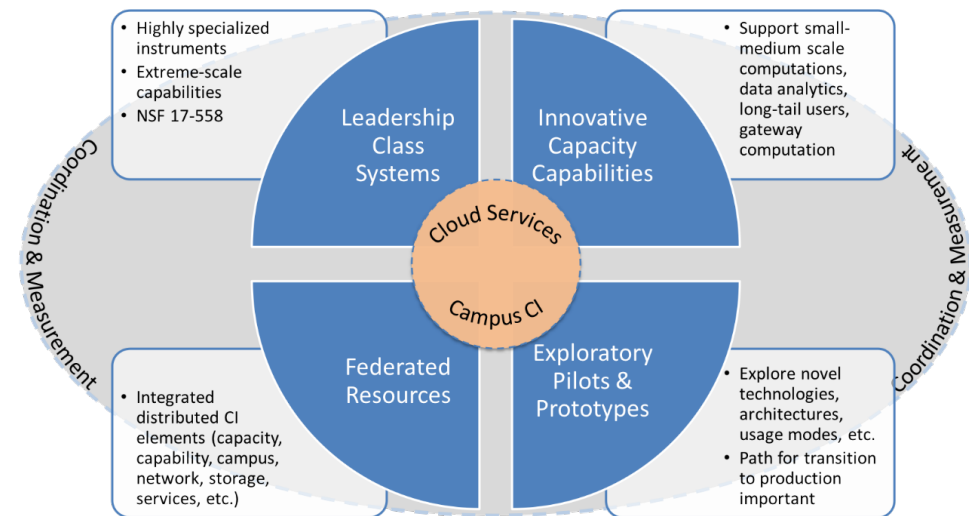
Two strategies

Deploy a balanced computational ecosystem that supports broad and diverse requirements, users and usage modes
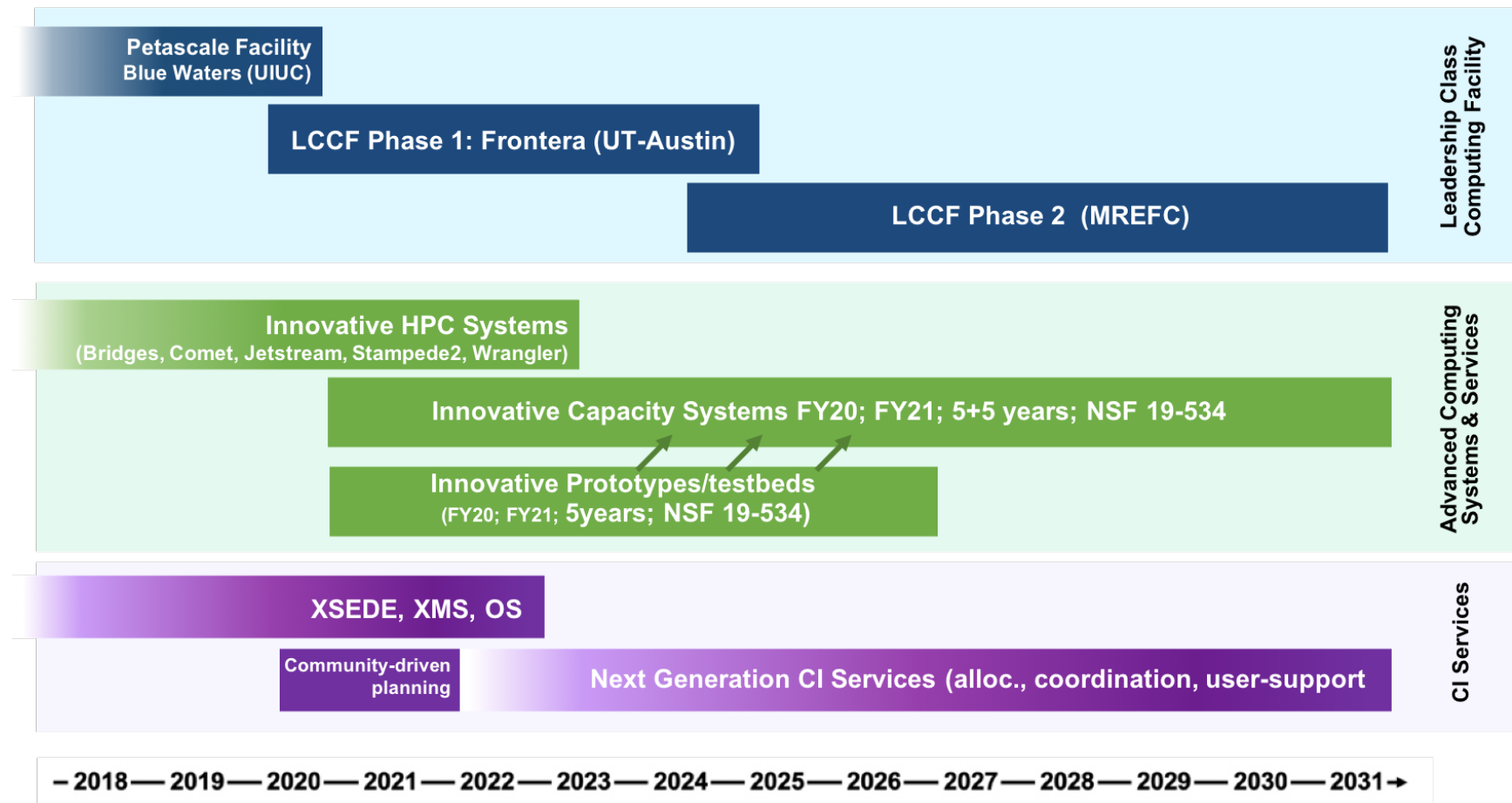
Achieve maximal impact from the array of computational capabilities and expertise
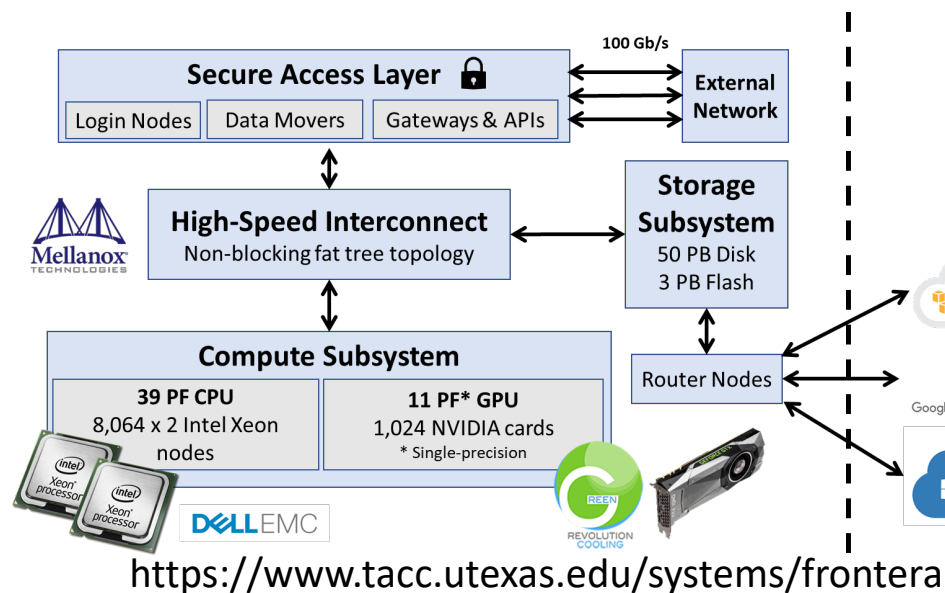

First of several blueprints focused on different elements of the CI ecosystem

Computational Blueprint: Elements of a balanced computational ecosystem

Computation for the Endless Frontier

FRONTERA

NSF

100 Gb/s

Secure Access Layer 🔒
Login Nodes | Data Movers | Gateways & APIs

External Network

Mellanox TECHNOLOGIES

High-Speed Interconnect
Non-blocking fat tree topology

Storage Subsystem
50 PB Disk
3 PB Flash

Compute Subsystem

39 PF CPU	**11 PF* GPU**
8,064 x 2 Intel Xeon nodes	1,024 NVIDIA cards *Single-precision

intel Xeon processor

DELLEMC

GREEN REVOLUTION COOLING

Router Nodes

amazon web services

Google Cloud Platform

Microsoft Azure

https://www.tacc.utexas.edu/systems/frontera

TACC TEXAS ADVANCED COMPUTING CENTER

THE OHIO STATE UNIVERSITY

Stanford

CORNELL UNIVERSITY FOUNDED A.D. 1865

PRINCETON UNIVERSITY

Caltech

Georgia Tech

A&M

THE UNIVERSITY OF UTAH

THE UNIVERSITY OF CHICAGO

UCDAVIS UNIVERSITY OF CALIFORNIA

Early user access started in May 2019

#5 on Top500 (06/19)

Frontera will be:
- A leadership-class computational instrument with the **broadest utility for all of S&E applications**
- The **largest CPU system** on a **US academic campus**
- A national asset that **complements** other leadership-class computing investments in the US research ecosystem

Advanced Computing Systems & Services (ACSS): FY19 Awards

Category I

Computing without Boundaries: Cyberinfrastructure for the Long Tail of Science

- *Increased capacity and performance for users of batch-oriented and science gateway computing;* integration with the public cloud and the Open Science Grid
- *PI: Michael Norman, University of California-San Diego*

Bridges-2: Scalable Converged Computing, Data, and Analytics for Rapidly Evolving Science and Engineering Research

- *High capacity, large memory system targeting high-performance data driven analytics with machine learning / deep learning / artificial intelligence applications*
- *PI: Nicholas Nystrom, Carnegie-Mellon University*

Category II

Ookami: A high-productivity path to frontiers of scientific discovery enabled by exascale system technologies

- *Explores the Fujitsu A64fx processor with ultra-high memory bandwidth to better support memory-intensive applications*
- *PI: Robert Harrison, SUNY at Stony Brook*

Advanced Computing Systems & Services (ACSS): FY20 Solicitation

Dear Colleague Letter: Revised Deadline for the Advanced Computing Systems & Services (ACSS): Adapting to the Rapid Evolution of Science and Engineering Research Program

OAC encourages the community to take advantage of this opportunity to consider novel and innovative services that are aligned with goals of the blueprint and the ACSS program solicitation, complement currently available (and planned) resources and services, and respond to current and emerging technologies and S&E needs. For example, Category I capacity systems that federate and leverage distributed resources and/or integrated cloud computing services are relevant. Likewise, Category II systems that explore novel technologies, architectures, and/or access models are also relevant. Across both categories of investment, the overarching goal of the solicitation remains *to provision the resources and services that enable discoveries and innovation across S&E while also advancing the state of the art of the CI ecosystem consistent with NSF's mission to support discovery and innovation*.

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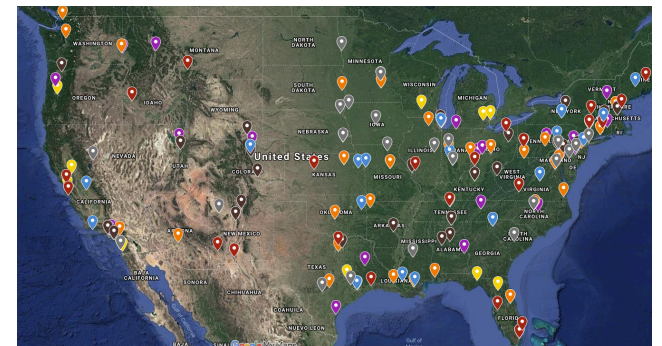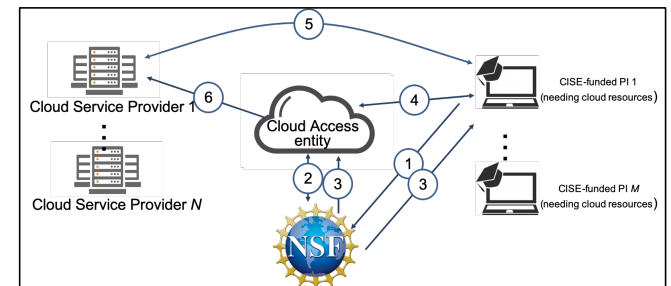
Clouds and the NSF CI Ecosystem

- CISE CloudAccess Solicitation
  - Explore models for providing (CISE) researchers access to Cloud services

- Exploring Clouds for Acceleration of Science (ECAS)
  - Explore clouds as platforms for leading edge science

- CC*: Clouds and Campus Computing
  - Integrated Cloud services/expertise into campus CI

www.internet2.edu/ecas

Request for Information (RFI): WH OSTP-led Update to Strategic Computing Objectives

- The NITRD Fast-Track Action Committee (FTAC) on Strategic Computing is requesting input from all interested parties on the **goals and necessary approaches** for sustaining and enhancing U.S. scientific, technological, and economic leadership in strategic computing.

- The results will be used to reevaluate the objectives of strategic computing, including those defined within the NSCI, in light of significant (and even disruptive changes) in the computing landscape.

- **Details**
  - **RFI website:** https://www.federalregister.gov/documents/2019/06/18/2019-12866/request-for-information-on-update-to-strategic-computing-objectives
  - **How to respond:** Send an email to StrategicComputing@nitrd.gov
  - **Deadline:** 11:59 p.m. (ET) on August 23, 2019

Conclusion

- Science and society are being transformed by compute and data – a connected, robust and secure cyberinfrastructure ecosystem is essential

- Rapidly changing application requirements; resource and technology landscapes
  - Our cyberinfrastructure ecosystem must evolve in response

- NSF/OAC strives to build a cyberinfrastructure ecosystem aimed at transforming science

Join the conversation

- OAC Webinar Series
  - 3rd Thursday @ 2PM ET
- OAC Newsletter
- Follow us on Twitter @NSF_CISE

Stay informed

- Join the OAC, CISE Mailing Lists

  - Learn about NSF events, programs, webinars, etc.

  - Send email to:

    - oac-announce@listserv.nsf.gov

    - cise-announce-subscribe-request@listserv.nsf.gov

Get involved

- Reviews proposals, serve on panels
- Visit NSF, get to know your programs and Program Officers
- Participate in NSF workshops and visioning activities
- Join NSF: serve as Program Officer, Division Director, or Science Advisor

NSF Office of Advanced Cyberinfrastructure (OAC) Newsletter

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Exploring the frontiers of computing
Arlington, Virginia · nsf.gov/dir/index.jsp?...

"Make no little plans; They have no magic to stir men's blood ..."

Daniel H. Burnham, Architect and City Planner Extraordinaire, 1907.

"If you want to travel fast, travel alone;
if you want to travel far, travel together"

African Proverb.

THANKS!

Manish Parashar

Office Director, Office of Advanced Cyberinfrastructure

Email: mparasha@nsf.gov

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