

## **Smart High-Performance Networks – Towards a New Generation of Intelligent Networking Infrastructure for Distributed Science Environment Workshop**

The purpose of this workshop is to bring together network researchers and operators from national laboratories, academia, and industry to identify and discuss emerging opportunities and challenges in the design and development of a new generation of smart high-performance network infrastructures to support distributed extreme-scale science.

Scientists increasingly depend on highly reliable and secure high-performance networks to access critical science facilities, collaborate, and share massive volume of data. As this trend continues, networks are expected to provide more sophisticated easy to use, secure, and predictable intelligent services. These expectations translate to a new generation of high-performance networks with intelligent capabilities delivered to scientists in the form of just-in-time Network-as-a-Smart service (NaaS).

The workshop will explore emerging concepts such as cognitive networking, machine learning, network science, Software Design Networking (SDN) as critical technologies for designing smart networks capable of delivering NaaS. The desired features of these networks include self-awareness, auto-defensiveness, self-reconfiguration, and self-healing that collectively define a new networking paradigm known as AUTOGNOSTIC networking – namely self-aware networks designed and instrumented to continuously adapt to its operational conditions, traffic loads, inter-domain policies, cyber trends, and performance conditions. The ultimate goal is a smart network infrastructure that can monitor itself, diagnose and resolve problems, defend itself from cyber-attacks, and provide intelligent services to scientists. The following key characteristics of smart networks are noted:

- Self-Aware & Self-Managed Networks:
  - Organization
  - Optimization
  - Configuration
  - Adaptation
  - Healing
  - Defense/Protection
  - Contextualization

This workshop is organized around four key Technical Focus Areas:

1. Smart Networks (Leads: Tom Lehman, Inder Monga, Bryan Lyles)
2. Smart Applications (Leads: Ian Foster, Raju Vatsavai)
3. Artificial Intelligence Based Technology for Smart Networked Systems (Leads: Prasanna Balaprakash, Kalyan Perumalla, Nagi Rao)
4. Smart Cyber Security Sub-systems (Leads: Stacy Prowell)

There will be separate breakout groups for each of these areas where the key issues, concepts, and recommendations will be discussed. The discussion in each of these breakout groups should be held in the context of smart networks. As an example there should be discussion about the interface between smart networks and smart applications, artificial intelligence systems, smart cybersecurity infrastructure. There should be discussion regarding what the smart network needs to provide to these other smart systems, and vice versa. The time frames considered should be near term (2-4 years) and longer term (5-10 years).

Each breakout group may start with one or more talks by a technical area expert. The outputs of these breakout groups should include the following:

- Describe the current state of the art and what communities/companies are leading
- Define differences between commercial and R&E needs, directions, issues
- Identify the key research problems
- Recommend approaches for DOE, and other Government Research organization, to make progress on smart networks and associated cross discipline systems

The workshop attendees have a been pre-assigned to one of the Technical Focus Area Breakout Groups, as listed in the Attendee List. The technical area leads will contact people in advance of the workshop for coordination or presentation requests.

A pre-workshop reading list has been prepared. Please do review these documents prior to the workshop, which are available at the below link:

<https://drive.google.com/drive/folders/0B78aI0njVQSUTGJabTJZaI9sM1E>

A listing of the documents contained in this folder is provided below.

The workshop report is expected to be about 15-20 pages. The technical area leads will organize and structure their breakout group activities with a goal to generate approximately a five page write up on their area by the end of the workshop.

---Workshop Reading Materials---

Reading Materials Folder:

<https://drive.google.com/drive/folders/0B78aI0njVQSUTGJabTJZal9sM1E>

An Analytics-based Approach to Cybersecurity  
An Analytics-based Approach to cyber security.pdf

Artificial Intelligence-Based Techniques for Emerging Heterogeneous Network:  
State of the Arts, Opportunities, and Challenges  
Artificial Intelligence-Based Techniques for6.pdf

The Vision of Autonomic Computing  
autonomic-computing.pdf

Software-Defined Networking (SDN) as an Enabler for Proactive Networks  
Bigdata and Traffic Engineering.pdf

Cognitive networks  
Cognitive Networks - CN.pdf

Internet of Things: Converging Technologies for Smart Environments and Integrated  
Ecosystems  
Converging\_Technologies\_for\_Smart\_Environments\_and\_Integrated\_Ecosystems\_IER  
C\_Book\_Open\_Access\_2013.pdf

Engineering Self-Managed Adaptive Networks  
Engineering Self-managed networks.pdf

Software Defined Networking for Extreme-Scale Science: Data, Compute, and  
Instrument Facilities  
intelligent-network-infrastructure-workshop-report.pdf

Machine Learning and Understanding for Intelligent Extreme Scale Scientific  
Computing and Discovery  
Machine\_Learning\_DOE\_Workshop\_Report\_6.pdf

The National Artificial Intelligence Research and Development Strategic Plan  
national\_ai\_rd\_strategic\_plan.pdf

An Enabling Platform for Autonomic Management of the Future Internet  
netserv-management-ieee-network.pdf

Preparing for the Future of Artificial Intelligence of Artificial Intelligence  
preparing\_for\_the\_future\_of\_ai.pdf

Self-Awareness in Computer Networks  
Self-aware Networks.pdf

Big data analytics  
Smart Networks and BigData Analytics.pdf

<https://en.wikipedia.org/wiki/Autognostics>  
wiki-Autognostics - Wikipedia.pdf

[https://en.wikipedia.org/wiki/Autonomic\\_networking](https://en.wikipedia.org/wiki/Autonomic_networking)  
wiki-Autonomic networking - Wikipedia.pdf  
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