a Possible Partnership Framework for AIR Transnational Research

CENTRA: Collaborations to Enable Transnational Cyberinfrastructure Applications (globalcentra.org)

Application areas: smart & connected communities, environment monitoring and disaster management

- Inherently international and dependent on IT
- Technically challenging with dynamic requirements
- Intersecting and important to huge populations

all of which require adaptable information technologies & cyberinfrastructures
What CENTRA enables now

- Face-to-face interdisciplinary meetings of experts on application domains and cyberinfrastructure
- Interactions between world-class experts and junior researchers
- Seeding/advancing projects
- Access to unique testbeds and data
- Exchange visits between sites
- Webinars and teleconferencing
- Researchers travel funded by their CENTRA site/institution
What are CENTRA meetings for?

Conceptualizing and reporting on projects, each including:

- Problem and ideas
- Team
- Work plans and testbeds
- Outcomes
  - Papers
  - Prototypes
- Schedule for team meetings and exchange visits

Networking interdisciplinary knowledge to enable demonstrable science-based innovation
CENTRA and associated meetings (2016 – 2018)

- Scientific expeditions, demos
- Invited talks, panel
- Smart Cities hackathons
What are exchange visits for?

- Seed new collaborations, advance existing projects
  - Edge Sensor and Resources Overlay VPN
  - SDN-IP Peering for IoT Data Transmission
  - IT for Natural Disaster Management & Visualization Alliance
  - Software Defined System on Disaster Mitigation and Smart Cities
  - Distributed Lifemapper
Spring 2018 Global CENTRA Webinar Series

1300 Hawaii | 1500 US Pacific | 1600 US Mountain | 18:00 US Eastern | 2300 Portugal
0600 Indonesia/Thailand/Vietnam | 0700 Taiwan/Malaysia/The Philippines | 0800 Japan/S. Korea

- **01/09** Development and Opportunities in the New Digital Society
  Shuo-Yan Chou, National Taiwan University of S&T

- **01/16** PRAGMA-ENT: An International SDN testbed for cyberinfrastructure in the Pacific Rim
  Kohei Ichikawa, Nara Institute of Science and Technology, Japan

- **01/24** Edge Computing for Autonomous Systems
  Christopher Stewart, Ohio State U., USA

- **02/06** Implementation of a Transnational Testbed with Layer 3 SDX
  Te-Lung Liu, NCHC, Taiwan

- **02/13** Dynamic Information Flow for IoT in Hardware
  Daniela Oliveira, U. of Florida, USA

- **02/28** Beyond Databases: Rethinking New Approaches to Virtual Collaboration and Data-sharing
  Tho Nguyen, U. of Virginia, USA

- **03/13** Automatic Traffic Control with Surveillance Cameras
  Hyuk-Jae Lee, SNU, South Korea

- **03/28** SafeFS: Secure Software-Defined Storage
  João Paulo, INESC TEC, Portugal

- **04/10** SafeDB: Secure Database Processing
  Francisco Maia, INESC TEC, Portugal

- **04/25** Analyzing Online Social Interactions for Cyber Security, Framing, and Network Interference
  Felix Wu, UC Davis, USA
Testbed examples

• **JOSE (Japan-wide Orchestrated Smart / Sensor Environment)** - 1200 physical servers with virtualization technologies, 1 PByte storage, OpenFlow-enabled networks and access to data from sensors monitoring the environment, rivers, buildings, highways, cars and so on.

• **PRAGMA Experimental Network Testbed (PRAGMA-ENT)** - A breakable international software-defined network (SDN) testbed.

• **StarBED (StarBED)** - A large-scale, general-purpose Internet simulator and a testbed that could be used to carry out multiple, large-scale simulations of next-generation networks for performance and dependability studies.

• **The Resilient ICT Research Center (ICT)** - A research center of the National Institute of Information and Communication Technology (NICT) of Japan with the mission to realize “connected” and “unbreakable” networks, especially in the case of a disaster, this center aims to advance research into resilient ICT technologies.

• **Research Infrastructure for Large-Scale Network Experiments (RISE)** - A New Generation Network Testbed (NICT JGN-X) wide-area SDN testbed including East Asia, Japan, and the US connected via TEIN.

• **National Center for High Performance Computing - Taiwan (NCHC)** - A member of the National Applied Research Laboratories (NARLabs) providing national services of compute, storage, and network services to Academia of Taiwan. A total of 200 teraflop compute, 6 petabyte storage, and 100 Gb/s Taiwan Research and Educational Network available.

• **Future Internet SDN Testbed** - A Taiwan SDN testbed connected to iGENI@US and JGN-X@JP.
Conclusions

• CENTRA: open framework for international collaboration
  • Member institutions host meetings, fund exchange visits of their researchers, share testbeds, participate in tele-connected activities
  • Scientific goals related to transnational problems
    • Smart & connected communities, environment, disasters...
    • Smart adaptable systems: from networks to applications

• Goals are to advance and launch projects that show how 
  networking global interdisciplinary knowledge enables demonstrable science-based innovation

• Participation in CENTRA is open to institutions who agree to follow CENTRA principles, including:
  • Accept visiting researchers
  • Must fund: one annual meeting (every 4+ years) and their researchers (to attend meetings, work on joint projects, visit other sites, ...)
  
  networking global interdisciplinary knowledge enables demonstrable science-based innovation
Acknowledgements

• CENTRA Steering Committee
  • Shinji Shimojo, U. of Osaka and NICT (Japan)
  • Fang Pang Lin, CECEA/NCHC-NARL (Taiwan)
  • Rui Oliveira, INESC TEC (Portugal)
  • Kum Won Cho (Korea)

• Funding from
  • National Science Foundation (NSF) of USA
    • ACI award 1550126 (Program Director Kevin Thompson)
  • Ministry of Science and Technology (MOST) of Taiwan
    • Center of Excellence for Cyber Enablement Application
  • International Program of NICT, Japan
  • INESC TEC, Portugal
  • Korea Institute of Science and Technology Information
  • AT&T Foundation
  • Dep. of Electrical & Computer Engineering/University of Florida
CENTRA in action
CENTRA is also social and cultural
Why international collaboration networks?

• For proper formulation and solution of problems that are transnational or global
  • Internationalization
• Sustained long-term collaborations require next-generation researchers
  • Who also get valuable training
• Diversity brings multiple points of view
• Leading world experts and brightest minds
  • “Being global requires starting global”
**CENTRA: Framework for sustained global Collaborations to Enable Transnational Cyberinfrastructure Applications** (globalcentra.org)

- Persistent collaboration amongst centers, institutes ...
- Next generation of collaboration networks (of people)
- Expanding partnership funded by NSF, MOST, NICT and INESC TEC.

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![Diagram showing collaboration between CECEA (Taiwan), ASEAN IVO (Japan), INESC TEC (Portugal), and CENTRA (US)]
The AirBox Project

- An ecosystem with a focus on PM2.5 monitoring

Deployment: World-wide

- 2,000+ devices
- 29 countries
Application areas: smart & connected communities, environment and disaster management

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Graphic from postscapes.com
IT research umbrella: software-defined/adaptable IT systems

- Requirements of smart cities/connected communities, environment modeling and disaster management change and interact over time -- thus IT solutions must also adapt.

Diagram:

- Analysis
- Sensor-based monitoring
- Distributed dynamic physical worlds
- Software definition
- Predictive modeling and planning

Diagram details:

- Management
  - Business processes
  - Web services
  - Applications
  - Middleware
  - Networking
  - Virtualization
  - Hardware + OS
Visualization Alliance: Trans-Pacific Visualization Research & Education Collaboration Networks Jason Leigh, U. Hawaii@Manoa

- Collaboration areas/opportunities
  - Build a display wall running SAGE2
  - Generate scenarios for interconnected visualization
  - Help in the design of a interconnection framework/architecture
  - Contribute visualizations/data
  - Contribute to finding and evaluating new apps for SAGE2: http://tinyurl.com/sageapps
Collaboration Areas:

- **UI/UX**: Test and improve the usability of the application; novel interaction modalities
- **Data integration/visualization**: Heterogeneous datasets; layered visualization
- **Infrastructure**: Integration with resilient, flexible networks
Distributed Lifemapper
James Beach and Aimee Stewart, U. of Kansas

• Distributed installations of Lifemapper for focused and comparative species distribution studies in Kansas, San Diego, Taiwan, Japan, Malaysia, Indonesia, Vietnam

Collaboration areas
• Integrate LM outputs with SAGE2 visualization platform
  • Create storyboard documentation of UI requirements
• Specialized LM Virtual clusters
Dynamically Aggregating Smart Community Sensors, Edge and Cloud Resources with Overlay VPNs

Renato Figueiredo, U. of Florida

Collaboration areas: please see R. Figueiredo’s talk at this workshop
Other example projects related to smart cities

- Interoperability of Smart City Testbeds and Applications
- Open Data
- Design for Edge-Centric applications and infrastructure
- Advanced Wireless City
- Urban Science
- AI Enabling Smartness
- Advanced Sensor Development
- Intelligent Assistant for Aging
- Pollution-control collaboration
- CENTRA Smart Cities Collaboratory
- International Participation in JOSE
CENTRA community challenges

• Intersection of domain and IT research communities
  • subcommunities
• What are the common scientific goals?
  • Interdisciplinary and cross dataset questions
• What are the opportunities for synergy across subcommunities?
  • Resource sharing
  • Shared testbed/prototype development and use
• Sustainability and community-level action models?
Brief history

• Evolution and spinoff from several international activities: PRAGMA, SEAIP and IVO (2014-2015)
• Funded by US NSF, Taiwan MOST and Japan NICT
• Kickoff meeting March 30 – April 1, 2016
• Founding Institutional Members
  • Center of Excellence for Cyber-Enablement of Applications (CECEA) – Taiwan
  • ASEAN International Virtual Organization (IVO) – Japan
  • Advanced Computing Systems Laboratory (ACIS) – USA
• Invited Institutional Member: PRAGMA
• Currently engaging additional organizations as members
Persistent Identifier (PID) Kernel Information
Beth Plale, Indiana U.

- PID Kernel Information
  - tiny amount of domain agnostic information to a PID that is resolvable at Internet scale speeds yet aids in smart filtering and routing of research data

- Collaboration areas
  - PID-enable your data collection
  - Use RPID testbed* to evaluate Research Data Alliance PID services upon which RPID partly built
  - Through your use cases help refine notion of PID kernel information
  - Have interest in trust aspects of the research
Invited talks

- NSF Initiatives in Smart and Connected Communities, Meghan Houghton, US NSF.
- Top 10 Signs of a Smart Community, Glenn Ricart, CTO of US Ignite, USA.
- Data Analytics and Embedded Systems for Understanding Cities, Charlie Catlett, ANL, USA.
- Smart University Initiative in Osaka University, Shinji Shimojo, Cybermedia Center, Osaka University and NICT, Japan.
- The Messiness of Innovation: How emerging technology infrastructure demands new types of civic order, Aaron Deacon, Managing Director of Kansas City Digital Drive, USA.
- A Resiliency Based Approach to Architecting a Smart Community, Matthew E. Delcambre, Informatics Research Institute, University of Louisiana at Lafayette, USA.
- Experiences and Opportunities of Smart and Connected Communities in Taiwan, Fang-Pang Lin, National Center for High-performance Computing, Taiwan.
- Transportation testbed in Gainesville, Florida: From concept to implementation, Lily Elefteriadou, UF Transportation Institute, U. of Florida, USA.