SEAIP
Southeast Asia International
Joint-Research and Training Program
科技部東南亞國際共同研究暨培訓研習會

Dec.05~09 2016
CLOUD COMPUTING &
Internet of Things 雲端計算與物聯網
Smart and Connected Communities

Smart and Connected Communities and the Role of PRAGMA, Global CENTRA and a Global Perspective

SEAIP 2016

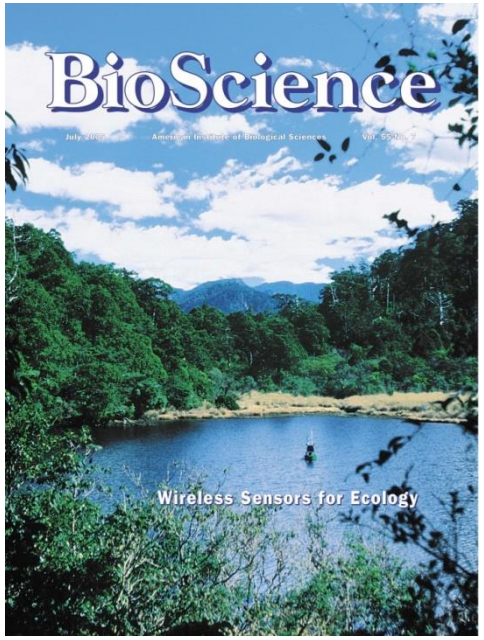
Tainan

2016.12.06

NSF

PACIFIC RIM APPLICATIONS AND GRID MIDDLEWARE ASSEMBLY
PRAGMA

CENTRA



Taiwan

Touch Your Heart

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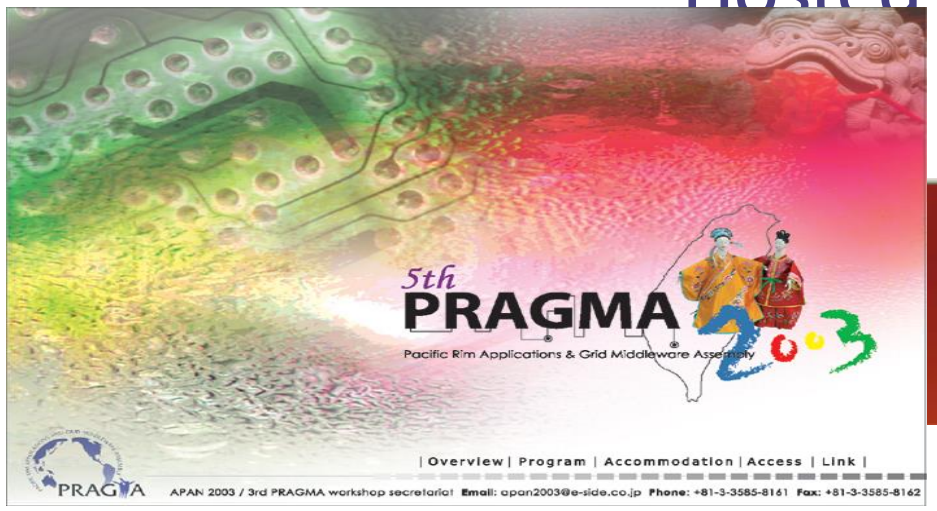
National Cheng Kung University

Key Moments in PRAGMA Hosted by NCHC-NARLabs



- PRAGMA 14

- PRAGMA 26
  - 9 – 11 April 2014, Tainan

- SEAIP and PRAGMA Institutes
  - 2005 - present
- Big Data
  - December 2012

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PRAGMA

Co-Hosts

網路科技應用卓越中心
Center of Excellence for Cyber Enablement Applications

CENTRA

Thanks to Hosts and Sponsors

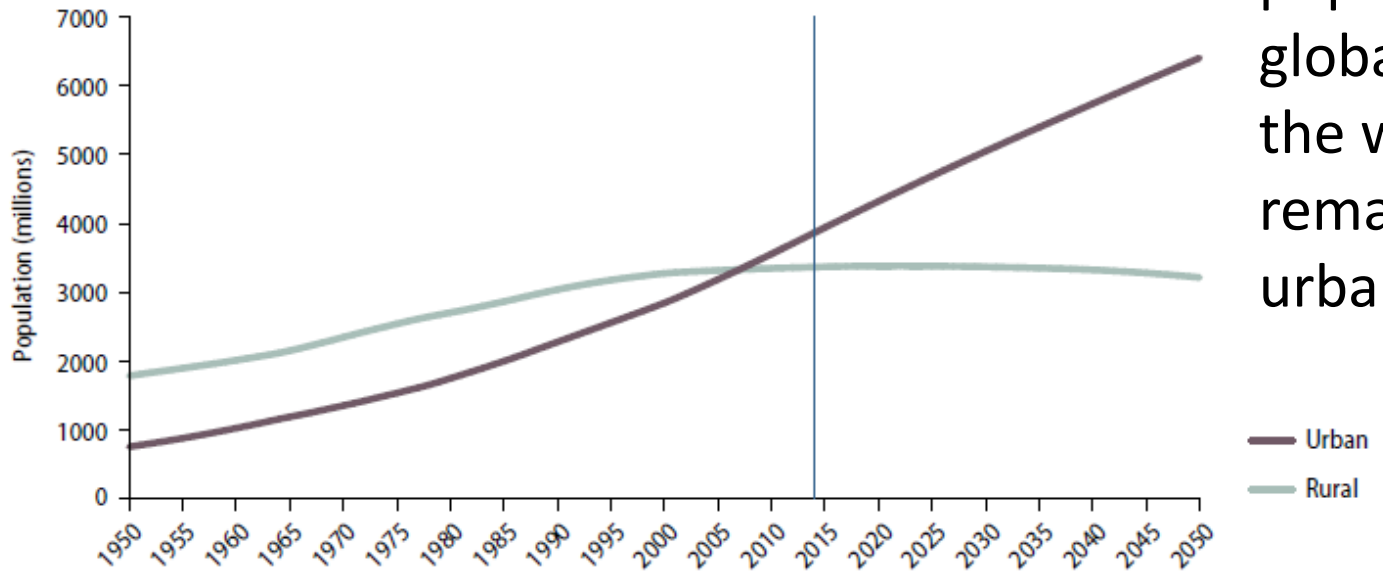
- SEAIP: Valuable to PRAGMA
  - New Members
- SEAIP: Important link with researchers in Southeast Asia and other parts of Asia, the Pacific Rim, and beyond
  - Wealth of talent
  - Key natural resources
  - Different perspectives on research, infrastructure

A Long-term Research and Education Agenda for Smart & Connected Communities

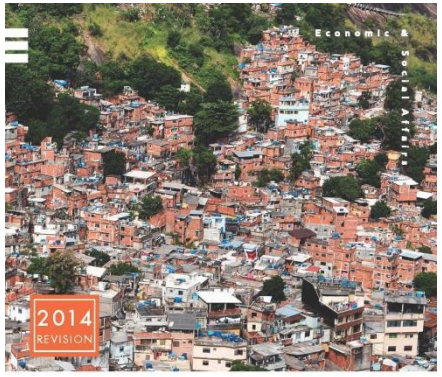
Growing an international inter- and multidisciplinary, multi-sector research and education community

A growing urbanization around the World

Figure 2.
Urban and rural population of the world, 1950–2050



"In 2007, for the first time in history, the global urban population exceeded the global rural population, and the world population has remained predominantly urban thereafter."



… although not uniformly

Source: World Urbanization Prospects, 2014 Revisions, United Nations

Some Additional Rationale to Focus on Cities

- Engines of Innovation and Economic Growth: responsible (on average) 75 percent of a country's Gross Domestic Product (GDP)
- Consumers of Energy: consume about 75 per cent of global primary energy (transportation, industrial and commercial activity, buildings and infrastructure, water distribution, food production)
- Source of Green House Gases: of world's total, cities produce 50 to 60 percent (figure rises to approximately 80 per cent when the indirect emissions generated by urban inhabitants are included" with most of the energy from fossil fuels (2012))

UN – Habitat Energy. http://unhabitat.org/urban-themes/energy/

What is a Smart City?
Key Concepts

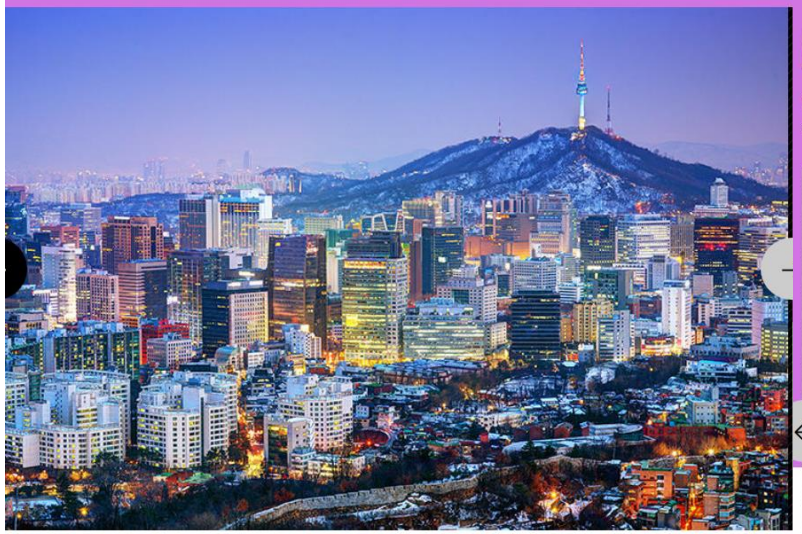
- Smart City .. is a community
  - Innovation city
  - Systems of people interacting with flows energy, materials, services and financing ..
  - Vision to integrate information and communications technologies
- Uses data and information ….. and technologies
  - From sensors, sometime invoking internet of things,
- Improves
  - Efficiency of systems or flows
  - Competitiveness
  - Quality of life of inhabitants

Metrics for Smart Cities

MINUTE READ

The 10 Smartest Asia/Pacific Cities

n the fast-growing region, which urban centers are poised to become the model city f the future?

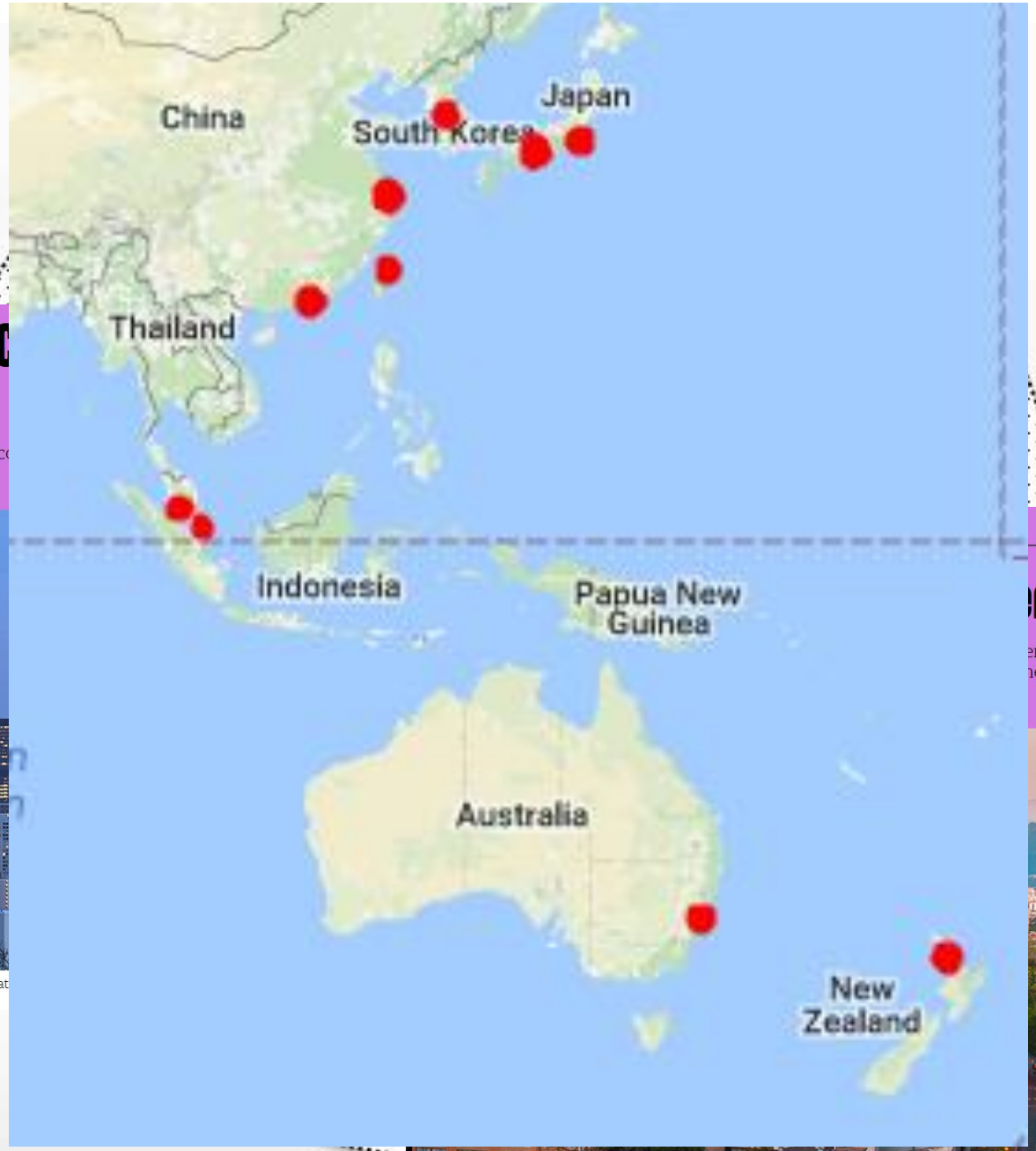


1 /10 The 10 smartest Asia / Pacific Cities. 1: Seoul

The 10 Smartest C America

Which cities are doing the most to bec city of the future?

01 /10 The 10 smartest cities in North America. 1: Seat

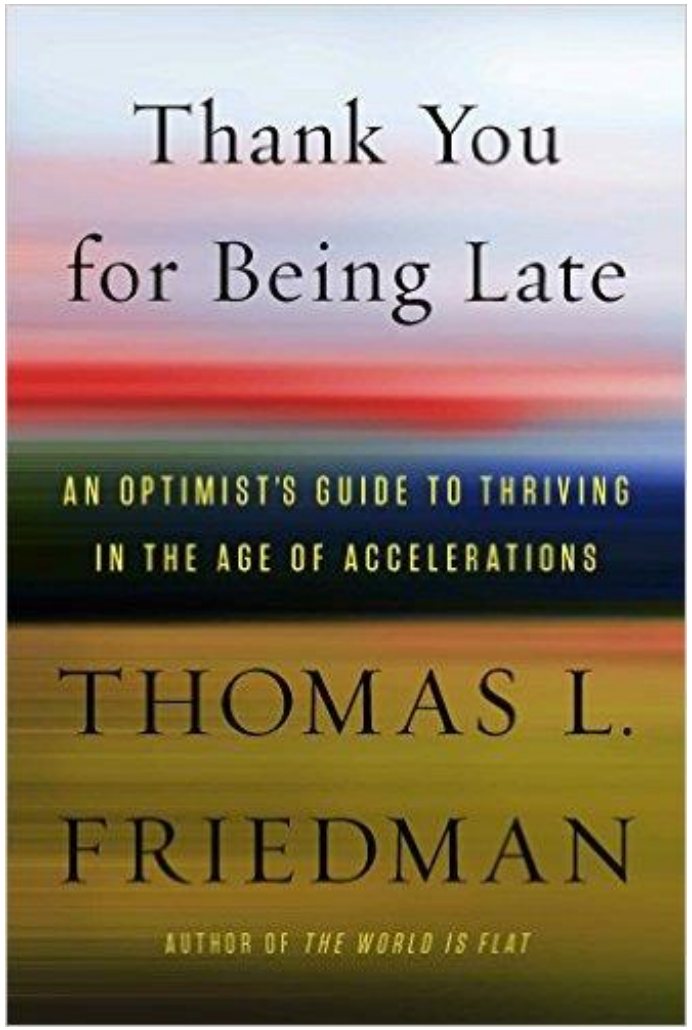


01 /08 The 8 Smartest Cities in Latin America: 1: Santiago

https://www.fastcoexist.com/1680538/what-exactly-is-a-smart-city 2012

A Technology Inflection Point: 2007

- iPhone Announced
- Google launches android
- Amazon release Kindle
- Hadoop started
- Github – development started
- Facebook opened (Sept 2006)
- Twitter spun off as separate platform
- Airbnb conceived
- IBM Watson started
- Intel Introduces non-silicon materials (high-k/metal gates)
- Cost of DNA sequencing begins dramatic decline



And the list goes on

Couple a proliferation of technologies…

Digital media

VIDEO

BLOGS

MOBILE

PINTEREST

EMAIL

VOIP

Sensing, computation, control

…and the data those technologies are producing…

Transforming the way we live, work, and play…

White House "Smart Cities" Initiative Launched
September 2015

> *"Every community is different, with different needs and different approaches. But communities that are making the most progress on these issues have some things in common. They don't look for a single silver bullet; instead they bring together local government and nonprofits and businesses and teachers and parents around a shared goal."* – **President Barack Obama**

Over $160 million in federal research investments and 25 new technology collaborations

Since September 2015, Agency Investments Align with their Missions Collectively Spanning from R&D to Deployment

GLOBAL CITY TEAMS CHALLENGE

NIST

usignite

NSF

Smart City Challenge

Columbus, Ohio, named winner of $50M prize, combined with nearly $100M in non-federal dollars raised.

DEPARTMENT OF TRANSPORTATION UNITED STATES OF AMERICA

Array of Things (Chicago)

PI: Charlie Catlett

Douglas Pancoast & Satya Mark Basu, School of the Art Institute of Chicago

Partnership between City of Chicago, University of Chicago, Argonne National Laboratory, School of the Art Institute of Chicago, Northern Illinois University, and University of Illinois at Urbana-Champaign

NSF

Urban Scale Instrument to Measure City's Fitness

Array of Things

- Developing and installing nodes for measuring the urban environment including carbon monoxide, nitrogen dioxide, sulfur dioxide, ozone, ambient sound, and pedestrian and vehicular traffic
- Data will be free and publicly available through the City of Chicago Data Portal
- Array of Things (AoT): open platform, supporting standard programming mechanisms to enable the broader science community to not only analyze the open data but to add capabilities (sensors, networks, etc.) and to program deep learning capabilities in the nodes.

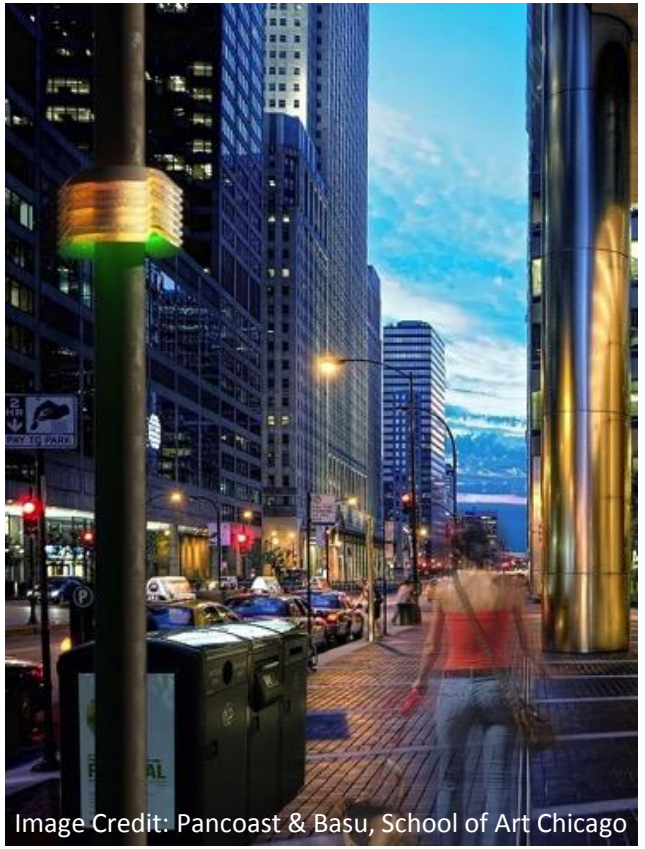


Image Credit: Pancoast & Basu, School of Art Chicago

(Catlett, et al., Argonne National Lab)

Researcher and Stakeholder Inputs via Workshops and Seed Awards Inform Research Agenda

- Multidisciplinary research with parallel emphasis on technological innovations and advances in social, behavioral and economic sciences
- Critical role for engagement of and partnership with stakeholders within communities and cities through all research stages
- Need for workshops and activities to develop research capacity among academic researchers, industry partners, and community stakeholders
- International partnership will be invaluable in advancing understanding of cities and communities worldwide and developing solutions
- Data sharing and open-access innovations will accelerate progress and enable improved solutions for our most pressing challenges

NSF Investments Span Disciplines & Research Areas

Cyber-physical Systems

Human-Technology Interaction

Resource Optimization

Data analytics
Big Data

Resiliency

Sociotechnical Systems

Security and Privacy

Urban Science

Smart Health

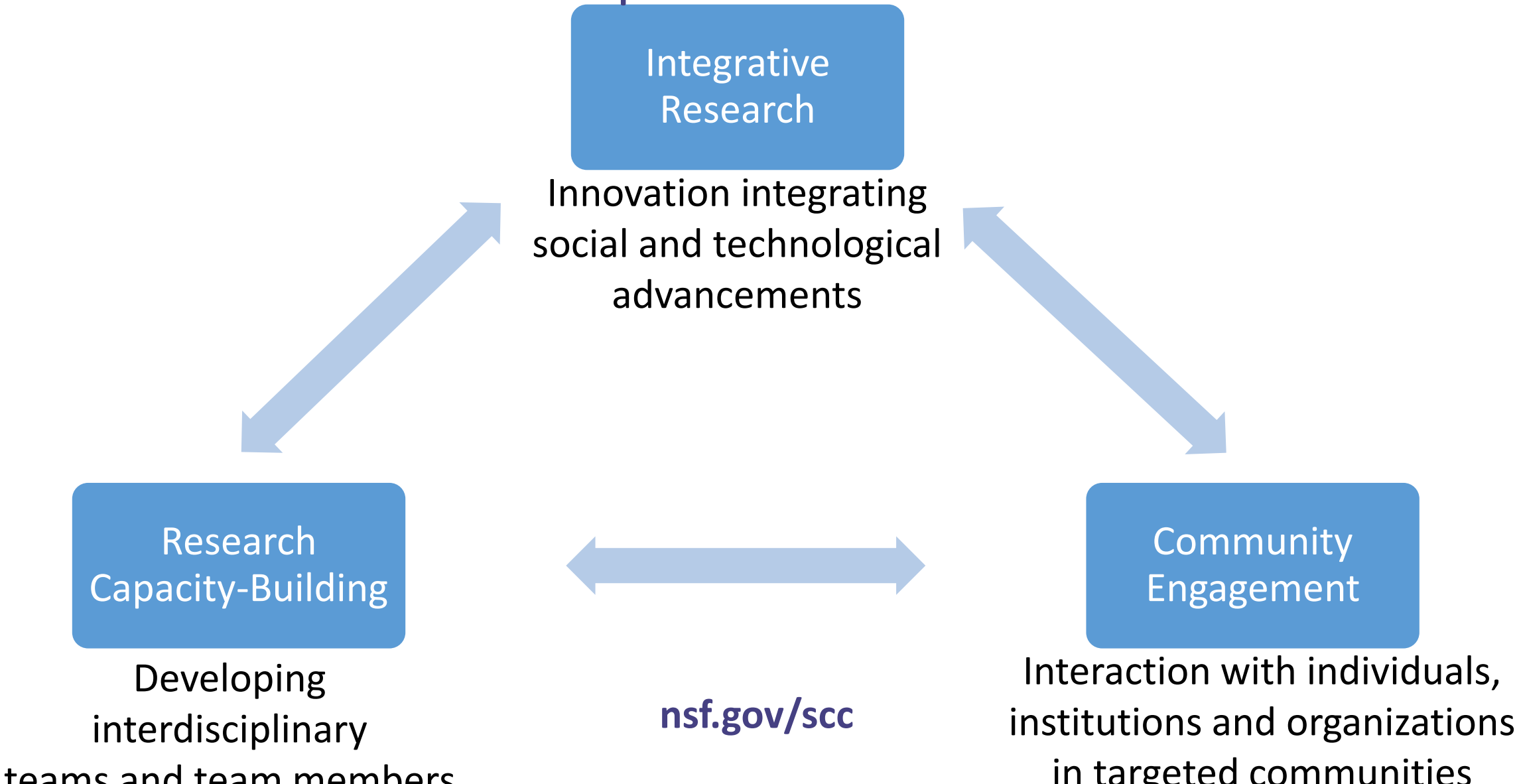
Advanced Networking

Cyber Learning

Cyberinfrastucture

Education and Workforce Training

Smart and Connected Communities Solicitation: Conceptual Framework



Future Smart and Connected Communities Research Directions Span Multiple Directorates

- Advancing our understanding of intra- and inter-community social and technical dynamics- *understanding the pulse of a city*
- Advances in modeling approaches to discover new opportunities for improving quality of life and predicting the impact of new technologies or policy decisions on the community
- Understanding community interactions with smart and connected systems and the role of social, behavioral, and economic, sciences
- Advances in education and learning theory to prepare individuals to work across disciplines and tackle community, city, and systems challenges

Ongoing technology research, developments, prototyping

Challenges for Smart and Connected Communities Research

It is not just the technology!

- Developing a multi-disciplinary research agenda
  - Not simply implementing or deploying what we have
- Integrating across “sectors”, e.g., transportation, smart grids, communication, …*mindful of environmental issues
- Sharing data
- Bridging local knowledge among cities and communities
- Establishing standards (both for “health” of city, but also for data and other technologies for interoperability)
- Ensuring privacy
- Testing in ALL physical settings (not just commercially lucrative or with existing infrastructure)
- Building research and workforce capacity
- Engaging community
- Enabling long-term persistence of solutions

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Credit: Douglas Pancoast & Satya Mark Basu, School of the Art Institute of Chicago/Array of Things

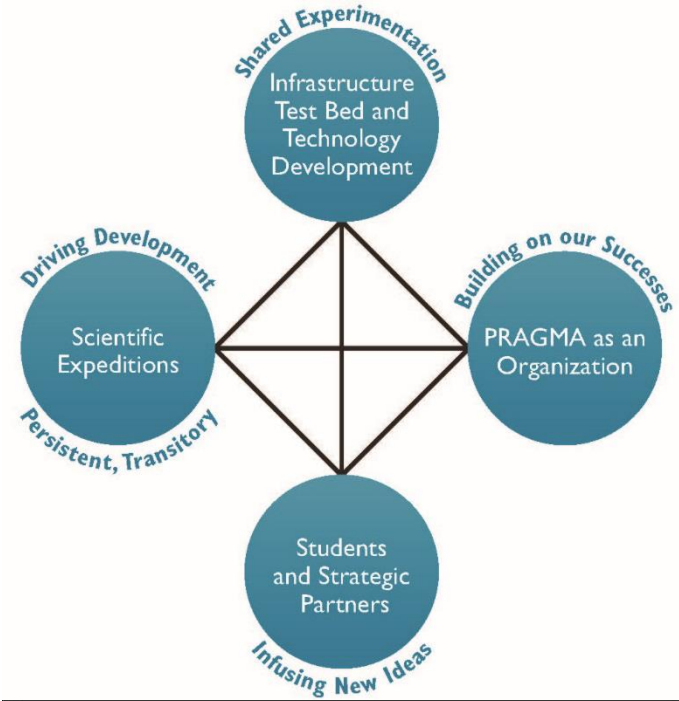
For more information, visit www.nsf.gov/scc.

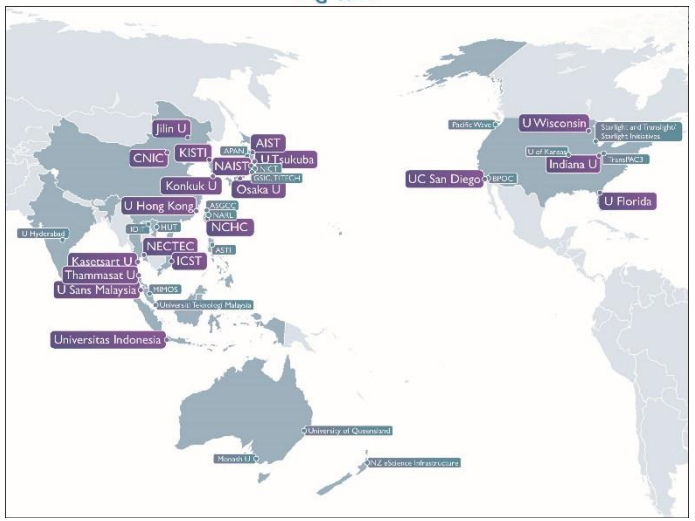
What are Possible Roles for PRAGMA and Global CENTRA in Smart and Connected Communities?

Community of Practice: Enabling the Long Tail of *Team* Science

Virtual Scientific Expeditions

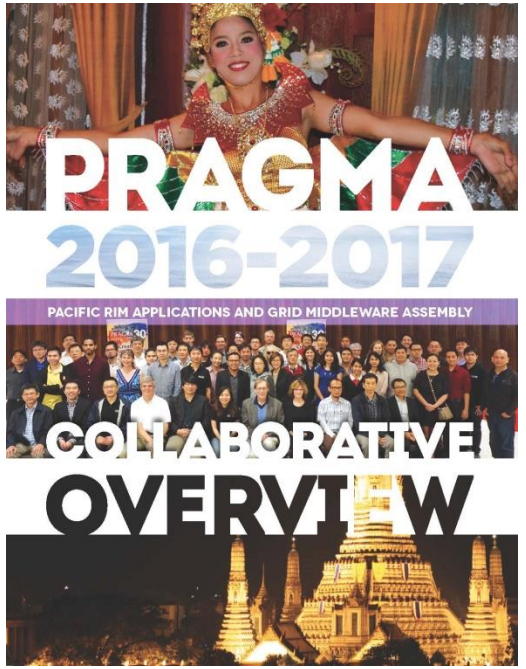
PRAGMA Students





PRAGMA Member Sites

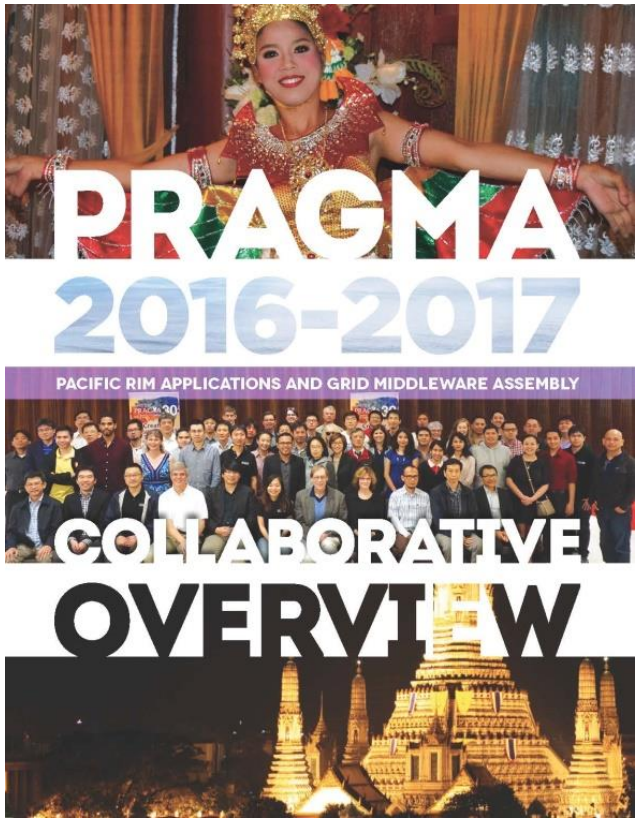
Trust Envelop



PRAGMA Community

Collaborative Overview
Progress in 2016

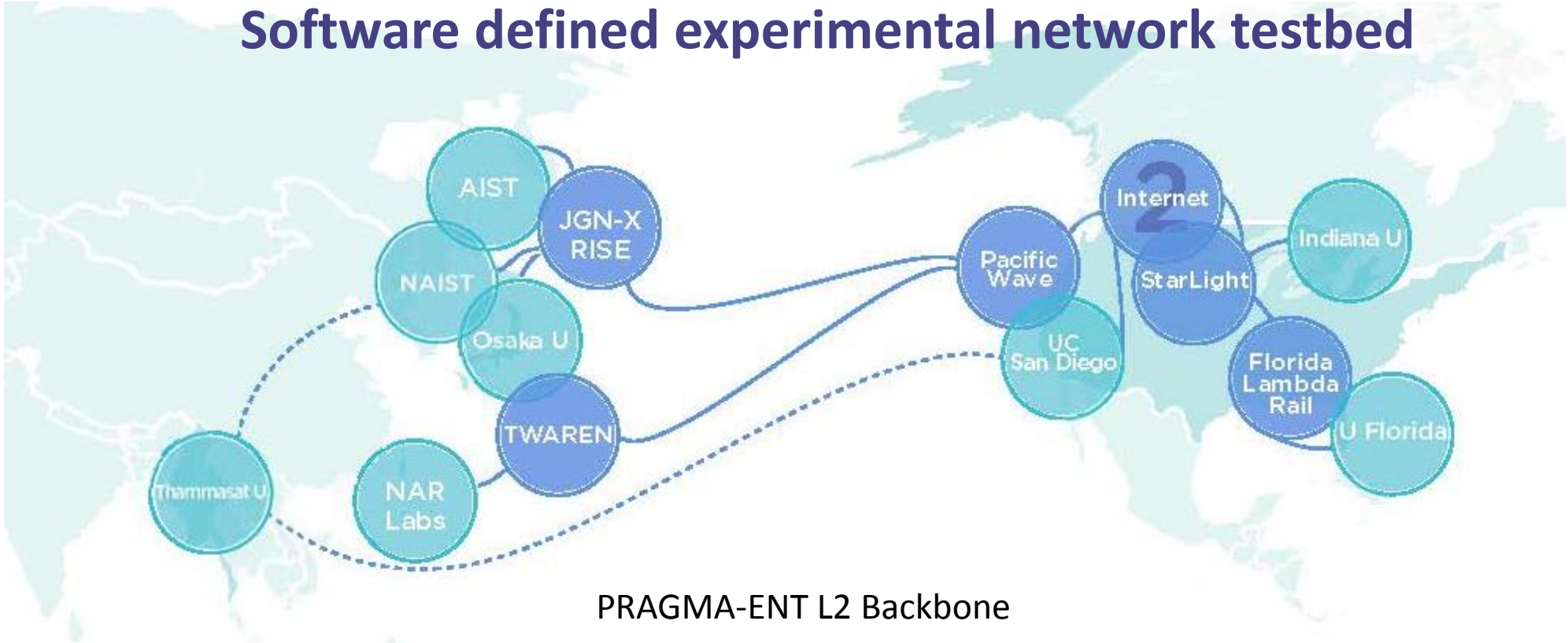
- Expeditions
  - Lake Ecology: Modeling with SDN
  - Lifemapper: Portability
  - PRAGMA ENT: Testbed for SDN
- Technical Advances
  - PRAGMA Cloud: Ease of Setup
  - Computational Genomics*
  - Data Sharing Testbed*
  - Air Quality Testbed: AirBox**
  - Visualization Testbed**
  - EDISON: An Environment for Learning



* From PRAGMA 30
** With CENTRA

PRAGMA-Experimental Network Testbed (ENT)

Software defined experimental network testbed



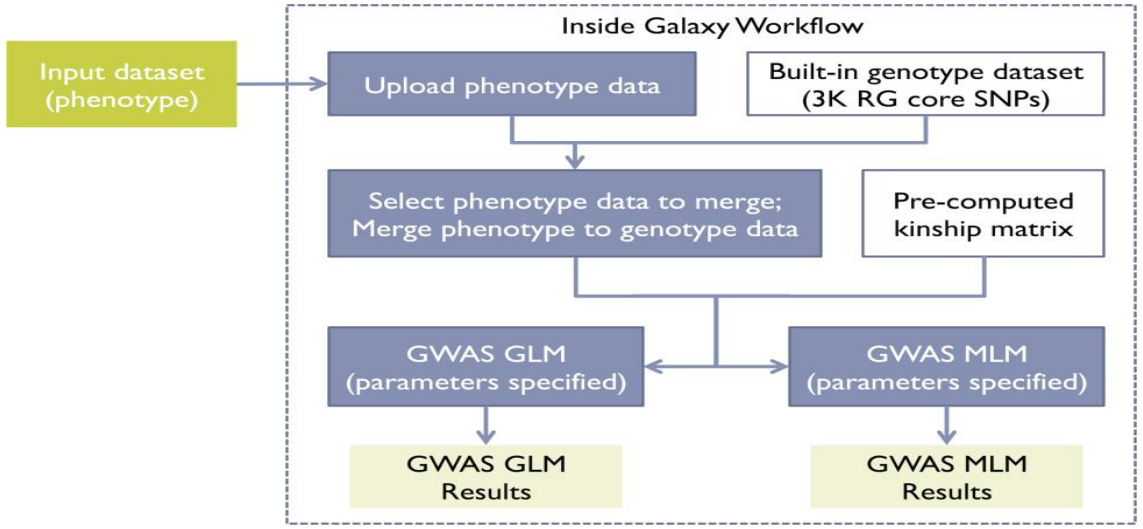
PRAGMA-ENT L2 Backbone

High-speed research networks (Florida Lambda Rail, Internet2, JGN-X, TWAREN, Pacific Wave and StarLight) interconnects OpenFlow-enabled hardware switches in the U.S. (University of Florida, UC San Diego and Indiana University), Japan (Nara Institute of Science and Technology, Osaka University and National Institute of Advanced Industrial Science and Technology), Taiwan (National Applied Research Laboratories) and Thailand (Thammasat University). The solid and dashed lines indicate physical connections and virtual connections respectively.

Expanded Backbone to Thammasat; Uses IPOP to expand backbone

International Rice Resource Institute

Stimulation from PRAGMA 30 for Biosciences and PRAGMA Data Activities

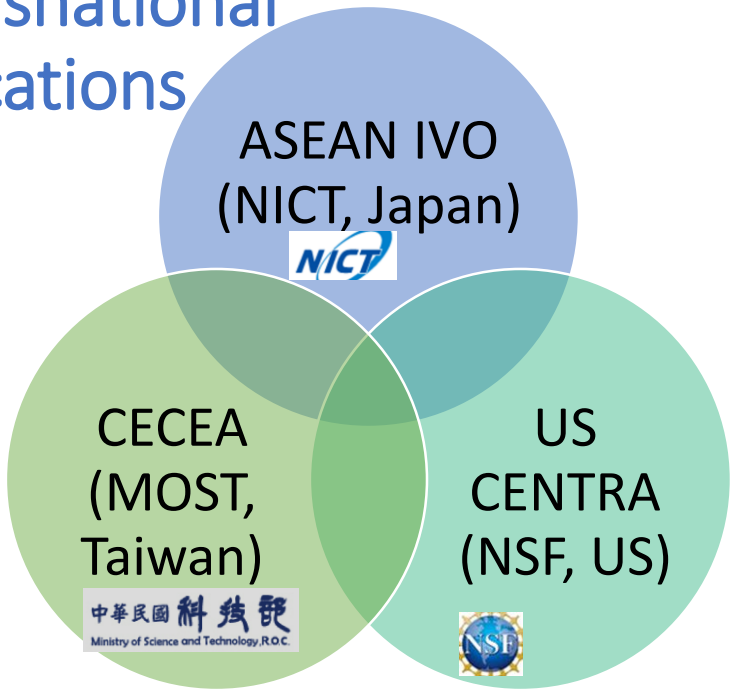


Overview of TASSEL-GBS workflow for rice genomics studies
- GBS: Genome-typing-By-Sequencing

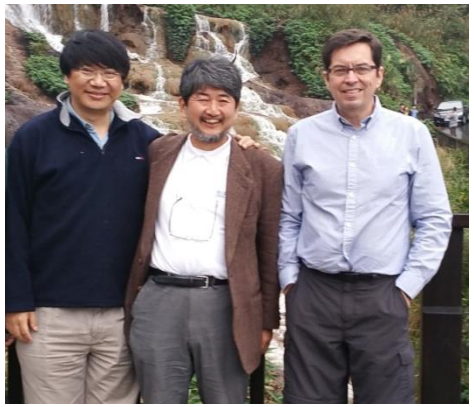
- Motivated at
- Engaged Biosciences, Data Expertise (RDA), and PRAGMA Students
- Products
  - Workflow
  - Captures data provenance within a PRAGMA VM, adds tooling to a VM to extract key data results from the VM
  - New standalone PRAGMA data services to assign Persistent Identifiers to key data results.

Contacts: Jason Haga, Beth Plale, Quan Zhou

Collaborations to Enable Transnational Cyberinfrastructure Applications Key Goals



- Promotes scientific advances at the intersection of
  - Applications: smart and connected communities, environmental monitoring, disaster management
  - Cyberinfrastructure: software-defined systems for data-sharing, middleware interoperability, coordination …
- Build next generation of collaboration networks of people

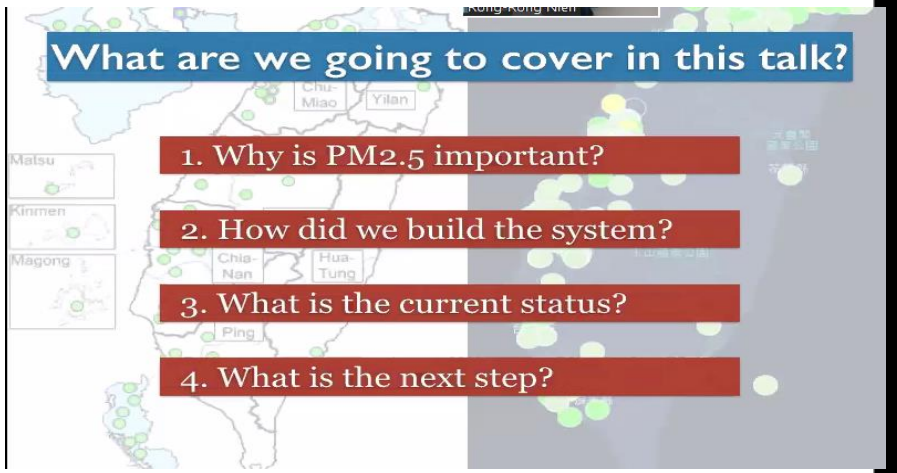


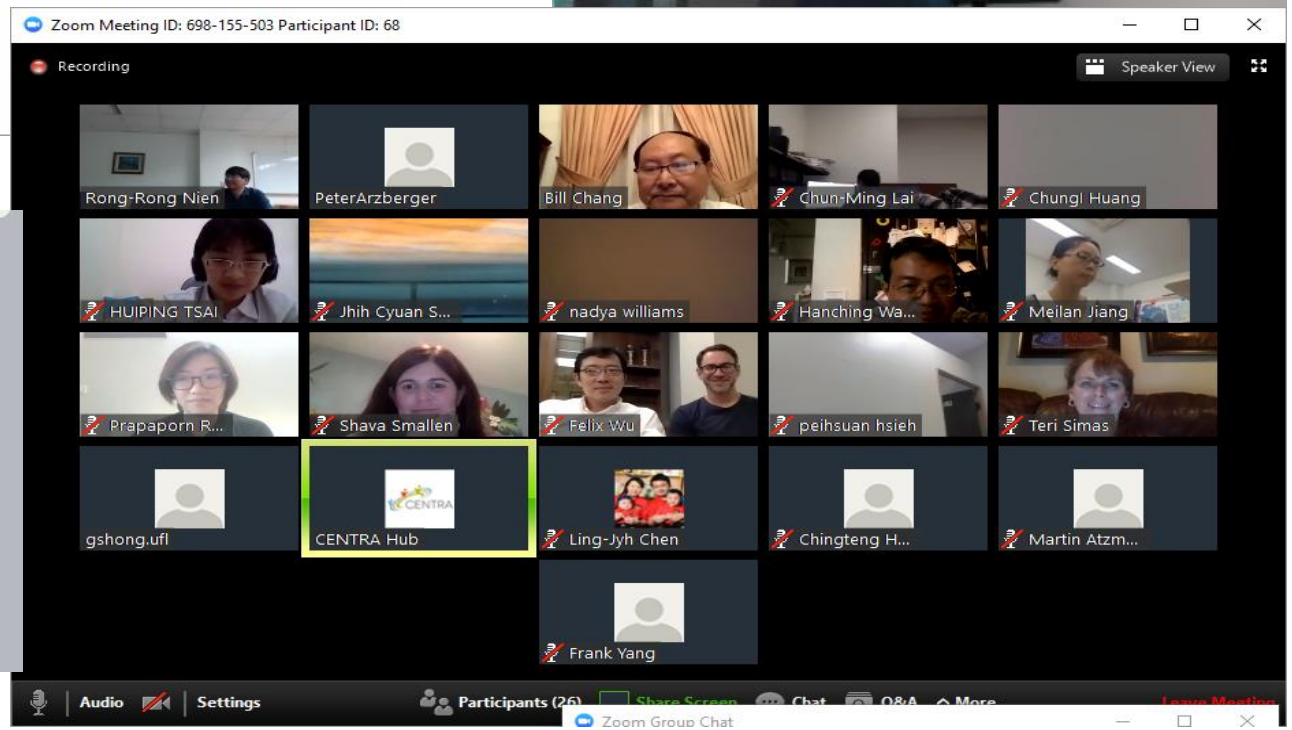
CENTRA

http://globalcentra.org/

CENTRA Seminar
AirBox – August 22, 2016

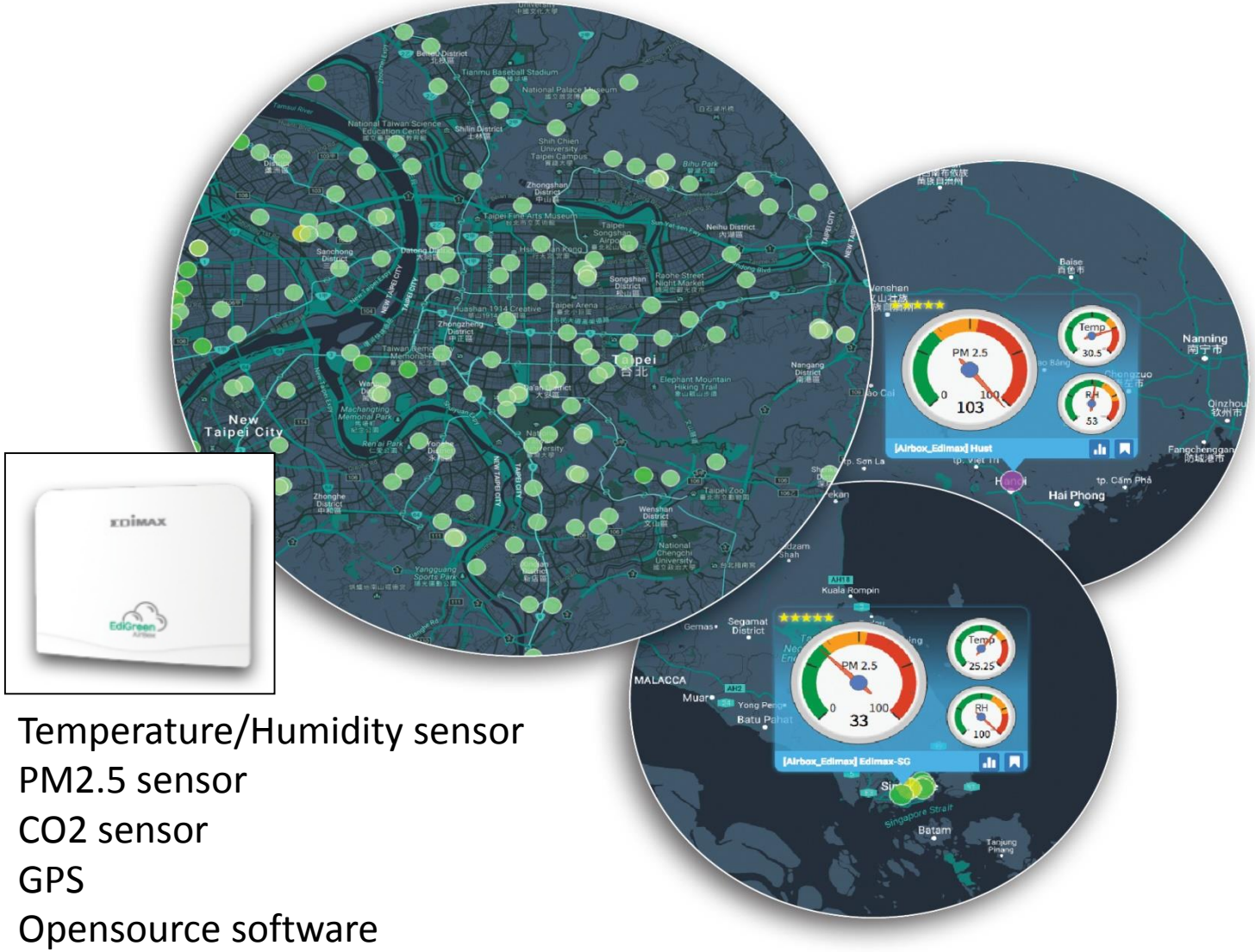
Ling-Jyh Chen





Air Quality Testbed

Expanding a Grassroots Urban Air Quality Monitoring Testbed



Temperature/Humidity sensor
PM2.5 sensor
CO2 sensor
GPS
Opensource software

PM2.5 monitoring using Airbox and location-aware sensor system (LASS.)

Left hand side is the active monitoring site at Taipei City and

right hand side is the newly deployed sites at Osaka and Singapore.

The data is visualized on g0v.tw shared platform airmap.g0v.asper.tw.

Roles of PRAGMA and Global CENTRA

PRAGMA

- Assets
  - PRAGMA's Expeditions
  - PRAGMA's Shared Resources
  - PRAGMA's Members
- Possible Role
  - Testbed for sharing data
  - Testbed for sensors
  - Forum for sharing knowledge

Global CENTRA

- Assets
  - Funding from three agencies for explicit work in Smart Cities
  - Connection with US Ignite, Array of Things, other Smart Cities /Nations (Singapore, …)
- Possible Role
  - Host workshop and seminars
  - Bring students to pilot activities

Models of trust in communities

Homework: Many other opportunities

Some Possible Activities in Smart and Connected Communities

- Participate in CENTRA + PRAGMA 32 Meeting in Gainesville Florida, April 10 -14, 2017. See Jose Fortes for details!
- Convene people (Shonan)
  - Interoperability of sensors (in cities/communities)
  - Sharing of data
  - Other topics
- Create or expand PRAGMA / Global CENTRA testbed of sensors and data
- Engage people that
  - Model processes of cities and communities, and/or
  - Bring social science perspective
- Expand or initiate mechanisms that engage / create student networks
- Develop network to help set research directions for Smart and Connected Communities and engage people

CENTRA-PRAGMA April Meetings

- 10-12 April 2017 -- CENTRA All-Hands meeting on Smart and Connected Communities
- 12 April 2017 – CENTRA/PRAGMA SUNTOWNS (Smart University TOWNS) Workshop
- 12 April 2017 -- GLEON Lake Modeling Workshop
- 13-15 April 2017-- PRAGMA 32 meeting on Internet of *People and Things
- 1-2 April 2017 – SUNTOWNS Hackathon

Take-Home Messages

- Smart and Connected Communities
  - Offers many challenges that can benefit many
  - Require multidisciplinary approaches
  - Issues are not just technical, but policy and community engagement
- Global Collaborations
  - Offer great opportunities and an added value to those involved
  - Require multiple approaches, understanding, time to develop, and trust
- PRAGMA, Global CENTRA, and Smart and Connected Communities
  - PRAGMA and Global CENTRA are models of trust
  - Multiple opportunities for years into the future
  - Value added to working together

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Smart and Connected Communities

Thank You

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PACIFIC RIM APPLICATIONS AND GRID MIDDLEWARE ASSEMBLY
PRAGMA

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Why the Great Interest Now?