Republic of the Philippines
Department of Science and Technology
Advanced Science and Technology Institute

Data for the FIRe: DOST-ASTI Science Infrastructure for Data and Computation

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PIDS Annual Public Policy Conference
19 September 2018 EDSA Shangri-la

The Changing Face of Computing

INDUSTRY 1.0

INDUSTRY 2.0

INDUSTRY 3.0

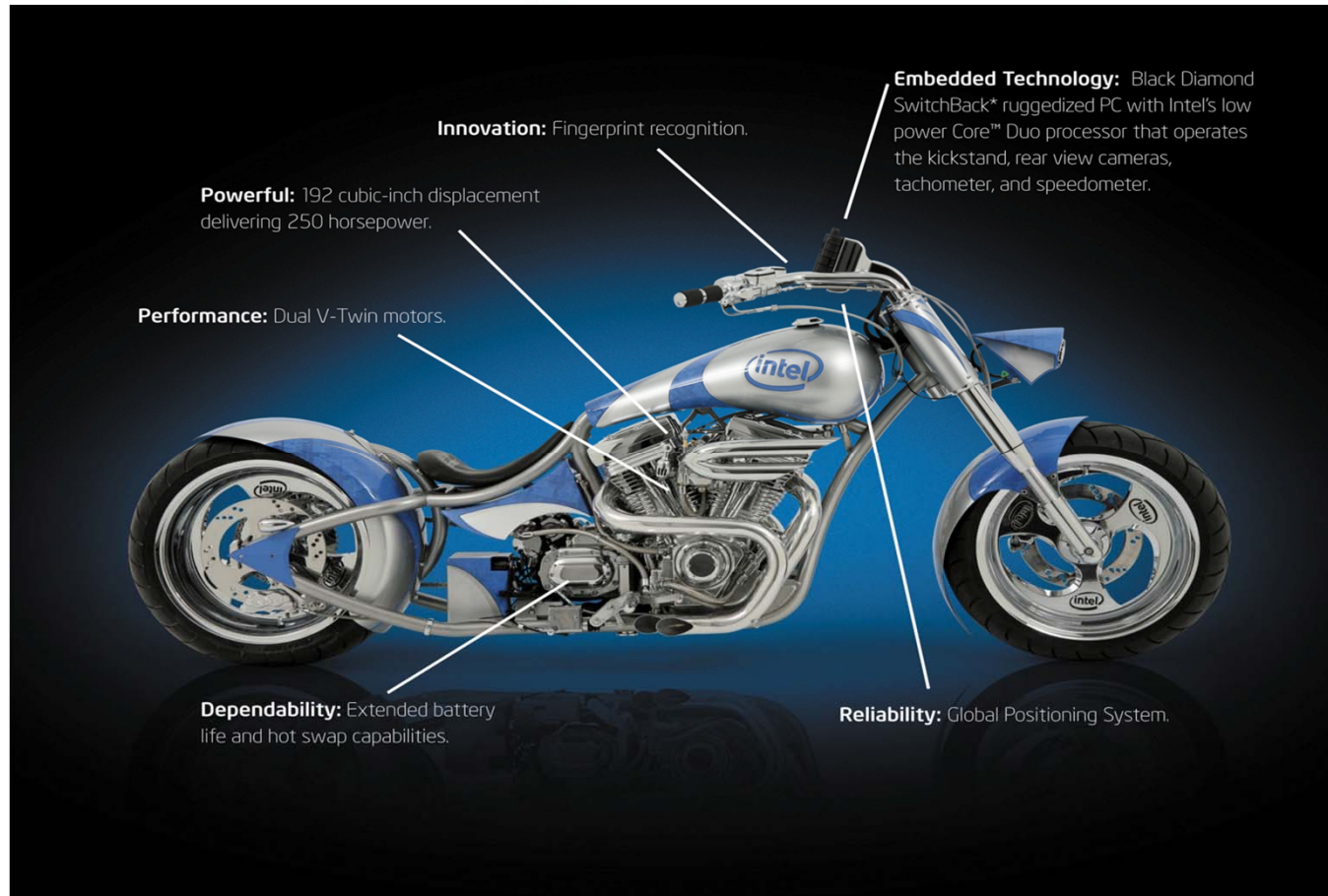1784
Mechanization,
steam power,
weaving loom

1870
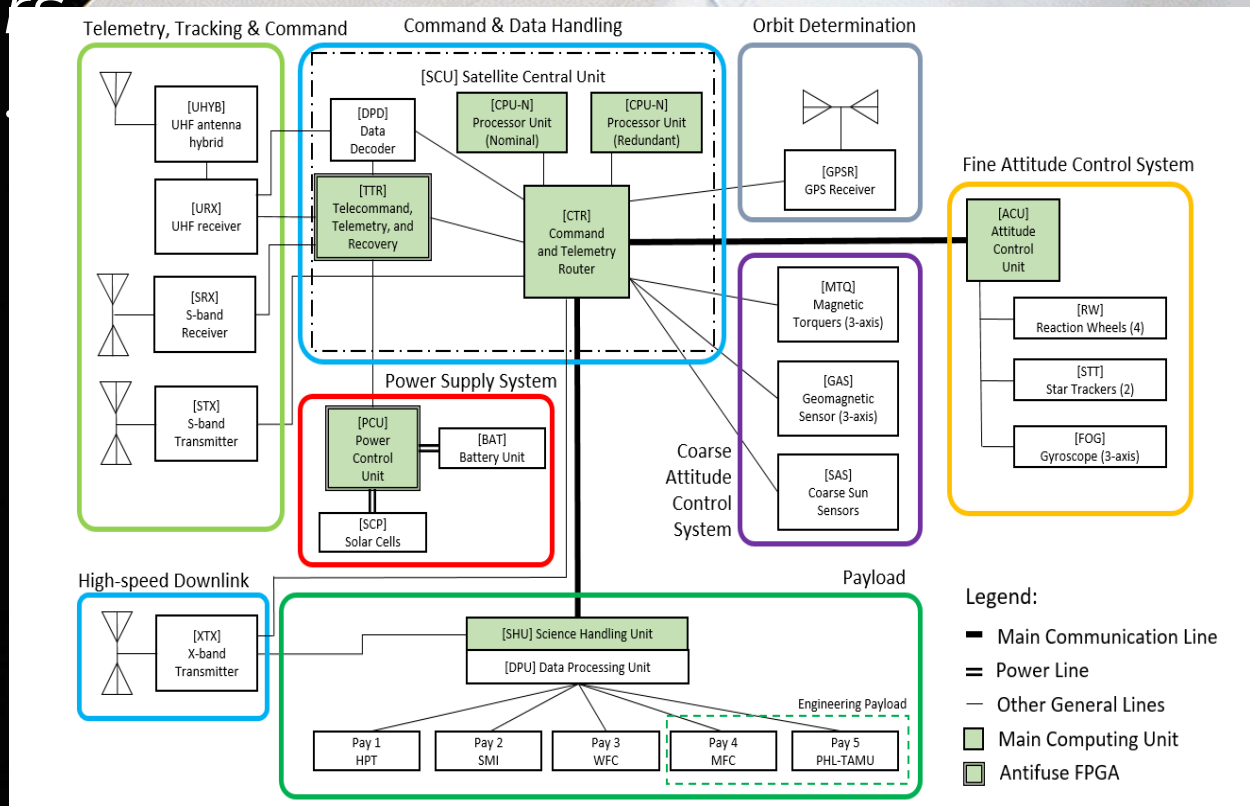Mass production,
assembly line,
electrical energy

1969
Automation,
computers and
electronics

The Changing Face of Computing
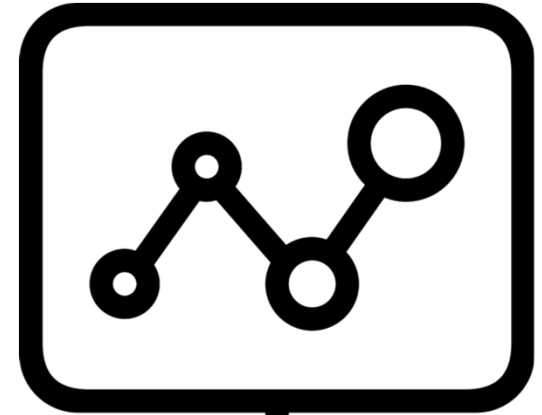
"Embedding" *computers* in space ...

We are not really launching satellites ...

We are putting computers in orbit.
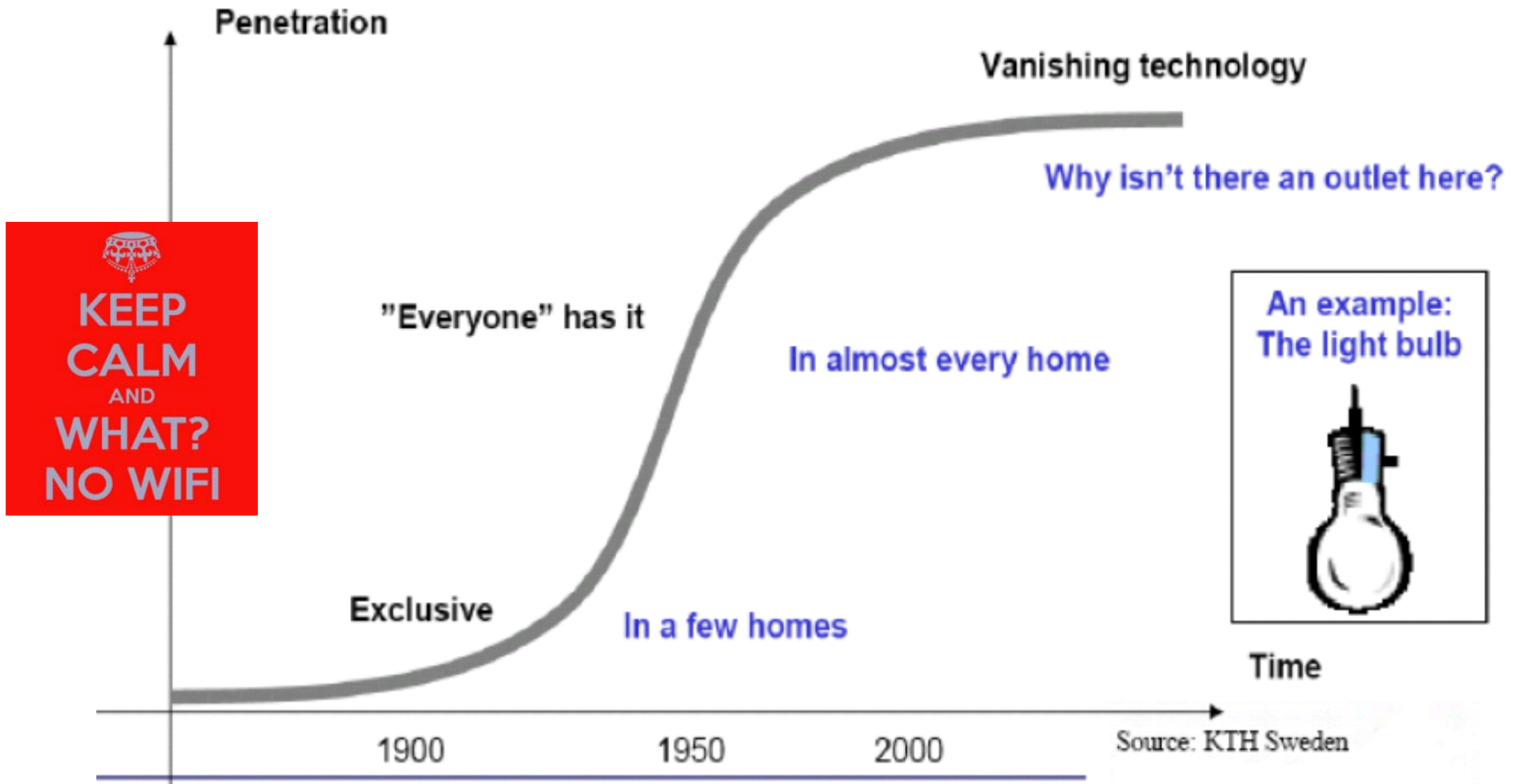
What for?

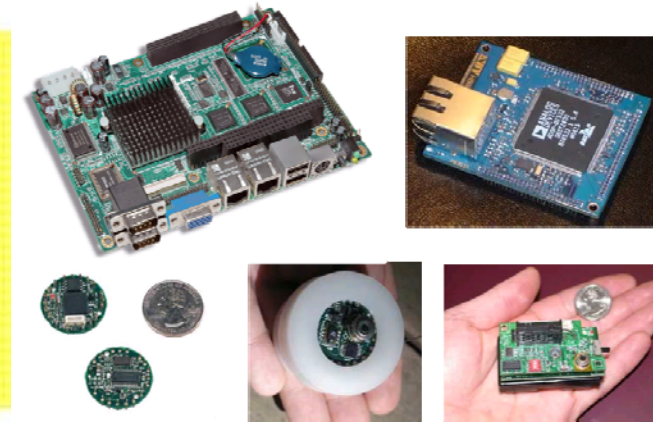DATA

DATA THAT FUELS THE UPCOMING FOURTH
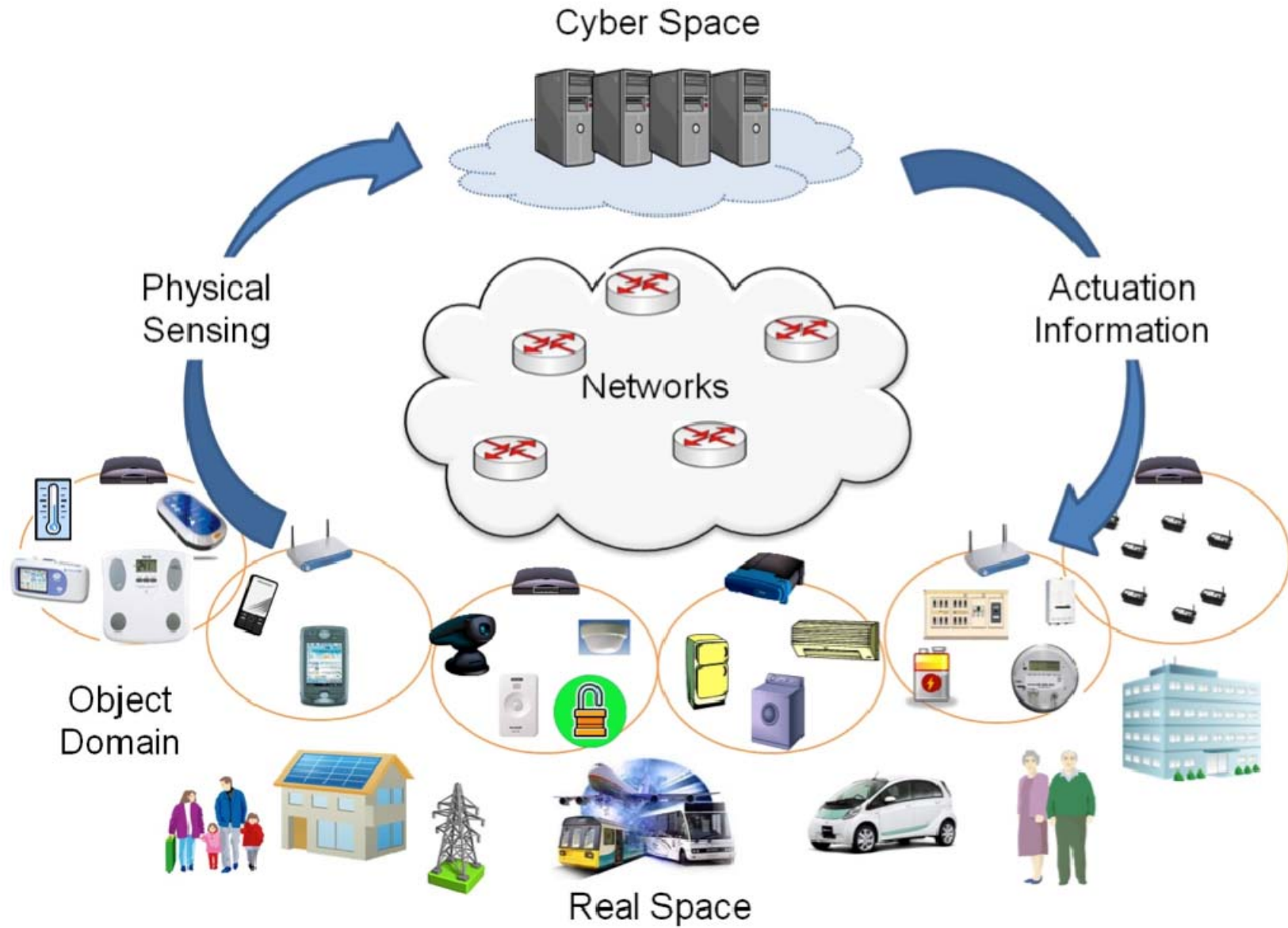INDUSTRIAL REVOLUTION.

Going the Way of the Light Bulb

"The most profound technologies are those that disappear. They weave themselves into the fabric of everyday life until they are indistinguishable from it."

Mark Weiser (1952 – 1999), Xerox PARC

Technologies are being *fused* and they *blend* into the background
A merger of the physical and cyber worlds → Cyber-Physical Systems!

Cyber Space

Physical Sensing

Actuation Information

Networks

Object Domain

Real Space

http://steffens.space/

INDUSTRY 1.0

INDUSTRY 2.0

INDUSTRY 3.0

1784
Mechanization, steam power, weaving loom

1870
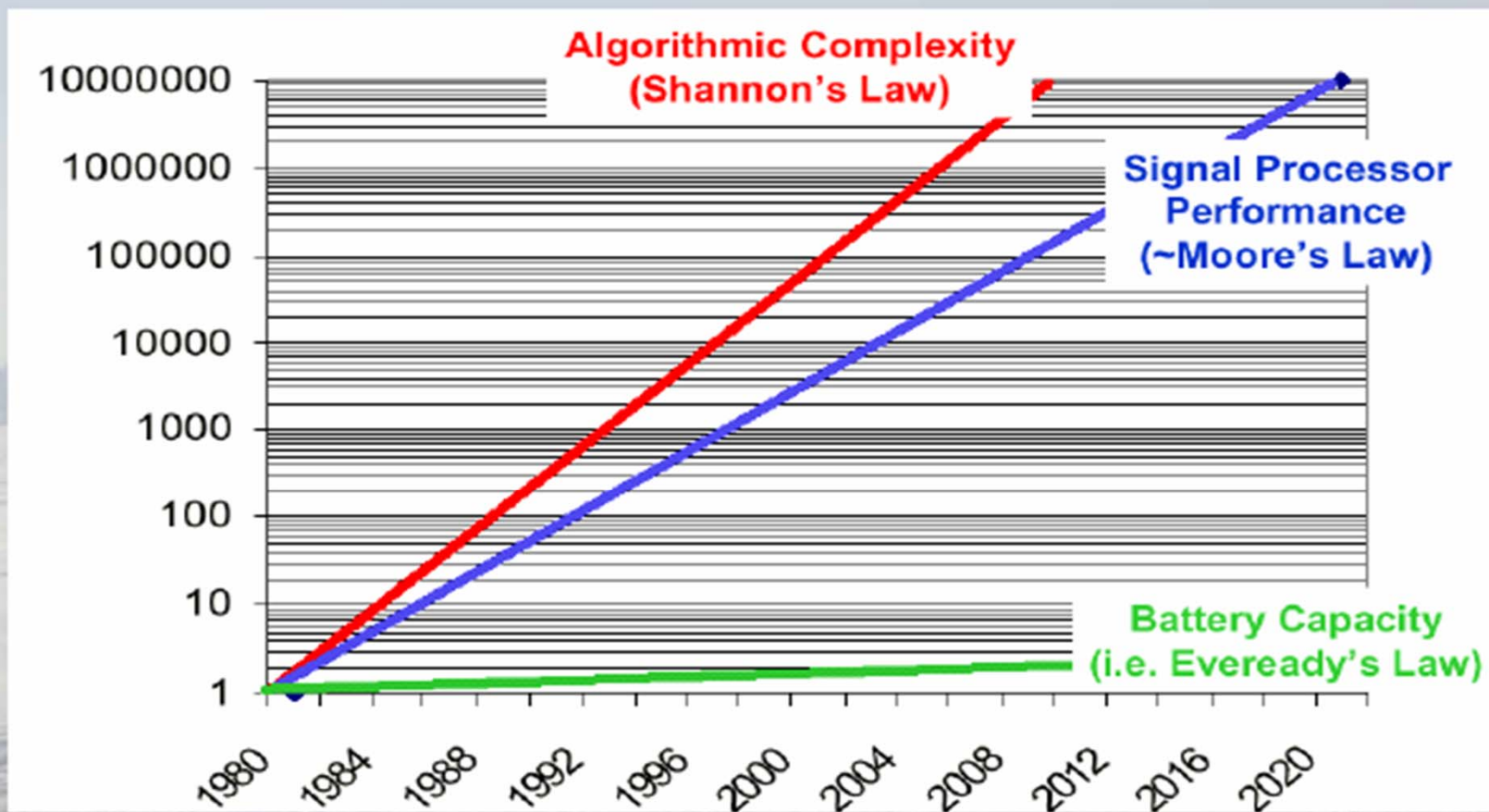Mass production, assembly line, electrical energy

1969
Automation, computers and electronics

DEVICES WORLDWIDE

	size	cost/item	power

USERS/APPS

		compute-ability	current status

CLOUD
- 100 Millions
- meters
- 1,000-10,000 $
- 1,000 W
- 100-1,000 GFLOPs
- well deployed keeps expanding

GATEWAYS/ CONCENTRATORS
- 10 Billions
- 10 cm
- 10+ $
- 1-10 W
- 100-1,000 MFLOPS
- well deployed keeps expanding

IoT NODES
- 1 Trillion
- 1-10 mm
- 1 $
- <1 µW
- 1-100 MFLOPS
- commercial nodes still far from IoT target

INTERNET OF THINGS

PHYSICAL WORLD
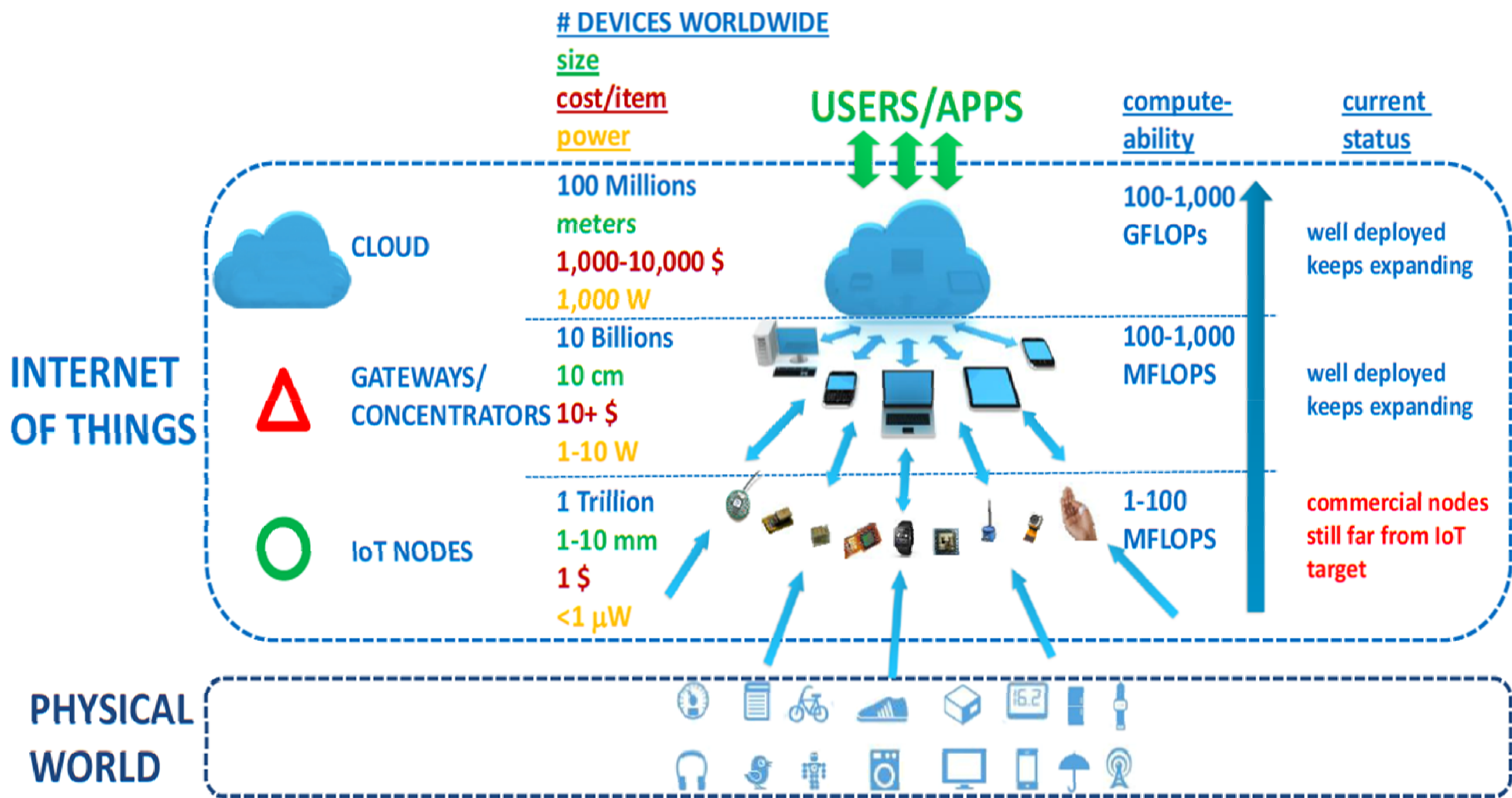
Massimo Alioto

AN *EXPLOSION* OF DEVICES

Energy Trends

Source: Ravi Subramaniam, MorphICs Inc.

TECHNOLOGY CONTINUES TO EVOLVE

Bandwidth (1)

Storage (2)

Computing (3)

Cost of globally networked information to fall 1,000-fold by 2015-20

… Showing No Signs of Slowing Down

US $ - LOGARITHMIC SCALE

1,000,000
100,000
10,000
1,000
100
10
1
0.1

70   80   90   00   10

(1) Cost of sending 1 trillion bits
(2) Cost of 1 megabyte storage
(3) Cost of 1 MHz processor speed

Source: Federal Reserve Bank of Dallas
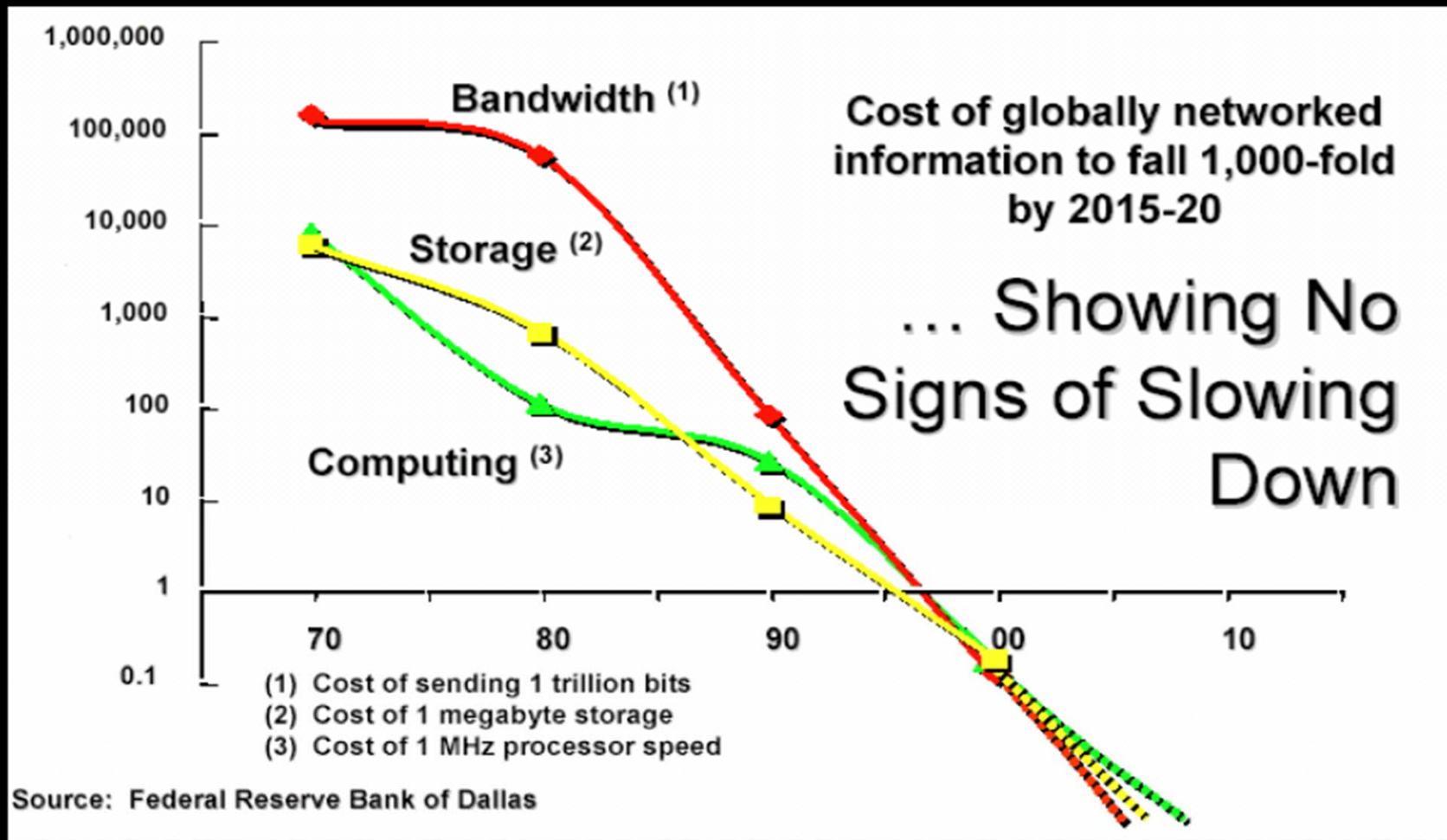
FiRE Feature: AI and Machine Learning at the "Edge"

The Deep Learning Ecosystem Today

Edge/On Device

DNN workload execution
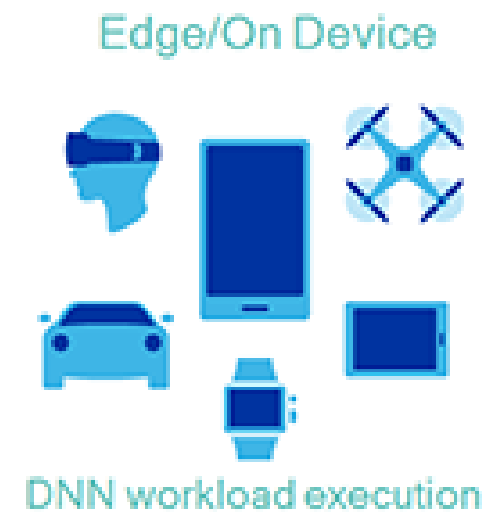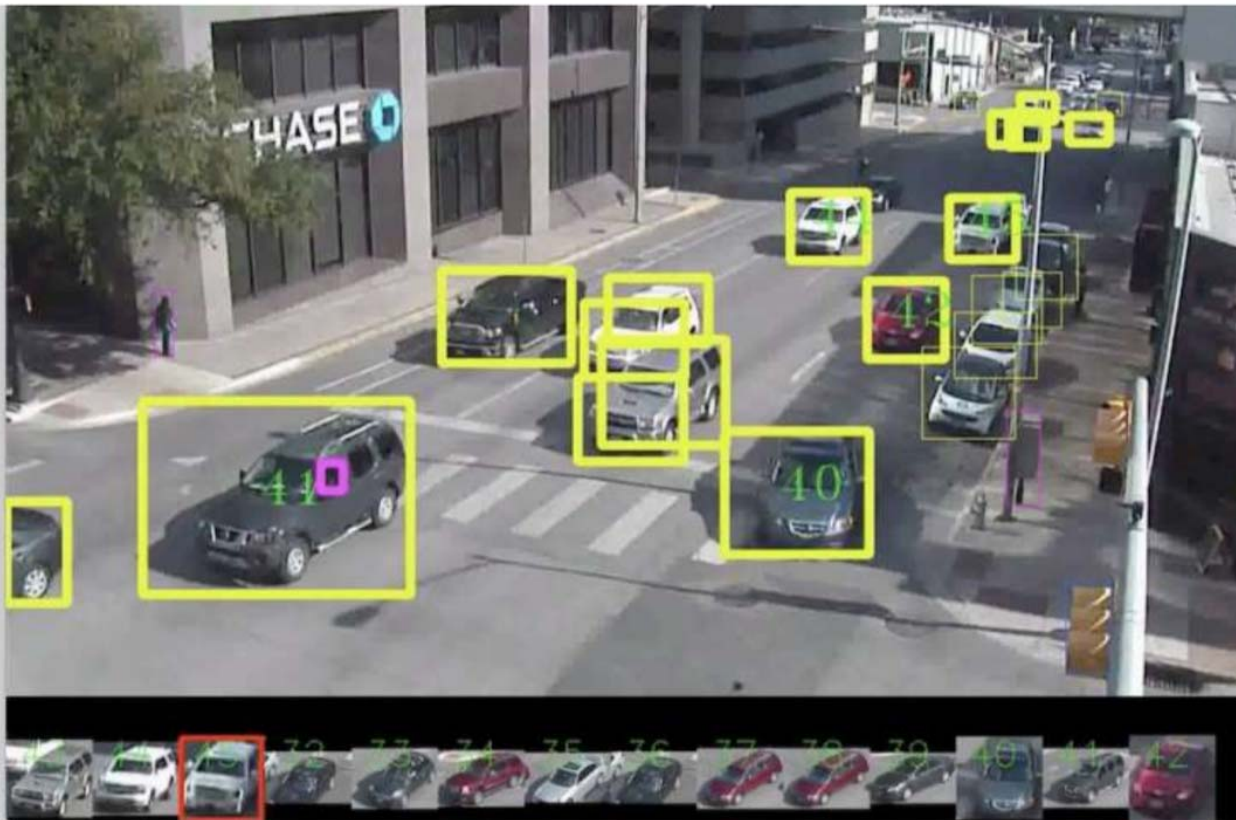
A new deep learning tool uses raw traffic camera footage from City of Austin cameras to recognize objects - people, cars,

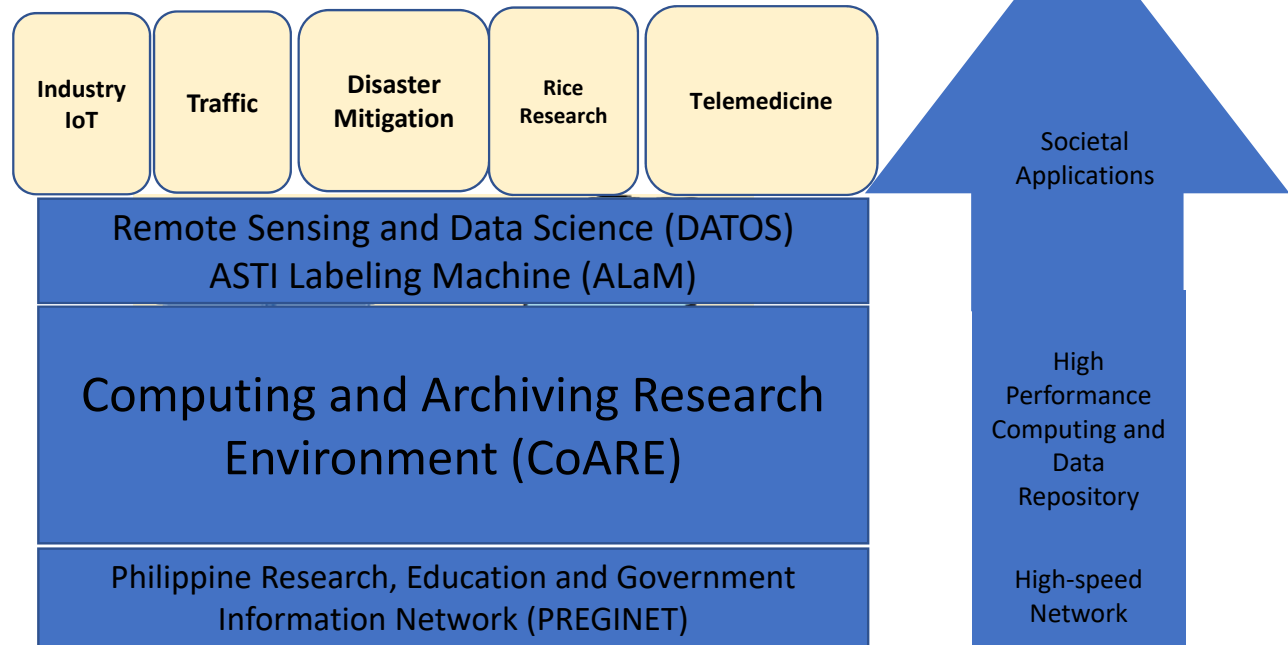Shardul Brahmbhatt, https://developer.qualcomm.com/blog/adopting-artificial-intelligence-internet-things

DOST ASTI 31 Years
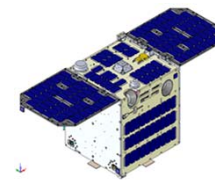Moving beyond possibilities

ADVANCED SCIENCE AND TECHNOLOGY INSTITUTE
DOST
"ISO 9001:2008 CERTIFIED"

PHOpenIX

COARE

PREGINET

DATOS

DOST-ASTI Science Infrastructure for Data and Computation

Industry IoT

Traffic

Disaster Mitigation

Rice Research

Telemedicine

Societal Applications

From Data to Information

Remote Sensing and Data Science (DATOS)
ASTI Labeling Machine (ALaM)

Storing, computing and accessing the data

Computing and Archiving Research Environment (CoARE)

High Performance Computing and Data Repository

Philippine Research, Education and Government Information Network (PREGINET)

High-speed Network

Generating (Big) Data for Science

ULAT
Understanding Lightning and Thunderstorms

Value creation from data

Sensor network: **1.7GB**
Hazard maps: **8.3GB**

3000 rice genomes: **132TB**

PAGASA data: **9.5TB**

COARE

LiDAR: **35TB**

HPC user data: **777TB**

Upcoming:
- Diwata-2
- Other satellite images
- Lightning data
- Himawari, VIIRS
- and more …

Satellite images: **10TB**
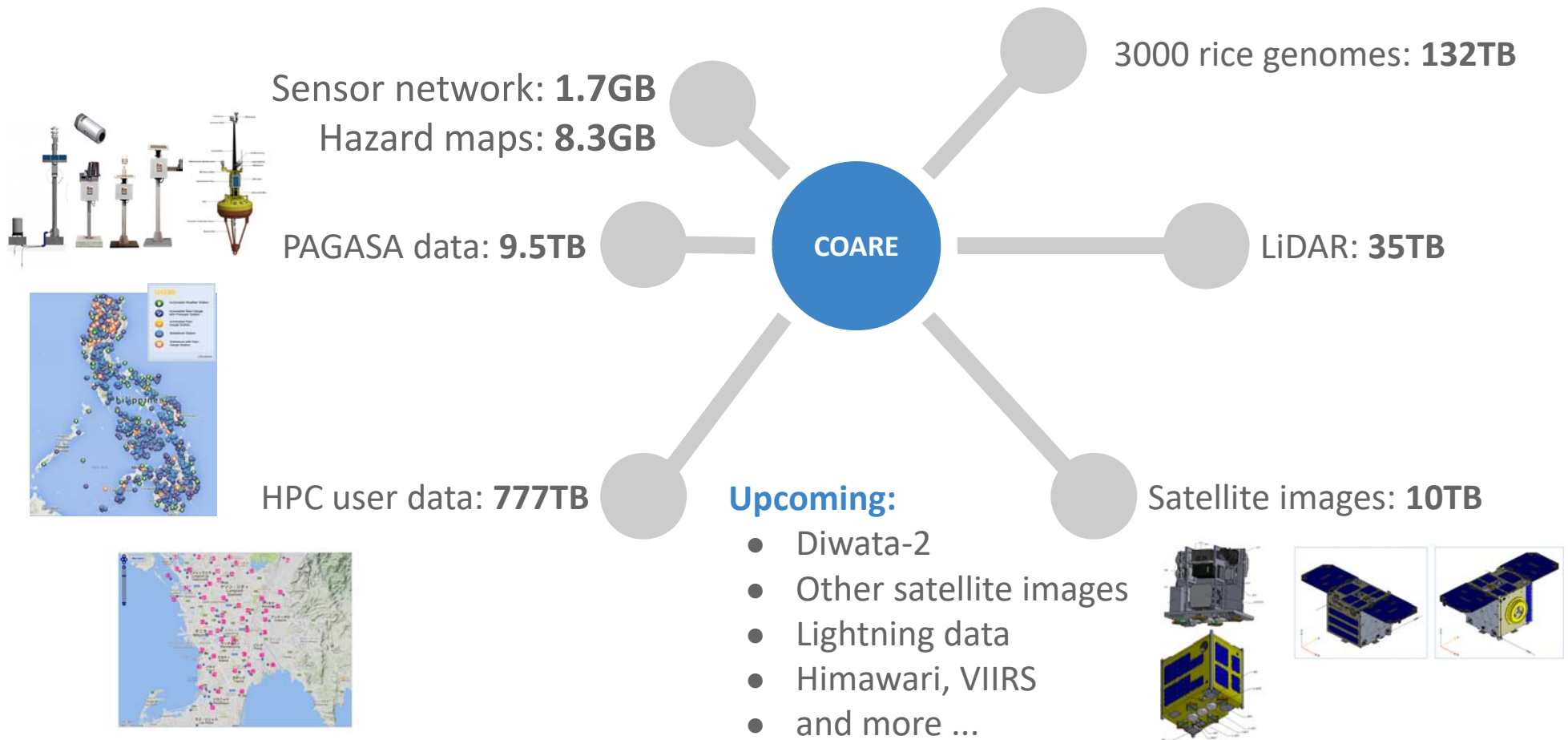
COMPUTING & ARCHIVING RESEARCH ENVIRONMENT
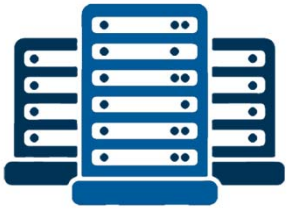
High Performance Computer

STORAGE

CLOUD

DATA CATALOG

Linux
Slurm

Lustre (HPC)
Gluster (User)
Nimble (Cloud)
Ceph (Archive)

Openstack
Ovirt

https://asti.dost.gov.ph/coare/data/
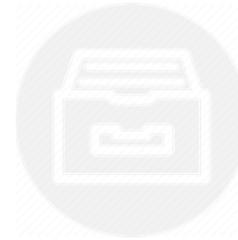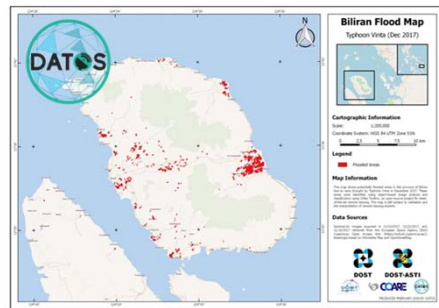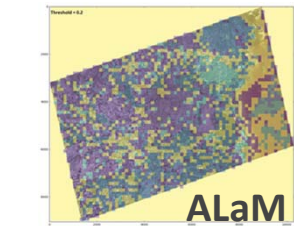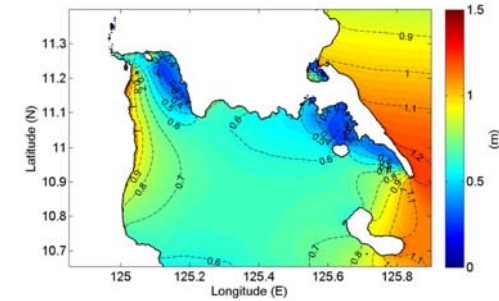
CoARE Evolution

Preparing for the coming of the FIRe

Year	Cores		RAM (GB)	Storage (TB)
	CPU	CUDA		
2019*	3,600 +96	20,800 +7,680	13,847 +4,096	2,417 +384
2017	3,600	20,800	13,847	2,417
2016	3,016	5,440	13,720	1,080
2015	1,760	448	7,424	96
2014	600	448	1,280	60
2010	408	--	--	30
2009	360	--	--	--
2008	128	--	--	9

ASTI HPC scientific workload
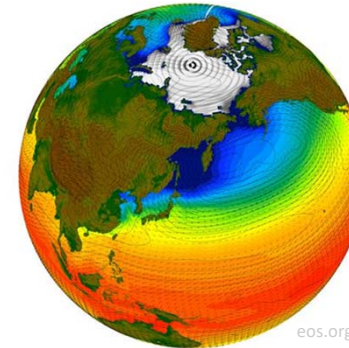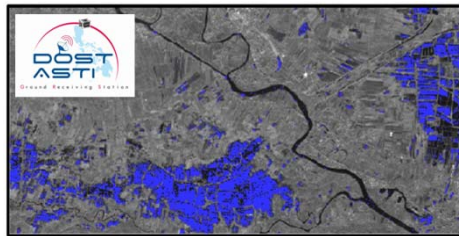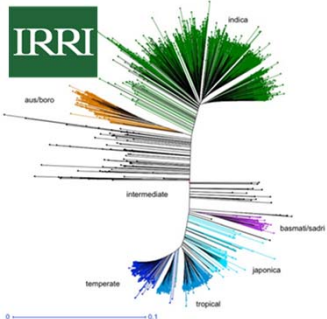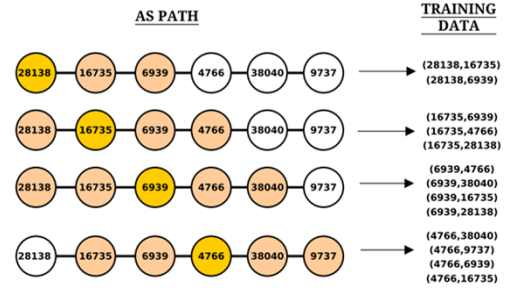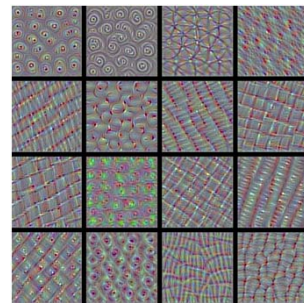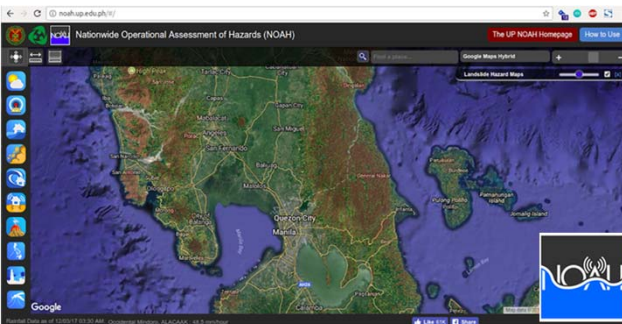
PREGINET and PHOpenIX as backbone
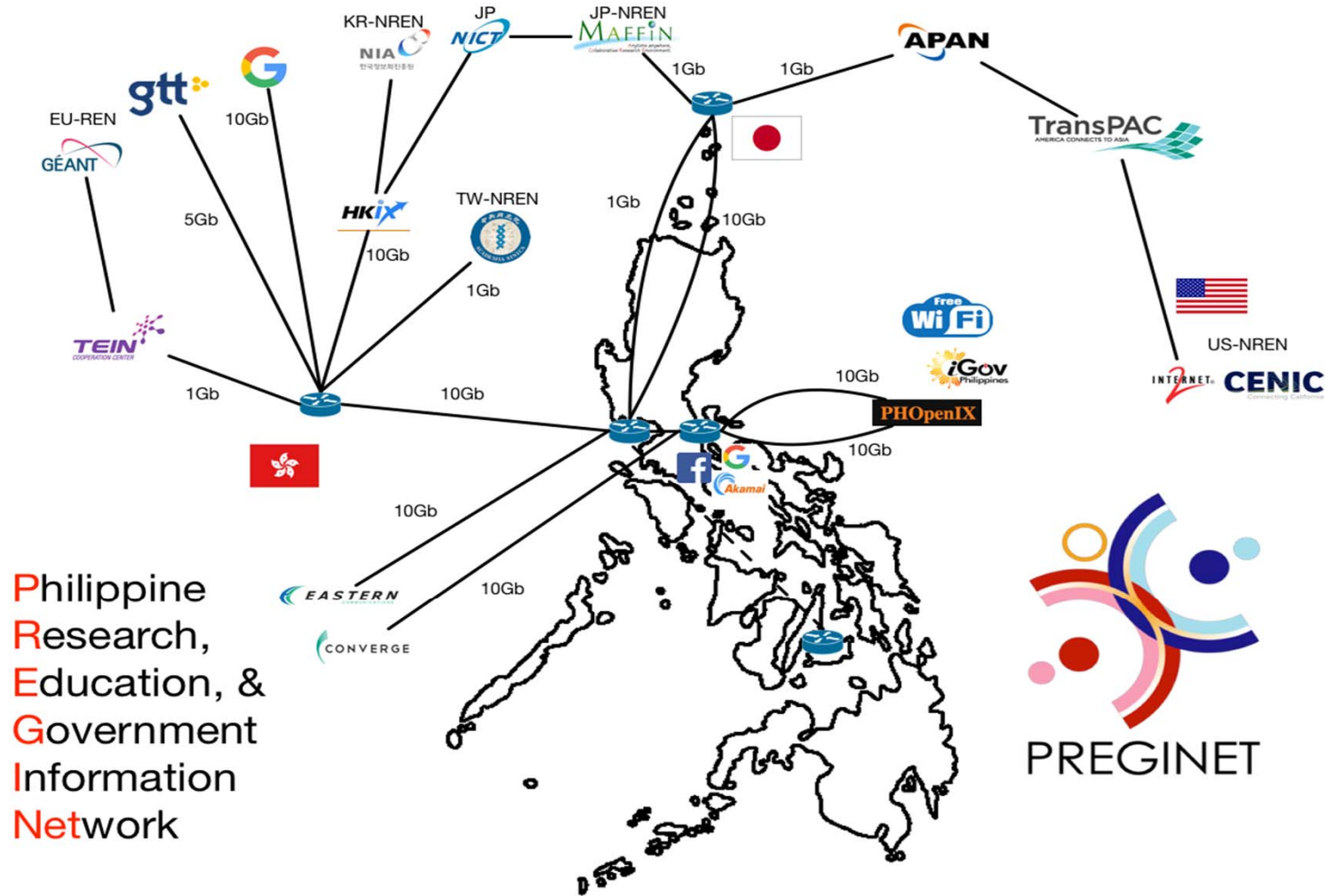
Expanding to a larger facility
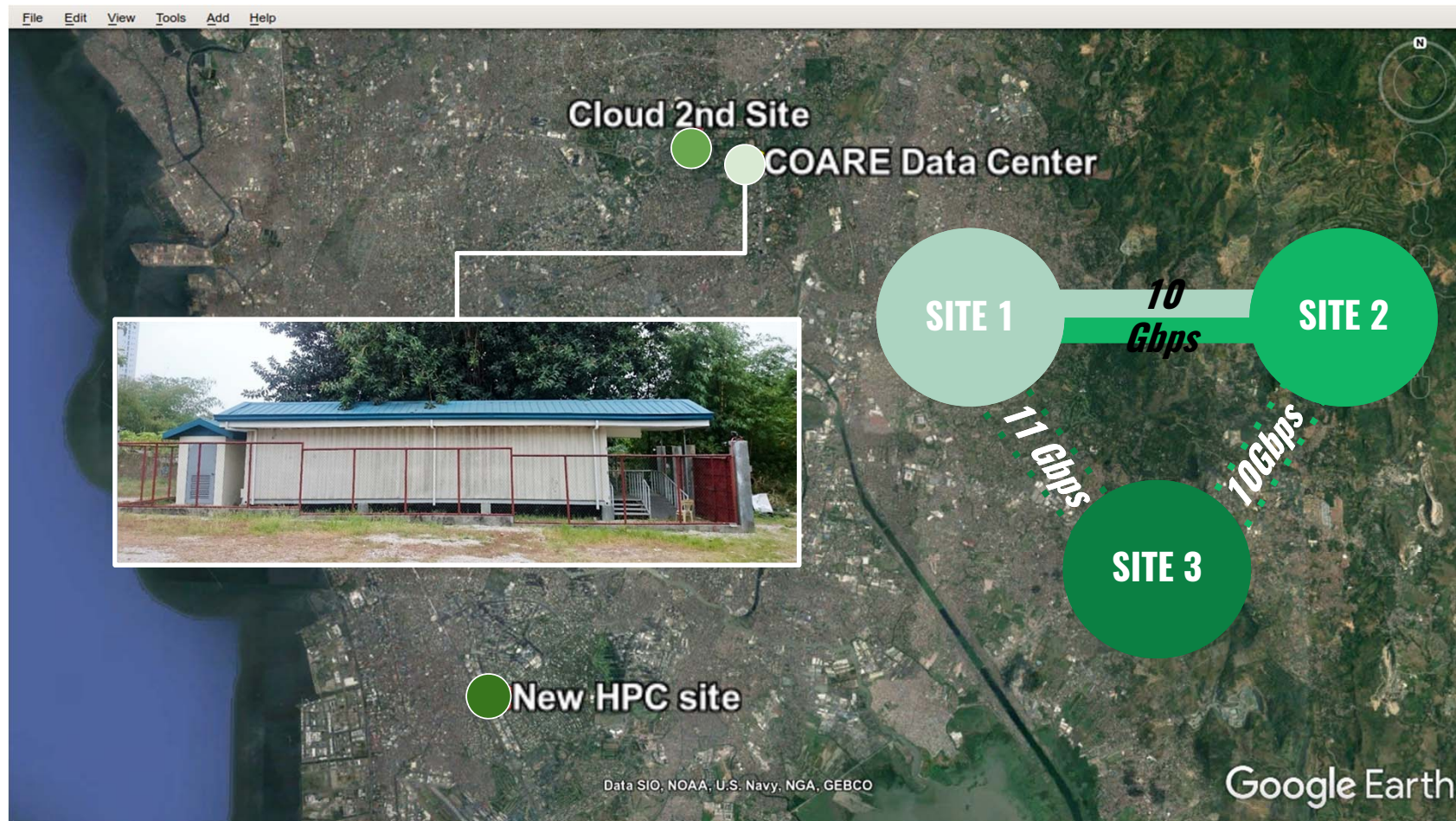
Responding to Operational Needs

Typhoon Mangkhut (Ompong)

Preparation of archive pre-typhoon images (Planet – 3m. resolution)
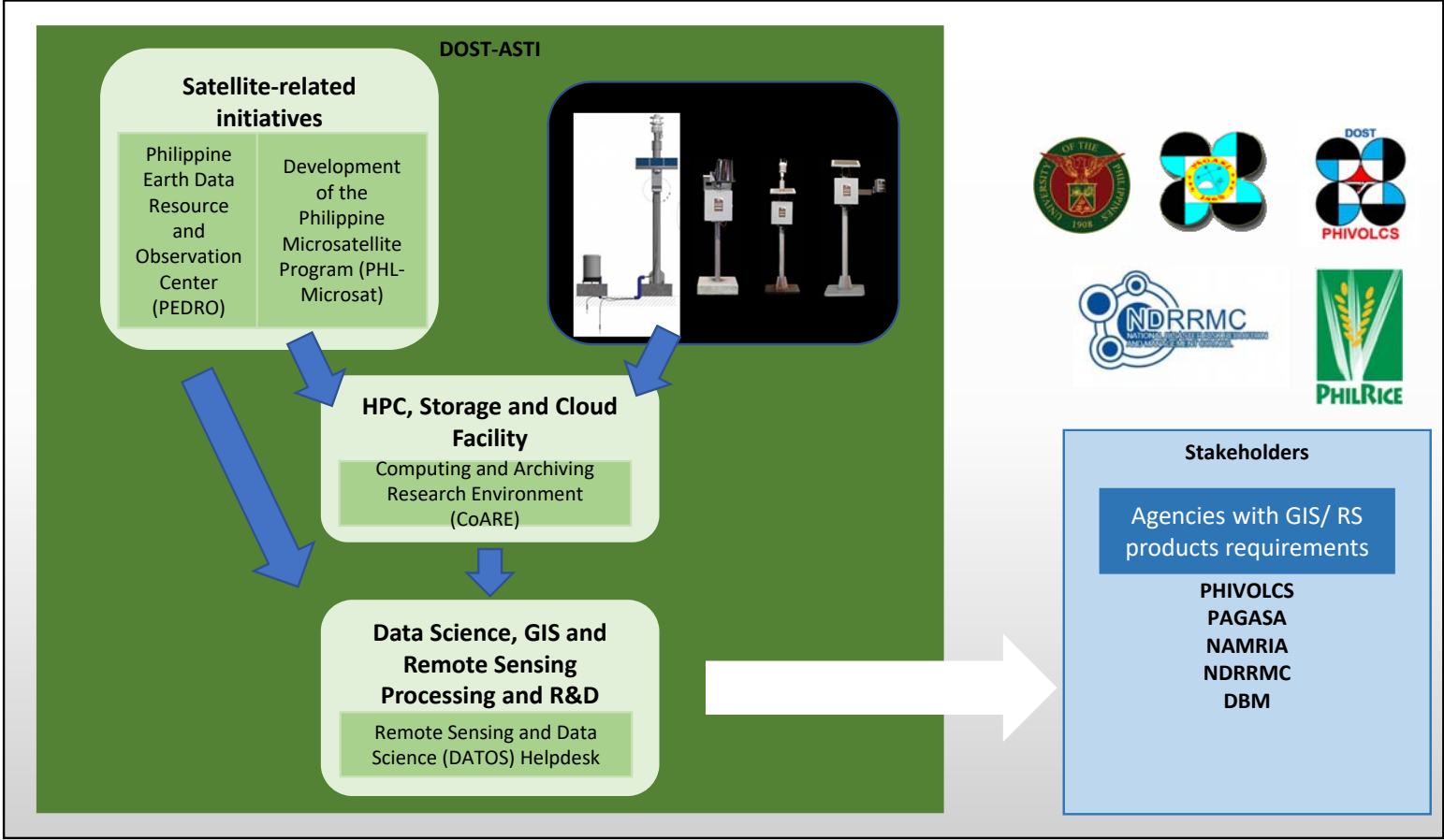

16/00Z - 105 knots

15/00Z - 120 knots

14/00Z - 14

~30,000 Archive images over the Philiipines (2016-2018)
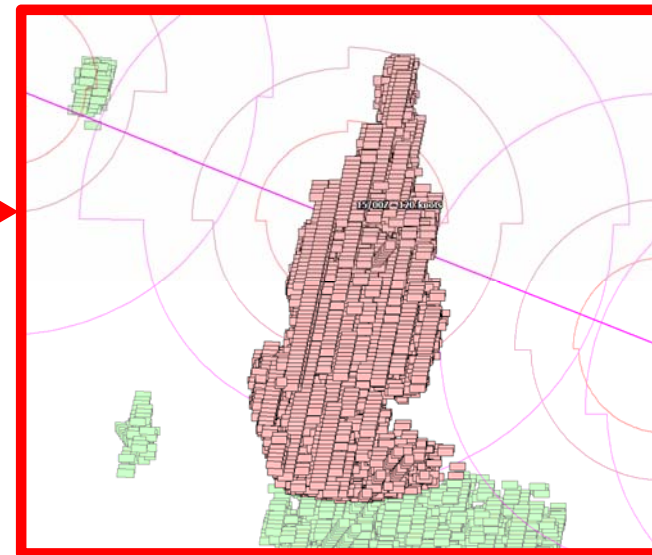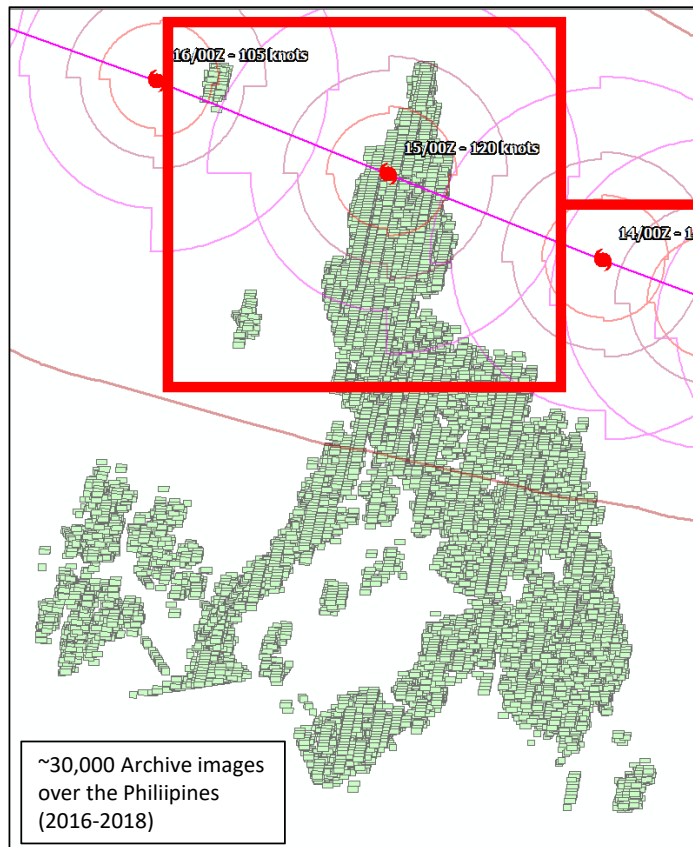
Sample image:
2018.09.13 - Ilocos
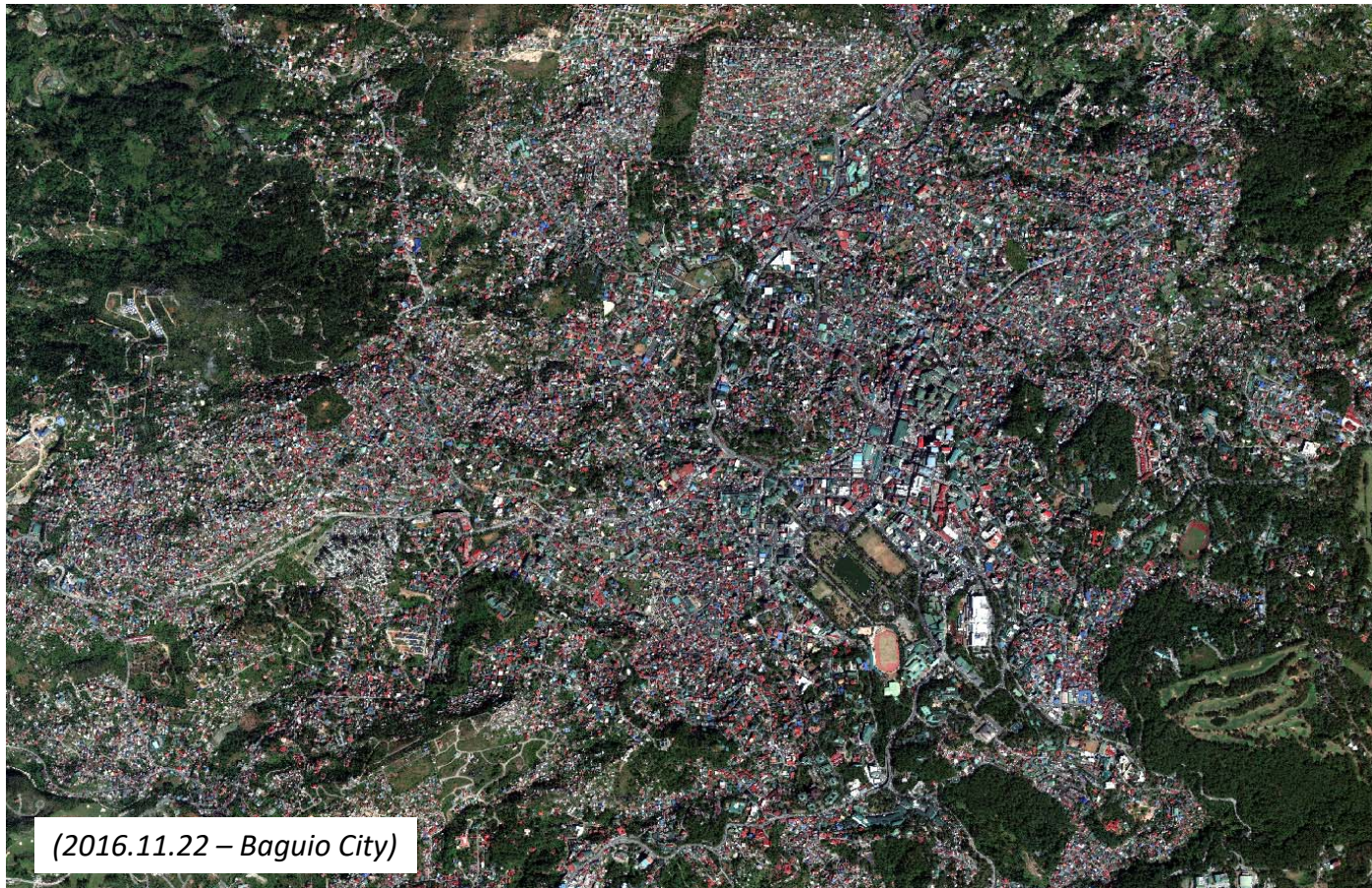
Typhoon Mangkhut (Ompong)

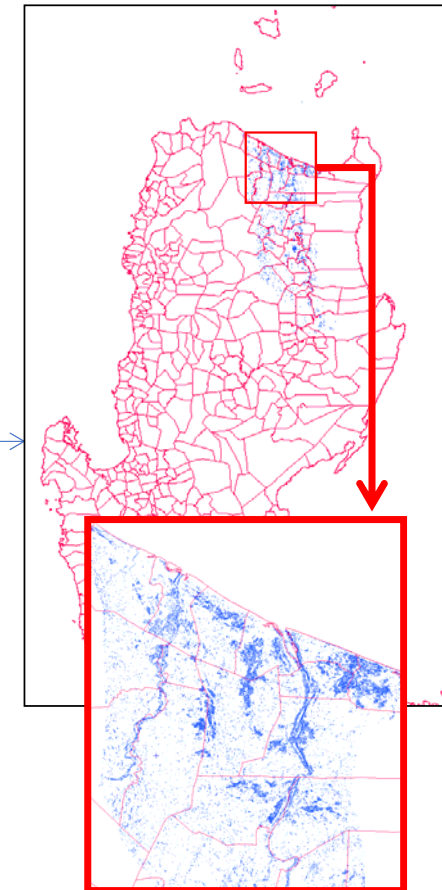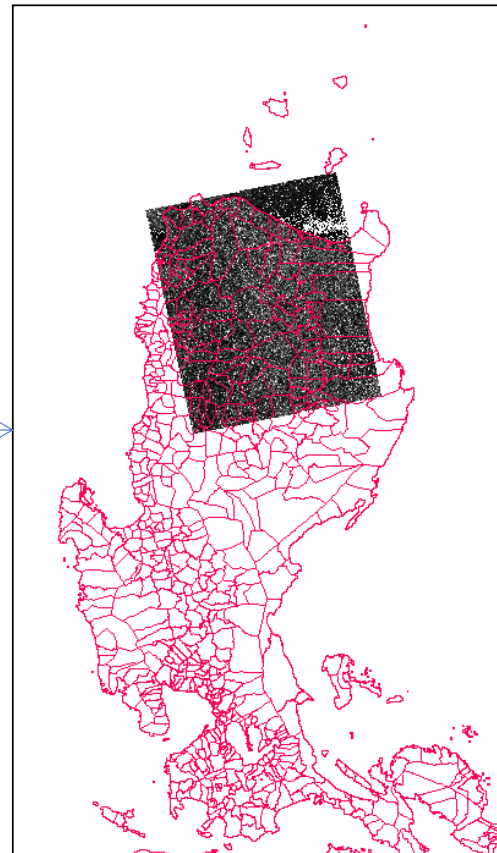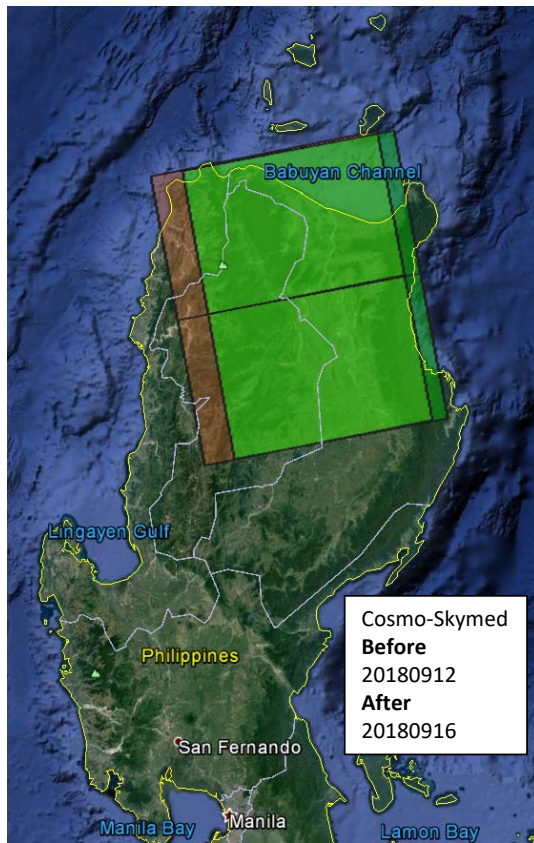Preparation of archive pre-typhoon images (WorldView-3 – 0.31m. resolution)

(2016.11.22 – Baguio City)

Typhoon Mangkhut (Ompong)

Satellite Tasking → Raw Data Acquisition → Data Processing

Cosmo-Skymed
Before
20180912
After
20180916

A *new* way to categorize typhoons (and other natural disasters)

- Data "mobilization"

| Source	Details	Notes	Total (gb)
Cosmo-Skymed	"32 scenes 16 scenes = before typhoon 16 scenes = after typhoon Northern Luzon Fresh tasking"	"Raw images = 8gb Once processed = estimate = 32gb PEDRO Subscription"	32
Planet Imageries	7300 scenes	"Pre-typhoon images used as training data for AI/Machine Learning PEDRO Subscription"	7700
Sentinel 1	"20 SLC scenes Flood Map Built-up Damage Map"	"4.4 Gb Raw per scene x 20 24 Gb flood map 2 Gb AI Prediction for flood 56 Gb Urban Damage Map 2 Gb Classified Free Data"	172
Radarsat	"Raw Flood Map"	"Pre and post-typhoon images to assess damages Free trial data"	24
DigitalGlobe	6 images of major urban centers	"Regions 1, 2, 3, & CAR (Pansharpened tiff files) Very high resolution images for pre-typhoon data PEDRO Subscription"	24
Diwata-1	"10 images (WFC - Wide Field Camera) (6mb total)"	Eye of the Storm	0.006

Mangkhut a.k.a "Ompong" *mobilized* ~ 8 TB (Terabytes) = 8,000 GB of ASTI data

Conclusion

- Computing becomes pervasive
  - Powerful computers becoming more and more embedded in the environment
- Embedded computers are "vanishing"
  - Profound technologies that "disappear into the fabric" of everyday life
  - Computers and data become fused into physical processes, infrastructure.
- Fusion of the physical and the cyber domains → *Cyber-Physical Systems (CPS)*
- CPS = Integration of computation, networking and physical processes
  - Blurring the lines between the physical and digital spheres
  - Sensors: better and pervasive monitoring
  - Actuators: more effective and responsive control
  - Feedback: Adaptive behavior, "tweaking"
- CPS → a highlight of the FIRe

Conclusion

- DOST-ASTI Science Infrastructure
  - Generating (big) data
    - DEWS, ULAT, PEDRO, etc
  - Storing, computing and accessing the data
    - PREGInet, PHOPENIX, CoARE
  - Processing data into information
    - DATOS, ALaM

- CoARE services
  - Data catalog
  - Cloud service
  - High performance computing

- Preparing Data and infra for the FIRe

- Available freely* to Filipinos
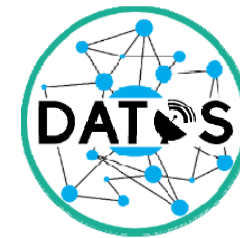
*non-commercial use

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Thank you

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