International Symposium on Grids & Clouds 2017(ISGC 2017)
Academia Sinica
Taipei, Taiwan

(5-10 March 2017)

e-Science in India
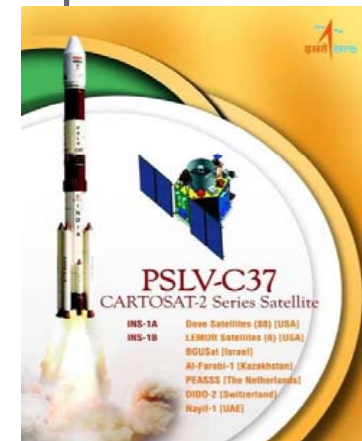
Dr. N Sarat Chandra Babu
Executive Director
C-DAC, Bangalore
India

09th March 2017

INDIA – IN S&T

- India's **ISRO** launches a record 104 satellites in a single mission
  - × PSLV–C37 the rockstar rocket launches Cartosat-2 series satellite for earth observation and 103 co-passenger satellites.
  - × Co-passenger nano satellites – 96 from USA, 2 from India, 1 each from Kazakhstan, Israel, The Netherlands, Switzerland, United Arab Emirates (UAE)
  - × Total weight: 1377 **KG**
- India is ranked 9th with five of its supercomputers listed in Top500

PSLV-C37
CARTOSAT-2 Series Satellite

INS-1A	Dove Satellites (88) [USA]
INS-1B	LEMUR Satellites (8) [USA]
	8GUSat [Israel]
	Al-Farabi-1 [Kazakhstan]
	PEASSS [The Netherlands]
	DIDO-2 [Switzerland]
	Nayif-1 [UAE]

2

DIGITAL INDIA VISION

- To transform India into digitally empowered society and knowledge economy.
- Focus is on making technology central to enabling change.
- Umbrella Programme covering many departments.
- 3 Pillars :
  - Infrastructure as utility to every citizen
  - Governance and services on demand
 - Digital empowerment

3

SMART CITY VISION

❀ Development of Smart Cities by leveraging IoT and M2M communications

❀ Several platforms which could be leveraged - GI Cloud Meghraj, Mobile Seva, PayGov India, etc.

❀ Smart parking

❀ Intelligent transport system

❀ Tele-care

❀ Woman Safety

❀ Smart grids

❀ Waste Management

❀ Smart City maintenance

❀ Digital-signage

❀ Water Management

❀ Smart Urban lighting

4

NATIONAL INFORMATION INFRASTRUCTURE (NII)

- Robust infrastructure through integration of networks and cloud
- Public Information Infrastructure for G2G, G2B, and G2C services
- Social services such as e-education, telemedicine, Financial Inclusion
- NII key components :

   Infrastructure : Cloud and connectivity up to village level

   Services : Platform for application service providers and users
- Integrate existing infrastructure like NOFN, NKN, SWAN, SDC, etc.
- Enhance storage & computing through GI Cloud (MeghRaj)
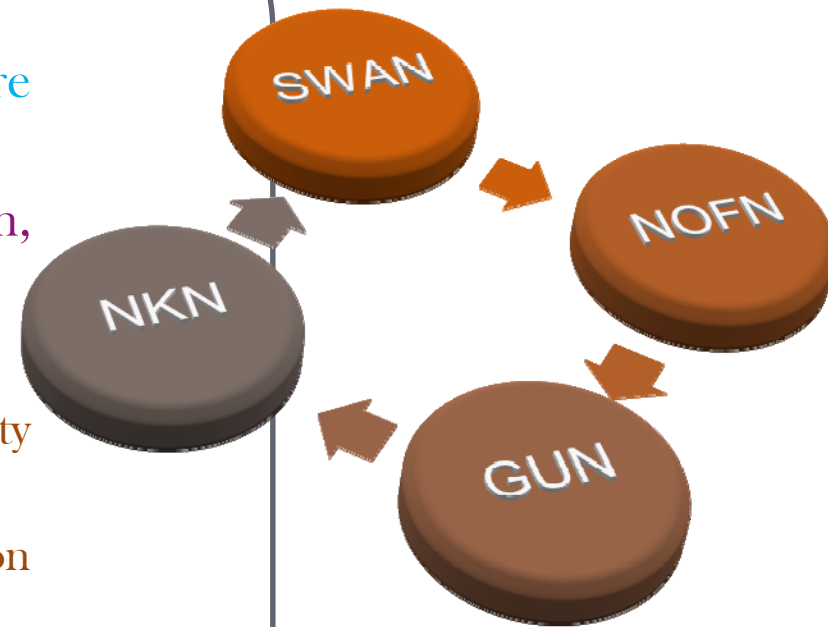
NATIONAL KNOWLEDGE NETWORK

- State-of-the-art multi-gigabit pan-India network
- Unified high speed network backbone for all knowledge related institutions in the country.
- 1635 Institutes already connected
- Envisaged applications are:
  - Countrywide classrooms,
  - Telemedicine,
  - E-Governance,
  - Grid technology .....
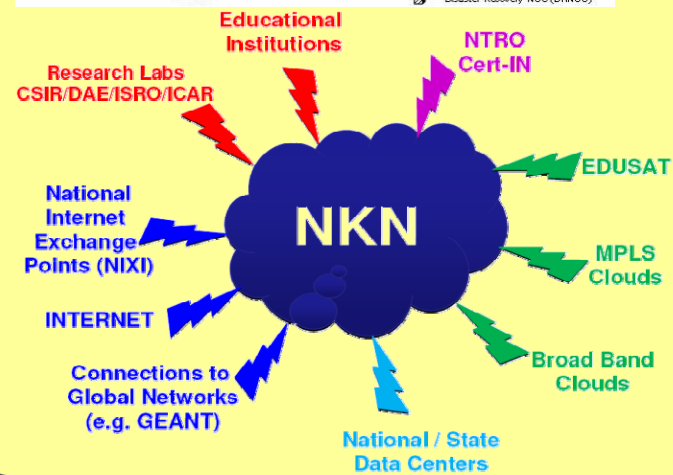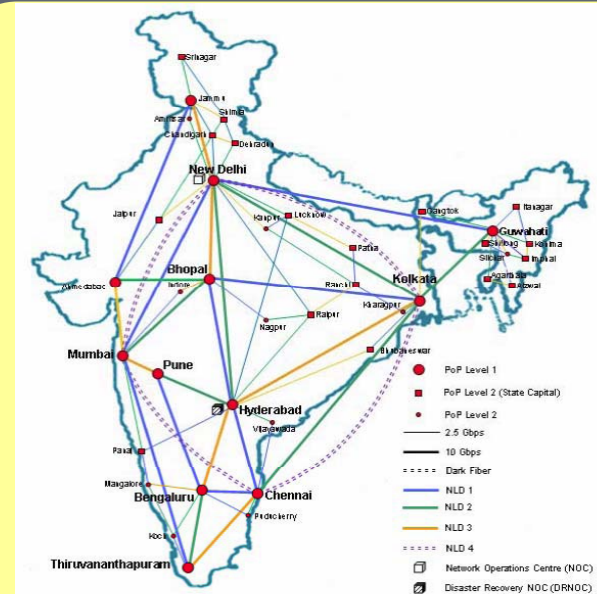
OTHER NETWORK INFRASTRUCTURES

- State Wide Area Networks
    - × Connects Govt Offices till Blocks
    - × Provide eGov services
    - × 7500+ PoPs upto Block Level
    - × Limited Bandwidth
- National Optical Fibre Network (NOFN)
    - × Block to GP Connectivity (2.5 Lakh GPs
    - × Serve citizens at GP level
    - × Laying 6 Lakh Km of OFC
    - × 100 Mbps bandwidth at each GP
- Government User Network (GUN)
    - × Service layer on NOFN for Govt. use
    - × District to Block Connectivity
    - × Last mile connectivity from GPs
    - × 10 Mbps bandwidth to each user

MEGHRAJ – THE GI CLOUD

❈ Cloud.gov.in

❈ 'GI Cloud' - Government of India's cloud computing environment that will be used by government departments and agencies at the centre and states

❈ Cloud computing environment at a national level

❈ A common repository of cloud - based infrastructure resources and applications available on a sharable basis

NATIONAL MONSOON MISSION

- Launched by Ministry of Earth Sciences (MoES), Govt. of India
- Execution and Coordination by Indian Institute of Tropical Meteorology, Pune
- In collaboration with National Centres for Environmental Prediction (NCEP), USA

NMM Objectives :

✂Building working partnership between the academic, R&D organizations and the operational agencies

✂Improve the operational monsoon forecast skill over the country

To set up a state of the art dynamic modeling framework for improving the prediction skill of:

a. Seasonal and extended range prediction system (16 days to one season)

b. Short to medium range prediction system (up to 15 days).

NATIONAL BIODIVERSITY INFORMATION OUTLOOK

- Launched by Ministry of Environment and Forests, Govt. of India
- Coordination by National Biodiversity Authority

✻ Biodiversity data – Enormous in size & nature

✻ NBIO goals
- Use of IT in collection, collation, analysis and dissemination of biodiversity data
- Facilitate and encourage progress in biodiversity informatics

http://nbaindia.org/blog/532/1/NationalBiodiversity.html

THIRTY METER TELESCOPE (TMT)

- Funded by **Departments of Science and Technology and Atomic Energy, Govt. of India**
- Participants: Indian Institute of Astrophysics (IIAP), Aryabhatta Research Institute of Observational Sciences (ARIES), Inter-University Centre for Astronomy and Astrophysics (IUCAA)

- India is a Full member of the project along with the U.S., Canada, Japan and China

- Located on Mauna Kea, Hawaii (13,290 ft. alt.)

- General purpose observatory -
  - Observations from near-UV, visible and mid-IR (0.31 to 28 µm wavelengths)

- 492 hexagonal mirror segments

- Collecting area of 650 m²
  - Compared to Hubble Space Telescope - 144 times the collecting area and ten times better spatial resolution at near IR wavelengths.

- India's role in setup
  - Create the control systems and software that keep the mirrors aligned and collects the data
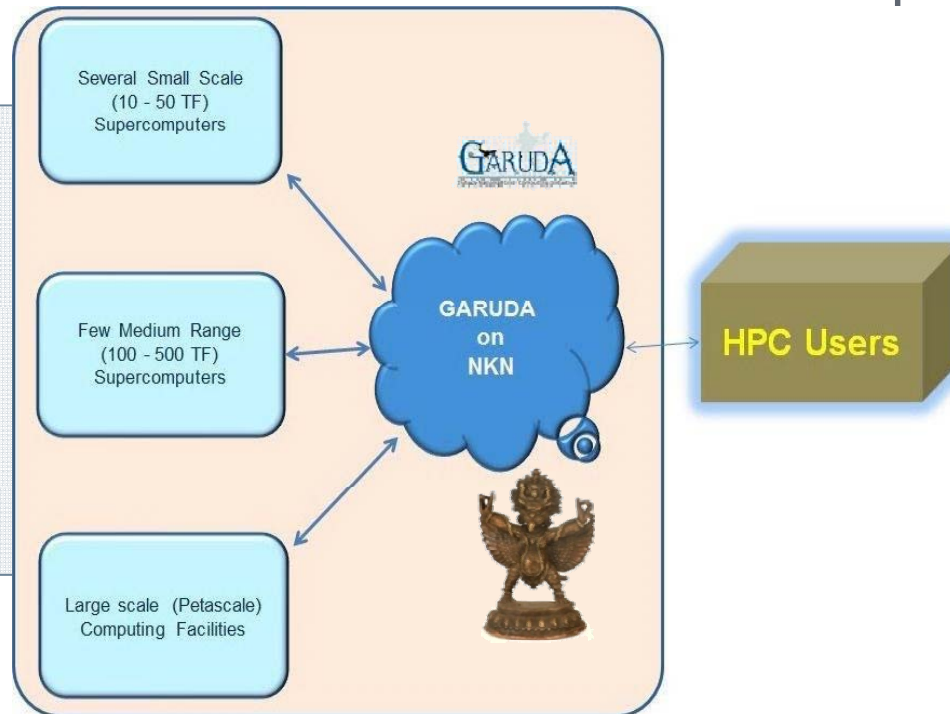
INDIA'S SUPERCOMPUTERS IN TOP500 AND GREEN500

Name	Top 500 Rank	Green 500 Rank	First Rank	Manufacturer	Total Cores	Rmax	Rpeak	Processor
IISc	133	168	79	Cray Inc.	31104	901506	1244160	Xeon E5-2680v3 12C 2.5GHz
IITM	193	239	36	IBM	38016	719220	790733	Xeon E5-2670 8C 2.6GHz
TIFR	264	152	114	Cray Inc.	11424	558800	730660	Intel Xeon E5-2680v2 10C 2.8GHz
IIT, Delhi	298	207	165	HPE	22572	524400	1170140	Xeon E5-2680v3 12C 2.5GHz
C-DAC	447	140	69	Netweb Technologies	30056	388442	520357.8	Xeon E5-2670 8C 2.6GHz

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Source: https://www.top500.org

NATIONAL SUPER COMPUTING MISSION

❈ Ambitious programme by : Dept. of S&T and Dept. Electronics and IT

❈ Seven-year mission aimed at raising India's ranking as a supercomputing power
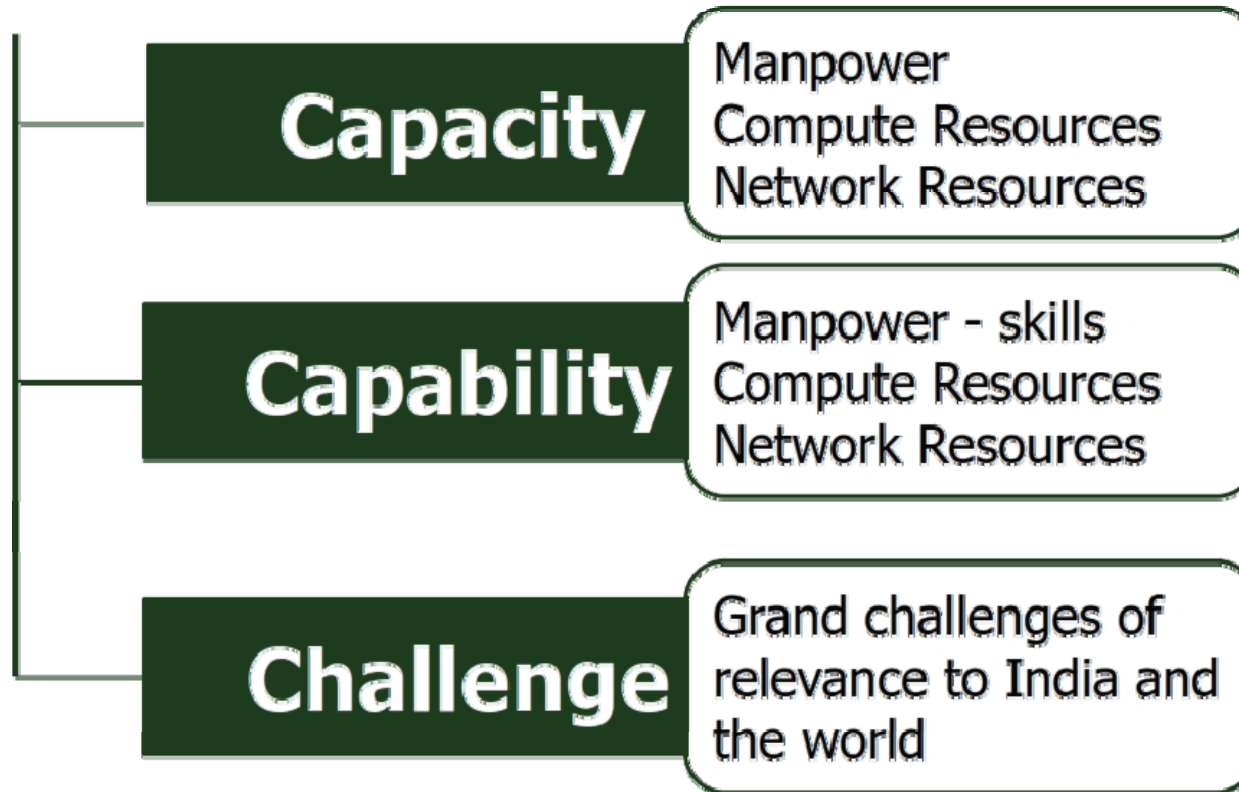
Supercomputing Grid:
✝ The Large Supercomputers
✝ The Midrange Supercomputers
✝ The Entry Level Supercomputers

Several Small Scale
(10 - 50 TF)
Supercomputers

GARUDA

Few Medium Range
(100 - 500 TF)
Supercomputers

GARUDA
on
NKN

HPC Users

Large scale (Petascale)
Computing Facilities

NATIONAL SUPERCOMPUTING MISSION
INFRASTRUCTURE | APPLICATIONS | R&D | HRD

Capacity
- Manpower
- Compute Resources
- Network Resources

Capability
- Manpower - skills
- Compute Resources
- Network Resources

Challenge
- Grand challenges of relevance to India and the world

Ministry of Electronics & Information Technology (MeitY)   &   Department of Science & Technology (DST)

INDIA TO UNVEIL 10PF SUPERCOMPUTER

� Indian Institute of Tropical Meteoroloty (IITM) and National Centre for Medium Range Weather Forecasting (NCMRWF) to build 10 Petaflop Supercomputer

✕ For Improving weather predictions and provide finer resolution and accurate forecasts

IITM's HPC Facility – AADITYA (790+TF system)

SWAYAM - STUDY WEBS OF ACTIVE-LEARNING FOR YOUNG ASPIRING MINDS

MOOC- A different educational space

Boundary less Institute / University

Massive - enrolment numbers

Open- no mandatory qualifications

Online - fully

Course - structured

is an online course aimed at unlimited participation and open access via the web.

The basic philosophy of MOOCs is **3A's** i.e., Anytime, Anyone, Anywhere.

SWAYAM – Programme initiated by Government of India and designed to achieve the three cardinal principles of Education Policy viz., Access, Equity and Quality

FREE ONLINE EDUCATION

swayam

शिक्षित भारत, उन्नत भारत

SWAYAM

Players

- ○ MOOC Platform MHRD
- ○ Massive courses across all subject domain
- ○ Courses from School to Universi
- ○ Certificate / Credit [By Regulators]

- ○ UGC
- ○ CEC
- ○ IGNOU
- ○ NPTEL
- ○ NCERT
- ○ NIOS, etc

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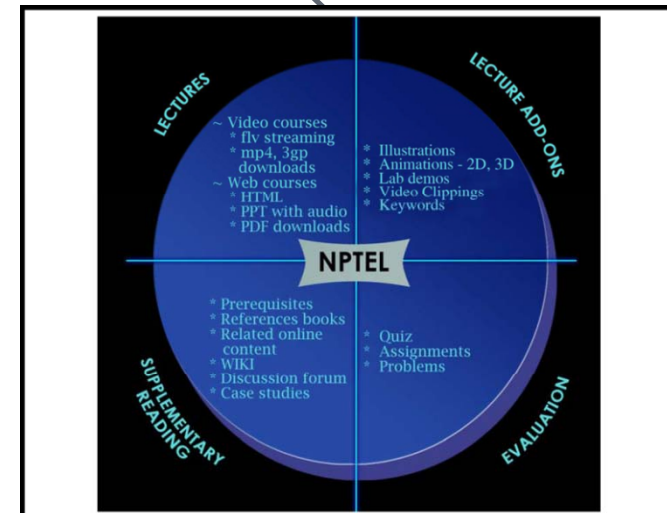# NATIONAL PROGRAMME ON TECHNOLOGY ENHANCED LEARNING (NPTEL)

✄ Enhance the quality of engineering education in the country by developing curriculum based video and web courses
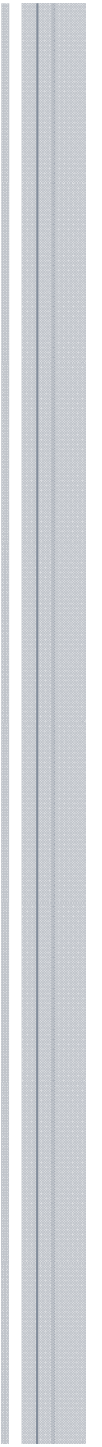
✄ 860+ Courses

✄ 16648 Videos

✄ 120 Million Views

✄ 3 Lakh+ subscribers

CENTRE FOR DEVELOPMENT OF ADVANCED COMPUTING - C-DAC

- Established in 1988
- Spread over 11 cities about 2750 employees
- R&D organization under Ministry of Electronics & Information Technology (MeitY)

Vision

To emerge as the premier R&D Institution for the design, development and deployment of world class electronic and IT solutions for economic and human advancement.

Mohali

Noida

Delhi

Silchar

Kolkata

Mumbai

Pune (HQ)

Hyderabad

Bengaluru

Chennai

Thiruvananthapuram

THEMATIC R&D AREAS OF C-DAC

- **High Performance, Grid & Cloud Computing** Hardware, Software, Systems, Applications, Research, Technology, Infrastructure

- Multilingual computing and heritage computing

- Professional electronics including VLSI & embedded systems

- Software technologies, including FOSS

- Cyber security & cyber forensics
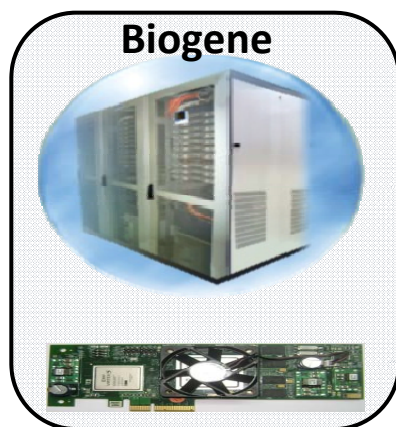
- Health informatics

- Education and training
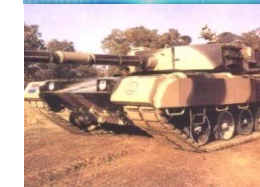
C-DAC'S NATIONAL HPC FACILITIES

NPSF @ Pune

CTSF @ Bangalore

Biogene

Biocrome System

Bioinformatics Resources & Applications Facility (BRAF), Pune

PARAM SHAVAK

× PARAM Shavak – Supercomputing in a Box

× 2 - 5 Teraflop compute power equipped with C-DAC's indigenous technologies and solutions for HPC applications

× Easy to deploy solution with no requirement of datacentre infrastructure

× Affordable solution for academic, scientific and research institutions that are on the verge of adopting HPC culture

× ONAMA and CHReME (C-DAC HPC Resource Management Engine) software tools included

× Powered with advanced accelerator based technology

C-DAC's PARAM Yuva II

Benchmarking:

- First Supercomputer in India to cross 500 TF mark
- Peak performance - 524 TF
- Performance per watt: 1850.16 Mflops / watt
- Top500 Rank: 447
- Green500 Rank: 140

Compute Node Configuration :

- 220 No.s (2 No.s of Compile nodes)
- Intel Server System R2208GZ4GC
- Dual socket
- Intel Xeon E5-2570
- Based on Intel Sandy Bridge Microarchitecture
- Made on Intel 32 nm Manufacturing process
- Oct core CPU with each core clocking at minimum 2.6 GHz and maximum 3.3 GHz with Turbo-on
- 20 MBytes L3 cache shared by all 8 cores
- Power consumption of 115 Watt/s
- 64 GBytes RAM(128 GBytes for 2 no.s of Compile nodes)
- 2 No.s of 180 GBytes Solid State Drives(SSD)

Co-processor Configuration Total :

- 440 Nos. of Co-Processors
- Intel Xeon Phi Co-processor 5110p - 2 Nos. per each Node
- 60 No.s of cores with each core clocking at 1.053 GHz
- Low power consumption IA cores connected in a Daisy chain
- ~1 TF theoretical performance
- 8 GBytes GDDR5 Memory
- Based on Intel Ivy Bridge Microarchitecture
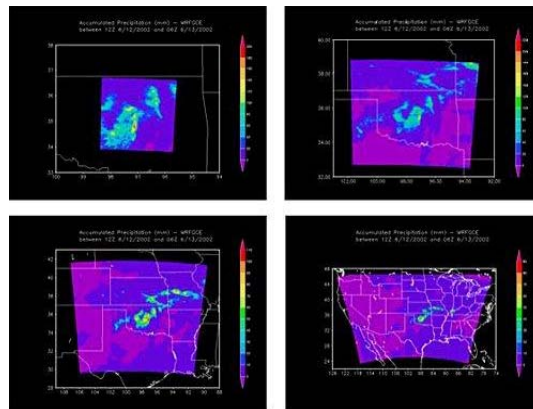- Made on Intel 22 nm Manufacturing process
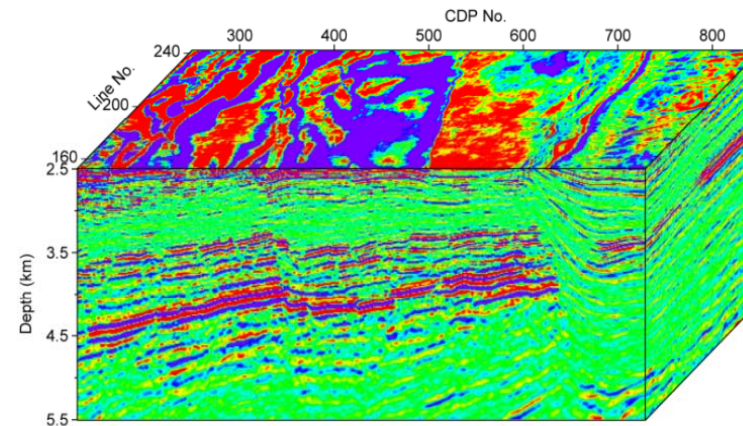
Applications on PARAM Yuva II
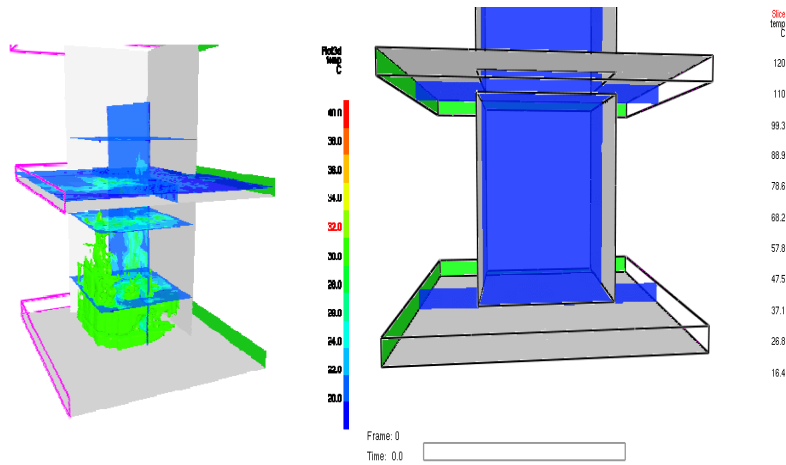
Computational Fluid Dynamics
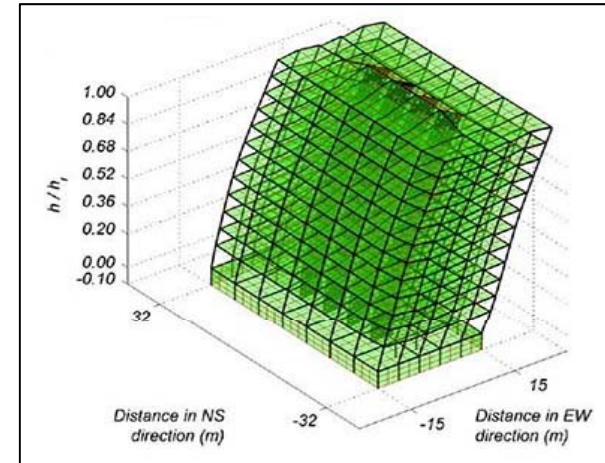
Earthquake Engineering

WRF in collaboration with ISRO

Seismic Data Processing

Applications and VO's

- Open Source Drug Discovery
- Disaster Management
- Computer Aided Engineering
- Climate Modeling
- Medical and Health Care
- Collaborative Learning
- Seismic Data Processing
- Computational Fluid Dynamics

Trainings/Workshops/Bootcamps

- Conducted 14 GARUDA Boot Camps during the last year at Pune, Chennai, Ahmedabad, Kannur, Hyderabad, Varanasi, Indore, Ropar, Chandigarh, etc

Tools & Services

- Grid Portal
- Grid Monitoring Tool
- Problem Solving Environments
- Workflows
- Visualization Gateway
- Indian Grid Certificate Authority (IGCA)
- Storage Resource Manager
- Grid to Cloud Interface

70+ Partnering Institutes

- Indian Institute of Astrophysics Includes:
- IITs
- Indian Institute of Science (IISc.)
- Physical Research Laboratory
- Jawaharlal Nehru University
- Vikram Sarabhai Space Centre
- Universities & Colleges

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Key Research Users of GARUDA Grid

✂ **Sri Shakthi Institute of Engineering and Technology (SSIET) Coimbatore, Tamilnadu, INDIA**

  Application: "Optimization of gas phase and crystal phase molecules" using the packages Gaussian 03 (32 bit Linux package) and MOLPAK/DMAREL (Linux version).

✂ **Department of Physics Periyar University, Salem, Tamil Nadu, INDIA**

  Application: Gaussian and AM BER based Bioinformatics experiments

✂ **Theoretical research group, H. P. T. Arts & R. Y. Science College, Nasik, India**

  Application: Material Science experiments

✂ **Laboratory of Mammalian Genetics Center for DNA Fingerprinting and Diagnostics (CDFD)**
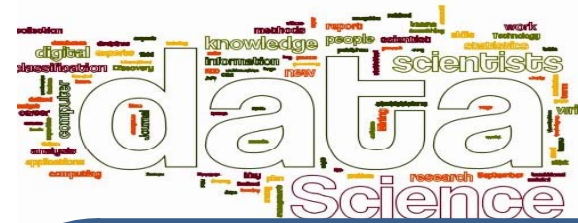
  Application: DNA-Protein interactions using Molecular Dynamics approach. System Size is "Protein-DNA complex of 9907 atoms"

✂ **National Institute for Research on Reproductive Health NIRRH (ICMR), Parel, Mumbai, India**

  Application: MD simulations

NSM HRD

(C-DAC's Parallel Computing Skill Development)

Big Data Analytics – Course contents

- Fundamentals of Linux Programming

- Statistical Analysis with R

- Data Collection and DBMS

- High Performance computing (HPC) and Cloud Computing & Operations

- Programming with Python

- Java with Scala

- Big Data Technologies

- Practical Machine Learning

- Data Visualization - Analysis and Reporting

- Business analytics

- Effective Communication & Aptitude

Think Parallel – Short term training

Syllabus:

- Advanced Computer Architectures
- Introduction to Parallel Programming
- Principles of Parallel Algorithm Design
- Building Compute Clusters
- Numerical Computing
- Programming Paradigms
- OpenMP
- Message Passing Interface (MPI)

- Performance Analysis and Debugging Parallel Programs
- Parallel Applications / Case Studies
- Accelerator programming (OpenCL/CUDA / OpenACC)
- Hybrid Parallel Programming on frontier Parallel Architectures
  (including HPC, Grid Computing & Cloud)
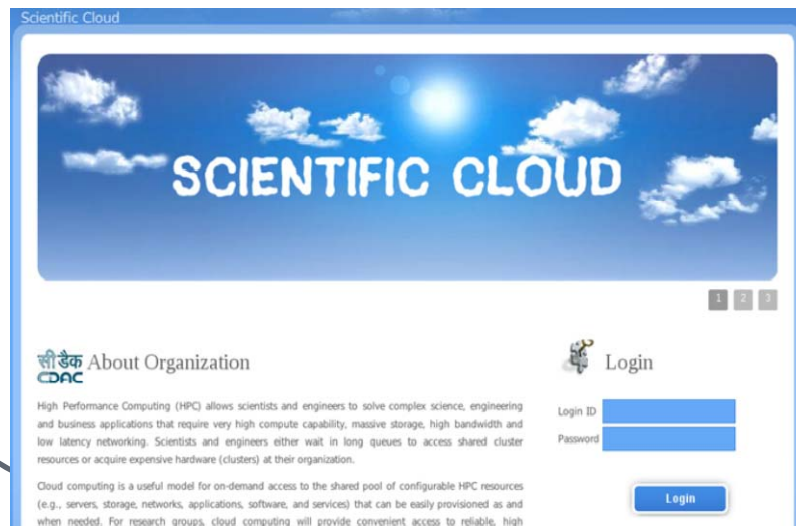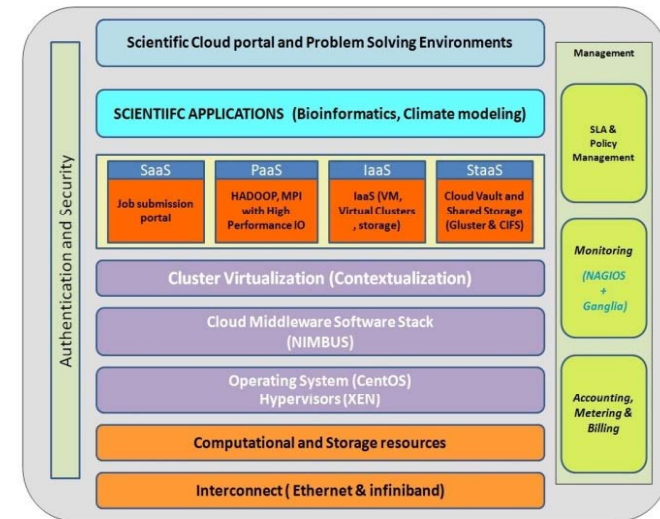
National Conference

SCIENTIFIC CLOUD : SUMEGHA HPC AS A SERVICE

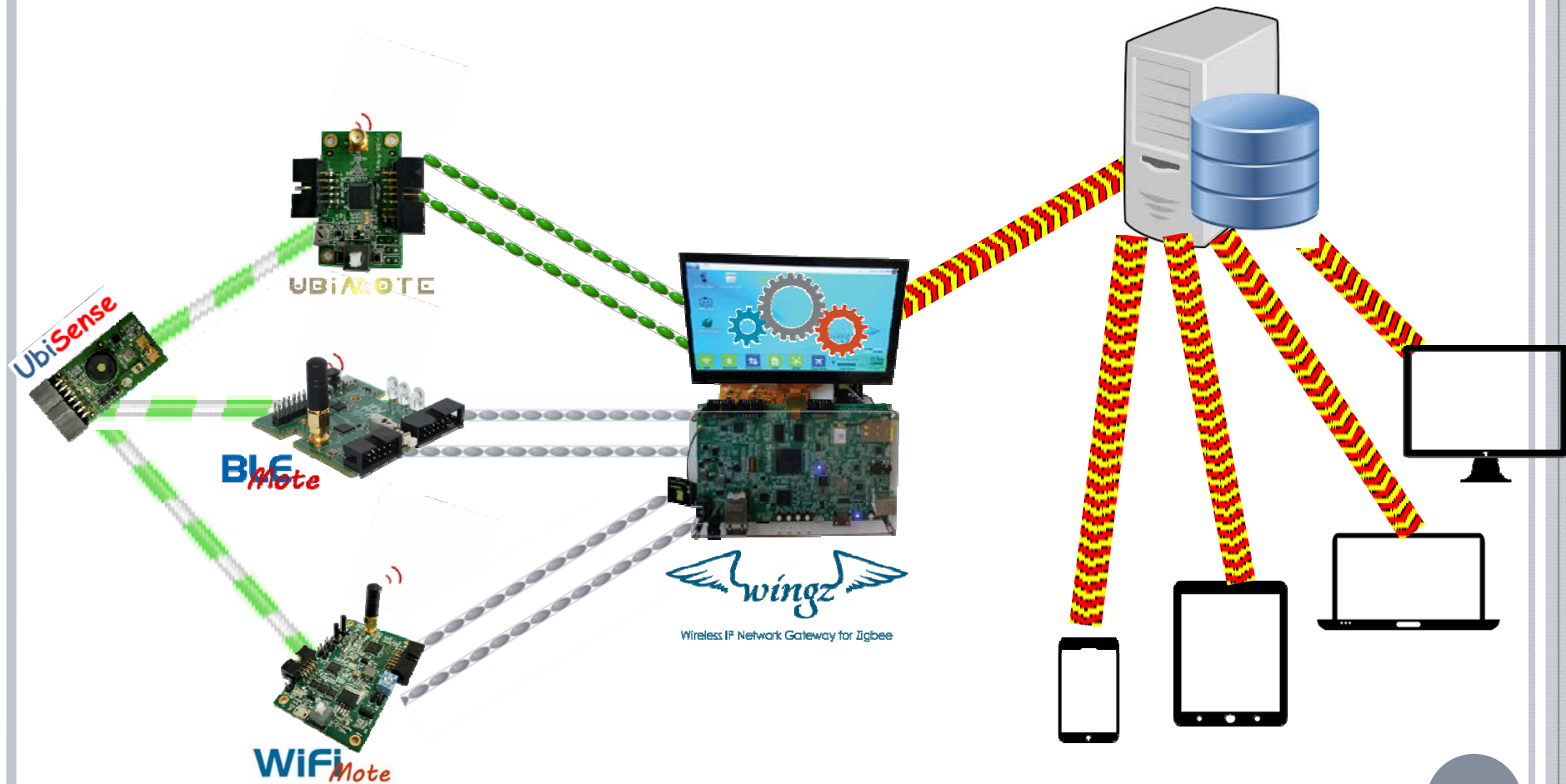## Services offered :

- ✳ IaaS : Virtual machines
- ✳ PaaS : MPI, HADOOP
- ✳ StaaS : Cloud vault
- ✳ SaaS : PSE, Job submission portal

C-DAC IOT PRODUCTS

UBiMOTE

UbiSense

BLE Mote

wingz
Wireless IP Network Gateway for Zigbee

WiFi Mote

IOT APPLICATIONS

Smart city Solutions

Early Fire Detection and safe exit guidance system

Proposed Architecture
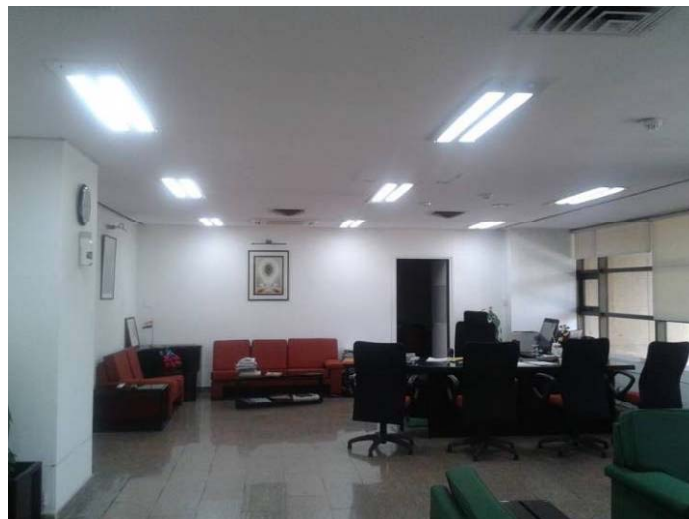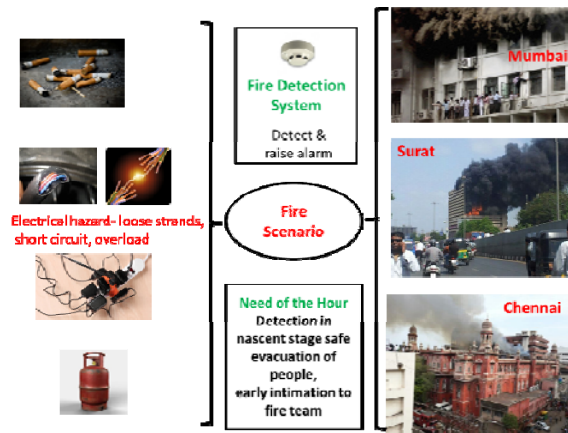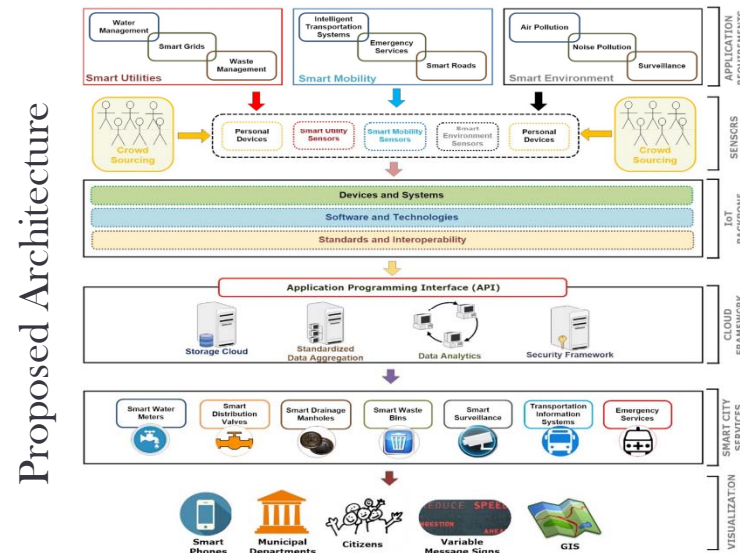
HaritaPriya - IoT for Agriculture

BIG DATA SOFTWARE SUITE (BDSS)
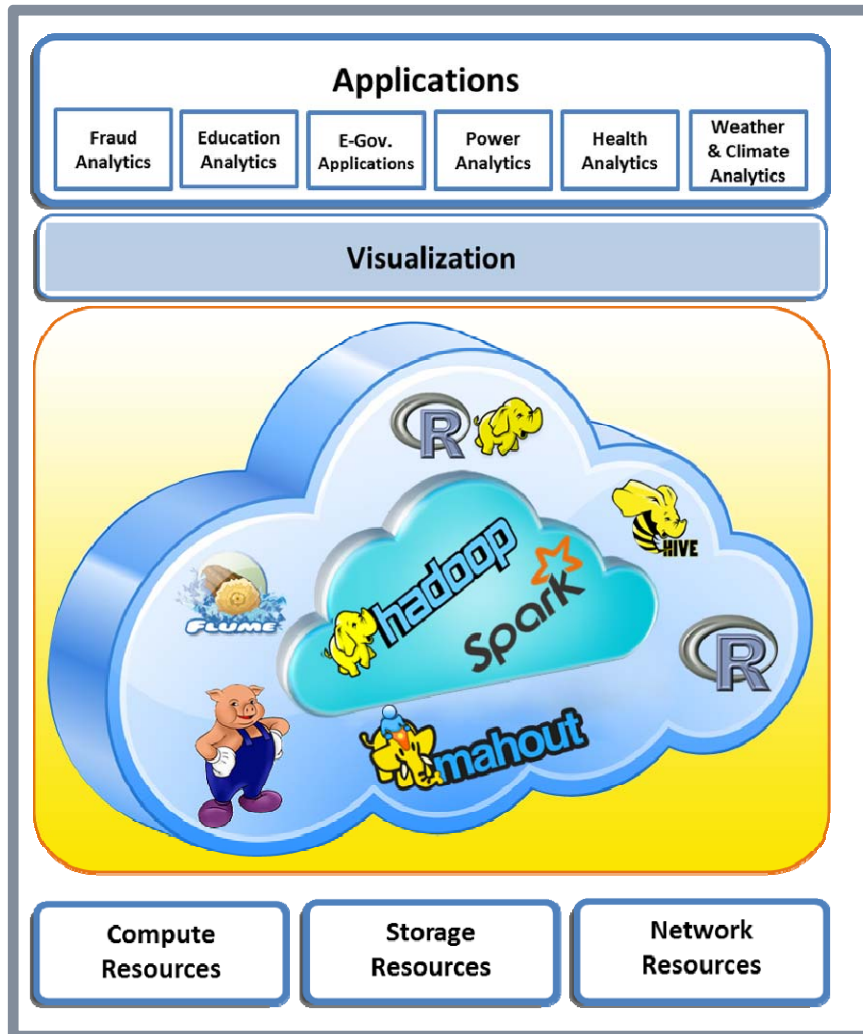
Core Capabilities

☐ Data Wrangling using R
☐ Hadoop based Analytics
☐ In-Memory Analytics using Apache Spark
☐ Stream Computing
☐ Data Mining using RHadoop
☐ Machine Learning using Spark MLlib
☐ Visualization and Discovery

Advantages

☐ Abstracts the complexity involved in setting up Big Data environment
☐ Customizable to deploy user's application

Anuman
Real Time Weather System

This site gets updated daily in the afternoon

Search: Type Location Name

Daily Rainfall

Hourly Rainfall

Maximum Temperature

Minimum Temperature

Mean Sea Level Pressure

Relative Vorticity

Temperature ▶

Dew Point Temperature ▶

Eqv. Potential Temperature ▶

Winds ▶

Relative Humidity ▶

Maximum Reflectivity

Stability Indices ▶

Location Forecast

Select State: KARNATAKA ▼   Select District: Bangaloreurban ▼   Select Location Name: Bangalore ▼

Three days forecast for **Bangalore** issued on 00UTC 28 FEB 2017

28 FEB 2017	01 MAR 2017	02 MAR 2017
Clear Sky	Clear Sky	Partly cloudy sky
MAX / MIN 29.8°C / 16.9°C	MAX / MIN 30.2°C / 17.3°C	MAX / MIN 30.2°C / 16.3°C
more...▼	more...▼	more...▼
view 6-hourly forecast	view 6-hourly forecast	view 6-hourly forecast

Hourly rainfall forecast for next three days

Hourly Acc. Rainfall (mm)

10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0

5:30AM 28 FEB   5:30PM 28 FEB   5:30AM 01 MAR   5:30PM 01 MAR   5:30AM 02 MAR   5:30PM 02 MAR

Time (IST)
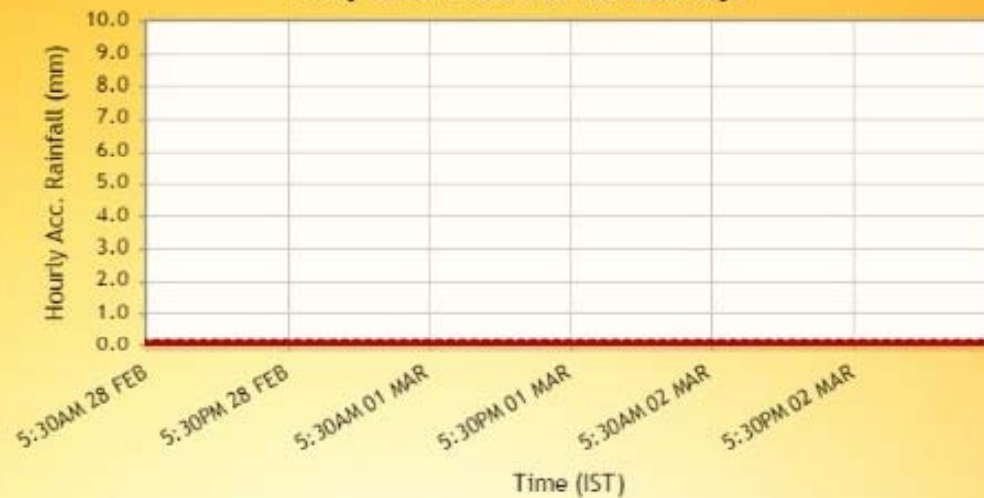
HYBRID COMPUTING

� **System platform consisting of**

  × Heterogeneous multi-cores

  × GPUs

  × FPGAs

  × Special purpose application specific processors

Fig: Cluster Architecture

✖ **Develop System software components and domain specific kernels for the hybrid architecture**

  • Hybrid Scheduler

  • Hybrid Monitoring & Management

  • OpenCL Generator

  • Hybrid IDE

  • Hybrid Runtime

  • Hybrid Debugger
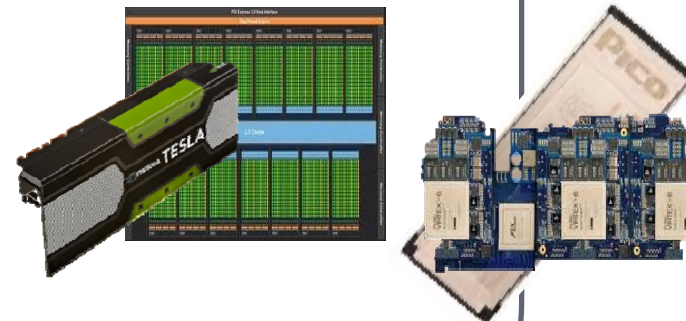
MULTILINGUAL COMPUTING AND HERITAGE COMPUTING

- Enablement of ".भारत" top level inter-national domain for 8 languages viz. Hindi, Marathi, Sindhi, Nepali, Maithili, Bodo, Dogri and Konkani

- Application Localization: Crowd Sourced LPMF

- Machine Aided Translation: Solutions such as MANTRA, AnglaBharti and MaTra for English to other Indian Languages

- Speech Technologies: Text to Speech, Speech-to-text, Speech-to-Speech translation systems, and Text-to-Braille system

- Indian Languages on Embedded Devices: Indian languages on mobile phones, Set-top-boxes, printers, cameras, etc.

- JATAN: Virtual Museum Builder for all national museums

- Evolved Standards for Indian Languages and Digital Preservation Standards

Online Handwritten Character Recognition
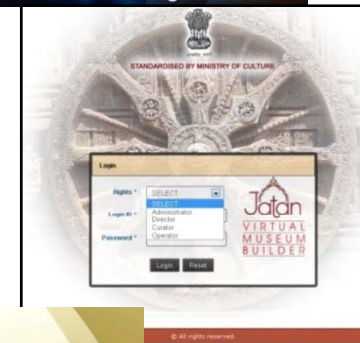
PROFESSIONAL ELECTRONICS

- ✂ VLSI and Embedded System
    - ✂ Microprocessors, IPs
    - ✂ SoC products for smart card, biomedical, etc.
- ✕ Power Electronics
    - ✂ Power Quality Improvement, Inverters and Converters
    - ✂ Electric Traction, Electric Vehicles, Automotive Electronics
- ✕ Intelligent Transportation Systems and Communications
    - ✂ Wireless Traffic Control System (WiTraC)
    - ✂ Red Light Violation Detection System
    - ✂ TETRA, SDR
- ✕ Medical and Agri Electronics
    - ✂ Wireless Digital stethoscope and Wireless ECG
    - ✂ Electronic Nose, Vision and Tongue
- ✕ Next Generation Control System, Strategic Electronics, Smart Grid and Smart Card
- ✕ Technology transfers carried out recently
    - ✂ Digital Programmable Hearing Aid, Pebrine-O-Scope, Handheld Electronic Nose (HEN) and Internet of Things (IoT)

Wimax Base station

SOFTWARE TECHNOLOGIES

- Bharat Operating System (BOSS): GNU/Linux based Operating System with Indian Language support. About 3.2 million deployments of BOSS carried out across various states including Government and defence agencies.

- Mobile Seva Platform: Integrated 2543 government departments

- e-Hastakshar: C-DAC's eSign service which is an on-line platform to citizens for instant signing of their documents securely. The same was launched by Hon'ble Minister of Electronics and IT on September 03, 2016

- National Voters Service Portal (NVSP): National electoral roll search, Registration With 84 crores voter's data and 2.2 billion hits, it is a one-stop solution to assist voters, to provide online services like of new voter, Registration of overseas voter, etc. National Electoral Roll Purification (NERP) programme to correct errors in electoral rolls was launched on July 18, 2016.

- "Online Labs" (OLabs): OLabs for CBSE based School Lab experiments was launched by Shri. Ravi Shankar Prasad, Hon'ble Union Minister for Communications and Information Technology on December 28, 2015.
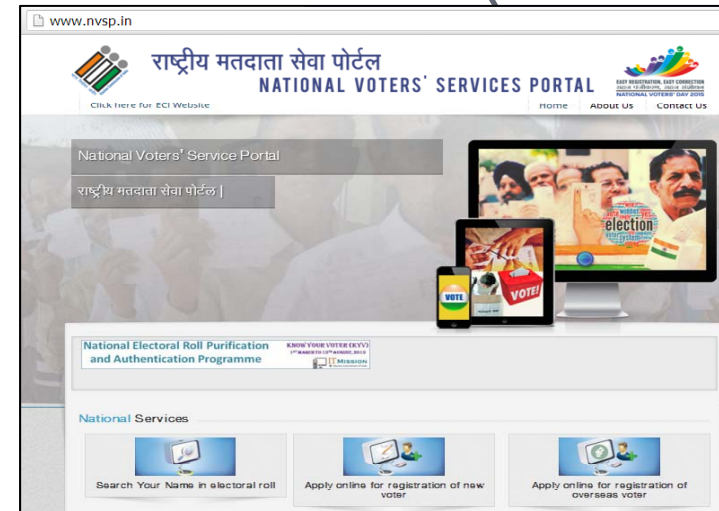
CYBER SECURITY AND CYBER FORENSICS

❀ Cyber Forensics Solutions

  ⨯ Device Forensics, Network Forensics and Disk Forensics

  ⨯ Licensed to various customers and Cyber Forensics Facility created in various states

❀ Network Security Solutions such as Guard Your Network; Dynamic Firewall are developed and put to use

❀ End-Point Security - Mobile Security, USB Pratirodh, Application Whitelisting and Application Device Control

❀ SCADA Security, Biometric Solutions,

❀ Large number of Information Security and Digital Signatures & PKI Awareness workshops are conducted nation-wide
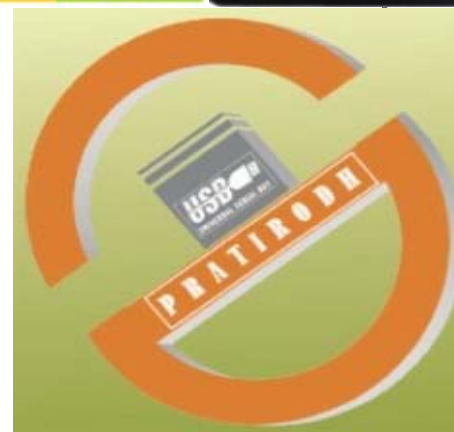
HEALTH INFORMATICS

- e-Sushrut - HIMS: Being implemented in Government Hospitals of Rajasthan, Maharashtra, Odisha and Andhra Pradesh

- e-Aushadhi - Web based Supply Chain Management solution - Deployed in the states of Andhra Pradesh, Telangana, Madhya Pradesh and Gujarat

- Telemedicine Solutions- Developed and Deployed Telemedicine technology across several states within India and abroad.

- E-Health Solutions
- Supply Chain Management for Drug Distribution
- Blood Bank Management System
- AyuSoft and CerviSCAN
- MOSQUIT: Disease Surveillance system for Malaria

- DICOM/HL7/ SNOMED-CT Standards for EHR and EMR

Sanjeevani +

MERCURY Web Interface
C-DAC's Integrated Telemedicine Solution

MoSQuIT™
Mobile based Surveillance Quest using IT

INDIA DEVELOPMENT GATEWAY

Harnessing the strength of collective wisdom for development

What is being offered in Vikaspedia

- Multilingual, multi-sectoral, interactive knowledge platform that enables collaborative content creation

- E-Learning Courses

- Mobile Apps

- Multimedia products

- Value Added Services
  - Ask an Expert, MOTHER, e-Vyapar etc.

- Capacity building of development stakeholders – digital for knowledge access & sharing in regional languages

- Outreach at state / district and community level

Outcome study – August 2016

- User base - 68% (rural), 32% (urban)

- Age group – 72 % (21-40 years), 19% (40-60 years)

- Categories - 62 % (self-employed entrepreneurs), Students (33%)

- Access – 24% (Desktop), 72% (mobiles)

- Frequency of visit – 46 % (daily), 36 % (Weekly once)

- Information – 59 % (Policies & schemes), 43 % - self-employment related content.

- Content – Reg. language preference – 73%, Eng – 27%

- Services – Mobile apps (70%), GK quiz, VLE corner, AAE

- User satisfaction – 40 % (Got all info reqd), 28 % (Got most), 29% (Got some), 3 % (Got nothing)

- Referring Vikaspedia to others – 50 % to > 5 people, 35 % (>10)

INTERNATIONAL PRESENCE

PROJECTS

※ Tripartite MoUs with Russian Agencies on HPC and Technologies for Navigational Satellites

※ C-DAC PARAM based HPC facility at HUST in Hanoi, Vietnam

※ India - Kazakhstan Centre of Excellence in ICT at ENU in Astana

※ Language Lab & E-Resource Centre at Yangon & Nay Pyi Taw, Myanmar

※ Centre's of Excellence in Cambodia, Laos, Myanmar & Vietnam under funding from ASEAN

※ Central Asia e-Network (India -Tajikistan, Uzbekistan, Turkmenistan, Kazakhstan & Kyrgyzstan)

※ Centre of Excellence in ICT at INICTEL-UNI in Lima, Peru

※ Centre of Excellence in ICT at UTN in Ibarra, Ecuador

※ India - Palestine Centre of Excellence in ICT at Al-Quds University, Abu Dis & Digital Learning & Innovation Centre in Ramallah, Palestine

※ Computer Labs in 50 Schools under Vayots Dzor region in Armenia

※ Centre of Excellence in IT at INADEH in Panama City, Panama

※ Centre of Excellence in IT at State Collage in Roseau, Dominica

※ Centre of Excellence in IT at UTN in Alajuela, Costa Rica

※ Computer Laboratories in 37 Schools in Tajikistan

※ Telemedicine network in Armenia

※ Strengthening of India-Myanmar Centre for Enhancement of IT skills at UCSY in Yangon, Myanmar

※ Telemedicine Network in Kyrgyzstan (under Central Asia e-Network)

PROMINENT INTERNATIONAL PROJECTS (CONTD..)

- Sustainable IT Infrastructure for Advanced IT Training using conventional, virtual classroom and e-Learning Technologies in Cambodia, Laos, Myanmar & Vietnam/ASEAN

- ICT Resource Centre at Nelson Mandela African Institute of Science & Technology at Arusha, Tanzania

- E-Library in Bhutan

- E-Library in Nepal

- Centres of Excellence in IT in 14 Pacific Island Countries

- Upgradation of IT Infrastructure & associated software at CARICOM Secretariat in Guyana

- Strengthening of India – Tanzania Centre of Excellence in ICT at DIT in Dar es Salaam, Tanzania

- Centre of Excellence in IT at Cairo in Egypt

- Centre of Excellence in IT at Casablanca, Morocco

- Collaboration with UIIP-NAS in Belarus for cooperation in advance areas of IT

- Appointment of AITI-KACE in Accra, Ghana as ATC of C-DAC

CONCLUSION

- ❀ e-Science in India is rapidly advancing
- ❀ Many cyber-infrastructures are in place
- ❀ C-DAC is playing an active role in the country's S&T charter
- ❀ Way forward - Building infrastructures for next generation e-Science through global collaborations

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Success is not a destination but the road you are on..

Applying Advanced Computing for Human Advancement

Thank You

In Observance of International Women's Day on 8th March, dedicating this presentation to my Women colleagues at C-DAC Bangalore..

sarat@cdac.in

Few Bioinformatics Initiatives in India

Research & Development:
- Indian scientists decode **Tulsi plant genome** and unravels key genes behind its strong medicinal properties (Multi-institutional project led by NCBS, Bangalore)
- ICMR sets up consortium to tackle tuberculosis and is adopting genomics to tackle malaria
- C-DAC has set up a high-throughput genome analysis facility (MeitY)
- GoBii - Global Open-source Breeding Informatics Initiative (ICRISAT)

Few Computational facilities for Bioinformatics activities in India
- Bioinformatics Resources & Applications Facility (BRAF) @ C-DAC
- National Agricultural Biocomputing Portal @ Indian Agricultural Statistics Research Institute (ICAR)
- Supercomputing facility for Bioinformatics and Computational biology @ IIT Delhi

At C-DAC KP
- Protein Kinases are considered as potential drug targets for cancer treatment. Large-scale data analysis using HPC to identify, annotate and classify kinases based on their sequence and structural information
- Big Data Platform is developed for Graph-based Pharmacogenomics data
- Use of machine learning approaches to find genetic diversity

DIGI-DHAN ABHIYAN

� **Digital Payments Awareness Campaign**

✖ The initiative plans to enable consumers and merchants to undertake real time digital transactions

✖ **Digital mode of banking more convenient than the cash-based traditional banking**

✖ RuPay

✖ AEPS

✖ UPI

✖ USSD

✖ BHIM

Super Computing, Big Data, Cloud Computing

C-DAC'S BIG DATA SOFTWARE SUITE (C-BDSS)

- - Integrated package of open source Big data tools – Hadoop ecosystem tools, Spark and R.
- - Rapid Big Data analytics Platform, easy to use by novice users for data exploration, visualization and analysis.

Extreme Scale Machine Learning Libraries Development

- -Development of parallelised ML libraries tailored for performance and ease of integration in scientific applications such as in Astrophysics, Climate Sciences, and Biology/ Bioinformatics.

Data Science & Big Data Analytics Capacity Building Training Programs & Workshops

-Short term Training Programs on Data Science & Big Data Analytics, Big data Tools & technologies
- PG Diploma in Big Data Analytics (6 months)