





e - Science Activities in India

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National **Knowledge** Network



India – Emerging Super Power in S&T

- India among the topmost countries in scientific research
- Mangalyaan Mars Mission Success on Debut - Among the top five nations Aggressively working towards establishing India as a leader in S & T



ESDM Make in India Initiative



National Monsoon Mission



MISSION



MISSION TRANSFORM-NATION













C - DAC







Thematic Areas of C – DAC

Thematic R&D Areas:

- HPC, Grid & Cloud Computing
- Software technologies including FOSS
- Multilingual computing and heritage computing
- Professional electronics, VLSI and Embedded Systems
- Cyber security & Cyber forensics
- Health informatics
- Big Data Analytics
- Education and Training











NATIONAL SUPERCOMPUTING MISSION



Indian Heritage Port



India's National Grid Computing Initiative



Infrastructure and Capacity Building





- 7-year Program
- self reliance global Attain and competitiveness
- Building Capability and Capacity 111 Supercomputing
- A 3-Tiered approach
- Major areas – System Software, Applications, R&D, Capacity Building (20000+),Industry oriented applications
- Readiness for Exa-scale systems
- Implementing Agencies: C-DAC & IISc





HPC Users

National Supercomputing Mission (NSM)

- **Application Areas**
- Climate modeling & Weather prediction
- Computational biology
- Atomic energy simulations
- Security and Defense
- Disaster management
- Computational chemistry
- Discoveries beyond Earth
- Big Data Analytics
- Government Information Systems



C-DAC in NSM

- System software solutions for Hybrid computing
 - Grid Computing
 - Think parallel Paradigm & Parallel Programing Centre
 - Parallelization of codes
 - Hardware (FPGAs)
 - Power optimization solutions

Super Computing Infrastructure in India

Rank Site

3

5

Pune

System

<u>Supercomputer Education and</u> <u>Research Centre (SERC), Indian</u> <u>Institute of Science (IISc)</u> , Bangalore	Cray XC-40 Cluster (1468 Intel Xeon processor CPU-only nodes, 48 [Intel X core processor+Intel Xeon Phi 5120D @ 2.4 Ghz single twelve-core process Cray Aries Interconnect. HPL run on OEM: Cray Inc., Bidder: Cray Supercomputers India Pvt.
<u>Indian Institute of Tropical</u> <u>Meteorology, Pune</u>	IBM/Lenovo System X iDataPle DX3 Infiniband FDR OEM: IBM/Lenovo, Bidder: IBM India Pvt. Ltd.
<u>Indian Lattice Gauge Theory</u> <u>Initiative</u> , Tata Institute of Fundamental Research (TIFR), Hyderabad	Cray XC-30 cluster (Intel Xeon E5-20 core NVIDIA Kepler K20x GPU nod OEM: Cray Inc., Bidder: Cray Supercomputers India Pvt.
<u>Indian Institute of Technology.</u> <u>Delhi</u>	HP Proliant XL230a Gen9 and XL25 2680v3 @ 2.5 GHz dual twelve-core K40 GPU nodes) w/Infiniband OEM: HP, Bidder: HP
Center for Development of Advanced Computing (C-DAC), Pune	Param Yuva2 System (Intel Xeon E5- core CPU and Intel Xeon Phi 5110P of w/Infiniband FDR

OEM: Intel, Bidder: Netweb Technologies

	Cores/Processor Sockets/Nodes	Rmax (TFlops)
n E5-2680 v3 @ 2.5 GHz dual twelve-core Xeon E5-2695v2 @ 2.4 Ghz single twelve- D] Xeon-phi nodes, 44 [Intel Xeon E5-2695v2 sor+NVIDIA K40 GPUs] GPU nodes) w/ only 1296 CPU-only nodes. Ltd.	36336C + 2880ICO + 126720G/ 3028C + 48ICO + 44G/ 1560C + 48ICO + 44G	901.51 (CPU-only)
360M4, Xeon E5-2670 8C 2.6 GHz,	38016/ /	719.2
680 v2 @ 2.8 GHz ten-core CPU and 2688- les) w/Aries Interconnect Ltd.	4760C + 1279488G/ 476C + 476G/ 476C + 476G	558.7
<u>0a Gen9 based cluster (Intel Xeon E5-</u> CPU and dual 2880-core NVIDIA Kepler	10032C + 927360G/ 836C + 322G/ 418C + 161G	524.40
<u>-2670 (Sandy Bridge) @ 2.6 GHz dual octo-</u> dual 60-core co-processor nodes)	3536C + 26520 ICO/ 442C + 442 ICO/ 221C + 221 ICO	388.44















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	Super	Super Computing Infrastructure in India				
Rank	Site	System	Cores/Processor Sockets/Nodes	Rmax (TFlops)		
6	<u>CSIR Fourth Paradigm Institute</u> (CSIR-4PI). Bangalore	HP Cluster Platform 3000 BL460c (Dual Intel Xeon 2.6 GHz eight core E5-2670 w/Infiniband FDR) OEM: HP, Bidder: HCL Infosystems Ltd.	17408/2176/1088	334.38		
7	<u>National Centre For Medium</u> <u>Range Weather Forecasting</u> , <u>Noida</u>	IBM/Lenovo System X iDataPlex DX360M4, Xeon E5-2670 8C 2.6 GHz, Infiniband FDR OEM: IBM/Lenovo, Bidder: IBM India Pvt. Ltd.	16832/ /	318.4		
8	<u>Indian Institute of Technology.</u> <u>Kanpur</u>	Cluster Platform SL230s Gen8, Intel Xeon E5-2670v2 10C 2.5 GHz, Infiniband FDR. OEM: HP, Bidder: HP	15360/1536/768	295.25		
9	<u>Vikram Sarabhai Space Centre</u> (VSSC), <u>Indian Space Research</u> <u>Organization</u> (ISRO, Trivandrun	<u>HP and Wipro Heterogeneous Cluster (dual Intel Xeon E5530 quad core and dual</u> <u>Intel Xeon E5645 hexa core CPUs, and dual 448-core NVIDIA C2070 and dual</u> <u>512-core M2090 GPUs) w 40 Gbps Infiniband network</u> OEM: HP&Wipro, Bidder: HP&Wipro	3100C + 301824G/ 640C + 640G/ 320C + 320G	188.7		
10	Tata Consultancy Services Pvt. Ltd., Pune	HP Cluster Platform 3000 BL460c (Dual Intel Xeon 3 GHz quad core E5365 (Clovertown) w/Infiniband 4X DDR) OEM: HP_Bidder: HP	14400/3600/1800	132.80		













Information Highways in India





National Knowledge Network (NKN)

- State-of-the-art multi-gigabit pan-India network.
- Connect the Institutions engaged in the generation and dissemination of knowledge in various areas.
- I,574 Institutes already connected (As on 9-3-16)
- Envisaged applications are:
 - o Countrywide classrooms,
 - o Telemedicine,
 - E-Governance,
 - o Grid technology

GARUDA Grid (C-DAC) connected using NKN





Multiple 2.5/10 G Connecting all the State Capitals & Gigabit Connectivity to all the Districts



Other Networks

State Wide Area Networks

- Connects Govt Offices till Blocks
- Provide eGov services
- 7500+ PoPs upto Block Level

National Optical Fibre Network (NOFN)

- Block to GP Connectivity (2.5 Lakh GPs)
- Laying 6 Lakh Km of OFC
- **100 Mbps bandwidth** at each GP

Government User Network (GUN)

- Service layer on NOFN for Govt. use
- Last mile connectivity from GPs Ο
- **10 Mbps bandwidth to each user**



National Information Infrastructure Robust infrastructure through integration of networks and cloud Public Information Infrastructure for G2G, G2B, and G2C services Social services e-education, telemedicine, **Financial Inclusion** Integrate existing infrastructure like NOFN, NKN, SWAN, SDC, etc Enhance storage & computing through GI Cloud (MeghRaj)



Major Collaborative e-Science Projects in India





Indian Space Research Activities

- Mars Orbiter Mission (MOM)
- 21 satellites were launched in 2015
 - Foreign 17 (France, UK, USA, Canada, Singapore, Indonesia etc.)

Indian - 4

- PSLV-C29 has launched six satellites of **Singapore** into the orbit
- Astrosat space observatory Took India to a selected group of Nations - US, Russia, Japan and Europe
- Chandrayaan 2 and Mangalyaan 2





Indian Space Research Organization (ISRO)'s PSLV C 29 carrying six satellites of Singapore



National Monsoon Mission (NMM)

Prediction of monsoon rainfall variability is crucial for: Agriculture, Water resources management, Power generation and Natural ecosystems

NMM Objective:

- Improve the operational monsoon forecast skill over the country (Duration: 2012-2017).
- Building partnership among the academic, R&D organizations and the operational agencies

C-DAC's Contribution:

- Porting Climate models on to different computing architectures (Little endian & Big Endian)
- Application enablement on Cloud and Grid







- Initiative companies encourage to manufacture their products in India
- **Objective:** Make India as renowned manufacture hub in the world – 25 Sectors were identified
- Job creation, Skill enhancement
- Six industrial corridors
- **C-DAC's Products:**
- IOT hardware products (Motes, Gateways)
- Smart homes technologies
- Cyber Security products, COPS (Scada, STOA, MPG etc.), Genesys (A traffic generator)

Make in India



to



Automobile



Electrical Machinery



Electronic Systems



IT & BPM



Pharmaceuticals



Space







- To transform India into digitally empowered society and knowledge economy
- Focus is on making technology central to enabling change
- Programme Umbrella covering many departments

3 Pillars :

- Infrastructure as utility to every citizen Ο
- Governance and services on demand \bigcirc
- Digital empowerment Ο

Digital India Vision



C-DAC's Digital India solutions

- e-Saadhya, e-Shradha and e-GAP
- AR- Board & AR-Book
 - Digital Signatures & PKI, Digital Locker
 - PG level lab kits for SCADA, Cloud, IOT, Mobile Computing
 - Research lab development environments
 - Knowledge Dissemination









- Development of Smart Cities by leveraging IoT and M2M communications (PPP Model)
- 100 Cities were chosen (20 in 1st Phase)
- Foreign Collaborations: Germany, US, Spain, Singapore

Critical Pillars of the Program:

- Governance
- Energy
- Environment
- Transportation

- IT & Communication
- Buildings
- Education
- Health & Hospitals

Smart Cities Mission









Smart Cities Network









Basic Requirements:

- Infrastructure for connectivity wired/wireless • A New Initiative proposed to develop Networks - NKN, NOFN, NSM, NMEICT etc. **IOT based systems and solutions** for Smart cities by C-DAC. Addressability (unique identity) – IPv6, …
- Early fire detection and safe exit Data collection, organized storage, and retrieval guiding system systems – Warehouses, Clouds, ...
- Metro Mitra **Data Analytics** – Results that give maximum benefit
- Useful Applications and Services contextual and decision oriented - Form personal information management to smart cities

Smart Cities...



C-DAC Partic	ipation
	pation





IOT in Smart Cities Mission

Early Fire Detection & safe exit guidance system



Need of the Hour in Smart Cities







Smart City Solutions



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- identification every citizen Unique Biometric and Demographic details of all the citizens
- Enrollment Volume:
 - 125 million UIDs, 5MB per citizen
 - ~15 PB of data
 - 30 TB I/O every Day
- huge data center and high Requires performance computing resources
- Data Analytics built over Hadoop Clusters
- e-Health system using Aadhar

AADHAR



Components of UIDAI System

- Multi-modal de-duplication in the enrolment server
- Verification subsystem within the authentication server
- Enrolment client
- Manual checks and exception handling
- Biometric sub-system monitoring and analysis.





Thirty Meter Telescope

- 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 10 times better spatial resolution
- India's role in setup: Create the control systems and software that keep the mirrors aligned and collects the data





Electronic Systems Design and Manufacturing

- a conductive environment for the manufacture capital intensive Create semiconductors and other high-tech electronic products
- Bridge the viability gap due to lack of adequate infrastructure and ecosystem
- Capacity building in the areas of Electronics Product Design and Production Technology
- C-DAC involved in Capacity building









Online Digital Signature Service (eSign)

- eSign is an online electronic signature service
- open API to facilitate an Aadhaar holder to digitally sign a document.
- Verifiable Signatures and Signatory, Legally recognized
- **Biometric or OTP based authentication**



*OTP - One Time Pin





Cyber Security Task Force

• Demand for security workforce to rise globally to 6 million by 2019, up from 4 million currently, with projected shortfall of 1.5 million.

Aim:

- Aims to build India as a global hub for providing cyber security solutions, Ο
- Build the cyber security industry in India from the 1 percent market share to 10 percent by Ο 2025;
- Ο
- **Build 100+ successful security product** companies from India.
- Taskforce members include: industry leaders across IT, BPM and Internet, leaders from user organizations like banks and telcos and the representative from Government organizations
- Study Indian cyber security ecosystem



A trained base of 1 million certified and skilled cyber security professionals

Open Source Drug Discovery

- Council of Scientific & Industrial Research (CSIR)-led global initiative – 2008 - 2017
- Affordable healthcare to the developing world
- Community of researchers, scientists, students, academicians, institutions, corporations and individuals
- Discover drugs for tropical infectious diseases which draw limited attention of research based pharmaceutical enterprises
- Using the concepts of openness collaborative spirit





Mangalayaan – India's Successful Mars Mission

- Mars Orbiter Mission (MOM)
- Launched on Nov 5, 2013
- Captured red planet's gravity on 24 Sep, 2014
- ISRO India's space agency just the fourth entity after US, European Space Agency and the former Soviet Union — to successfully place a spacecraft in Mars orbit.
- India has become the FIRST Country to go to MARS in the very first try.





Mangalayaan – India's Successful Mars Mission







North Pole of the red planet – Mangalyaan Taken from 55,000 Km – 1st Jan, 2016

Wall-E





Thank You