



ANNUAL REPORT

1999 - 2000

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CENTRE FOR DEVELOPMENT OF ADVANCED COMPUTING

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* as on 31-Mar-2000

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OVERVIEW

Established in March 1988, as a Scientific Society of the Ministry of Information Technology (formerly Department of Electronics), Government of India, the **Centre for Development of Advanced Computing (C-DAC)**, is primarily an R & D institution involved in the design, development and deployment of Information Technology products and solutions.

In a little over a decade since its inception, C-DAC has developed a range of high performance parallel computers, known as the PARAM series of supercomputers. C-DAC's operations in this area are mission oriented and driven by its mission objectives.

C-DAC's expertise also extends to other areas of Information Technology (IT). It has undertaken pioneering work in the field of multilingual and multimedia technologies, education and training and has extended its expertise in developing and deploying IT based solutions in areas like Financial modeling, Data warehousing, Network & Internet security, Telemedicine, Geomatics, Real Time Systems, e-Governance, Digital library and Artificial Intelligence.

A large portion of C-DAC's financial support, for its mission related and specific sponsored R&D projects is met by the Government of India. The outlay on Mission and such R&D projects amounted to Rs 20.50 crores in the year 1999-2000. Part of this requirement was met from C-DAC's business activities which covered commercialisation of spin-offs of technology developed at C-DAC, training programs and turnkey contracts in key sectors. C-DAC registered a turnover of Rs. 73 crores through such activities in the year 1999-2000.

Vision

Consolidating on its diverse activities and gains in the last few years, C-DAC recreated and unveiled its vision during the year at the hands of its Chairman, Shri Pramod Mahajan, Hon'ble Minister for Parliamentary Affairs and Information Technology:

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

A Mission statement was also prepared spelling out its role and areas towards realizing this vision :

Mission Statement

- To carve out a niche in the global arena of advanced Information Technology and enhance our brand image.
- To continue to create and deploy the finest talent in our quest for further expanding the frontiers of High Performance Computing and Communication Technologies and its applications.
- To achieve rapid and effective spread of knowledge by overcoming language barriers using natural language oriented computing and multimedia technologies.
- To share our vast reservoir of experience for education and knowledge enrichment in the field of Information Technology.
- To utilize the intellectual property thus generated, bring benefits of Information Technology to society, by converting it into an exciting business opportunity and establishing a self-sustaining and wealth creating operation.

ACTIVITIES

C-DAC's range of activities extends to the following areas in Information Technology:

- **Research and Development**
- **Sponsored Projects**
- **Business Operations**
- **Education and Training**

RESEARCH & DEVELOPMENT

C-DAC's R&D efforts are focused in the areas of:

- **High Performance Computing and Communication (HPCC) Technology and Applications**
- **Language Technology**
- **Multimedia**
- **Advanced areas in Information Technology based on sponsored and inhouse projects**



HIGH PERFORMANCE COMPUTING AND COMMUNICATION (HPCC)

In January 1999, the Government of India approved C-DAC's third mission for development of Next Generation **High Performance Computing and Communication (HPCC)** Technology and Applications. This three and a half year mission is scheduled to be completed in July 2002.

A total budget of Rs 49.5 crores, including Rs 39.5 crore of budgetary support and internally generated revenue of Rs 10 crore has been approved to cover the four major activities:

- **Advanced Technologies for Next Generation HPCC**
- **National PARAM Supercomputing Facility (NPSF)**
- **Applications Development**
- **Office Infrastructure Enhancements and Collaborative Initiatives**

The next generation HPCC technology covers both hardware technologies and system software.

In this mission the NPSF is proposed to be offered as a large computing facility to aid researchers and application developers countrywide, in the scientific and engineering fields.

C-DAC's Third Mission also focuses on the development of critical and strategic scientific applications such as Weather Forecasting, Seismic Data Processing, Computational Fluid Dynamics, Structural Mechanics and Biotechnology. It also aims at addressing application development in business computing, for example in Electronic Governance, Telecom, Banking and Finance.

Hardware Technology Development

This Mission is aimed at the development of the next generation parallel computers based on commodity processor elements and high speed, low latency System Area Networks (SAN). As part of the first phase, the Hardware Technology Development Group (HTDG) completed the development of the SAN Switch and Network Interface Card (NIC) using C-DAC's Communication Co-Processor (CCP)-II chip. Simultaneously, the development of the more advanced and complex next generation CCP-III chip for Virtual Interface Architecture (VIA) was undertaken.

PARAM Anant

PARAM Anant is a low-cost supercomputing solution based on C-DAC's unique OpenFrame architecture for scalable and high performance computing that incorporates the well-known Cluster of Workstations (COW) and Massively Parallel Processing (MPP) concepts. The core supercomputing technologies for the PARAM Anant are derived from C-DAC's PARAM 10000 high performance computing system.



PARAM Anant is based on off the shelf, low-cost, commodity processors and networks but provides a similar environment and features available with the larger and more comprehensive PARAM 10000. Multiple Intel processor based servers are used as basic building blocks as nodes running replicated operating systems (Solaris/ Linux) bringing in the advantage of a host of application software available on these operating systems. These nodes are interconnected through C-DAC's PARAMnet, a high-bandwidth, low latency System Area Network. It is also possible to configure PARAM Anant with off-the-shelf networks such as Gigabit Ethernet, Fast Ethernet and ATM. The architecture allows the parallel system to be viewed as an ensemble of independent workstations, a cluster of workstations, or as Massively Parallel Processing (MPP) systems connected through a scalable high bandwidth network.

The mechanical packaging of PARAM Anant is flexible enough to scale from a system having only a few nodes to systems having a very large number of nodes. The PARAM Anant cabinet is conceived as a complete, integrated environment for high performance computing.

The entire system including the compute nodes, network elements and the system software are upgradable at the system, component and technology levels to suit the needs of the users. With the PARAM Anant, supercomputing is made accessible to the education, research and business communities at an affordable cost.

Several benchmarks and test suites such as C-DAC's own designed and developed P-COMS (PARAM-Communication Overhead Measurement Analysis suites), P-MACS (PARAM – Matrix Computation Suites) and P-CFD (PARAM Computational Fluid

Dynamics Suites) and international standards such as LAPACK, ScaLAPACK, NAS and LINPACK have been executed successfully on PARAM Anant. The process of extracting performance for several applications and system benchmarks using tuned matrix computation libraries and Active Messages (AM) over PARAMNet system-area network with C-DAC's Message Passing Interface (MPI) is in progress.

PARAMnet

The PARAMnet inter-connect fabric is a high speed, low latency and scalable system area network. The host interface is based on the industry standard PCI bus. PARAMnet supports C-DAC's KSHIPRA lightweight communication substrate, as well as the streams driver for TCP/IP.

PARAMnet currently offers speeds of 400 Mbits per second x 2 and latency of 15 micro seconds.

PARAMnet is being upgraded with C-DAC's next generation System Area Network (SAN) that will support speeds of upto 4 Gbits/sec and latencies of 1-2 microsecond(s).

System Software

A rich repertoire of System Software developed by C-DAC drives the high performance computing system. The HPCC software suite of products include high performance compilers, parallel debuggers, data visualisers and performance profilers, which are broadly organized as :

- Base Software, which includes a lightweight communication substrate, optimized MPI, and a parallel file system with MPI-IO interface.
- Program Development environment, providing a rich set of Fortran 77 / Fortran 90 program development tools developed jointly by C-DAC and Apogee Inc, and an integrated debugging environment for parallel programs.
- System Management tools for monitoring the effective utilization of the cluster resources and for administration of large UNIX clusters.
- Software engineering tools for developing high quality programs.

These tools have been optimized to achieve a maximized overall throughput from the PARAM system.

To further augment the throughput of the system, C-DAC has evolved a novel scheme of incorporating finely tuned 'hardware libraries' and solvers for some frequently used algorithms. This sub system, called **Reconfigurable Computing System**, consists of hardware, preprogrammed with specific algorithms. The study phase of this project has been completed and the design and development of the prototype board for proving the technology, is in progress.

System and Application Benchmarks on PARAM 10000 Installed at Premier Institutes

As part of the supply of a 4x2 node configuration PARAM 10000 for premier academic institutions in India, the performance of Application and System benchmarks on PARAM 10000 has been carried out at C-DAC.

Several benchmarks and test suites such as P-COMS (PARAM- Communication Overhead Measurement Analysis Suites), P-MACS (PARAM – Matrix Computation Suites), P-CFD (PARAM Computational Fluid Dynamics Suites), LAPACK, ScaLAPACK, NAS and LINPACK have been executed successfully on PARAM 10000.

C-DAC also demonstrated the capabilities of PARAM 10000 and achievable timings for raw/optimized Computational Fluid Dynamics and Computational Atmospheric Science third party code on PARAM 10000.

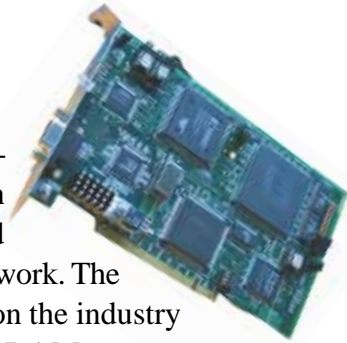
Scientific and Engineering Applications on the PARAM

Over the years, C-DAC's applications development program has been growing rapidly and now covers a wide range of applications including specific mission critical ones.

Some of the major applications are listed below:

Atmospheric Science

Forecasting of the weather and climate has emerged as an important discipline that requires large computing power and accurate modeling. The PARAM has been utilized for



the design and development of weather and climate modeling.

C-DAC's atmospheric science applications team, which is mainly involved in the parallelisation of Atmospheric and Oceanic Models, has been interacting with the National Centre for Medium Range Weather Forecasting (NCMRWF), New Delhi; Indian Institute of Tropical Meteorology (IITM), Pune; European Centre for Medium Range Weather Forecasting (ECMWF), UK; Institute of Numerical Mathematics (INM), Moscow; Centre for Mathematical Modeling and Computer Simulation (C-MMACS), Bangalore.

A PARAM 10000 has been installed at the NCMRWF, New Delhi for the purpose of weather forecasting. The forecasts generated through this system have been validated using the T-80 model for an end-to-end forecasting cycle exhibiting reliability and repeatability in performance.

C-DAC and the Indian Institute of Tropical Meteorology (IITM) are collaborating to develop a parallel climate model, based on NCMRWF's T80 model. This project has been supported by the Department of Science and Technology of the Government of India.

C-DAC is carrying out a joint collaborative project with INM to develop a Parallel Coupled Atmosphere-Ocean Model under the Indo-Russian Integrated Long Term Programme (ILTP) of the Department of Science and Technology and the Russian Academy of Sciences. The parallel model will be ported on the PARAM series of parallel computers and will offer a solution to long range area weather modeling.

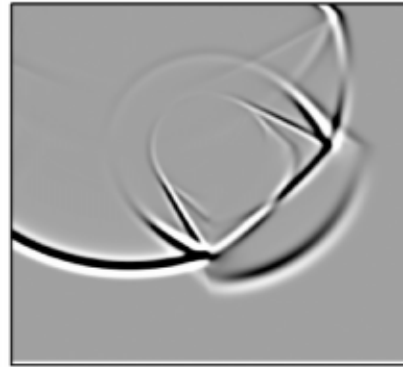
C-DAC has also initiated an activity to port a regional forecasting model for the Snow and Avalanche Study Establishment (SASE), Chandigarh.

Seismic Data Processing

This area of application deals with a large amount of data processing. For this, several new seismic processing algorithms, including migration and modeling algorithms have been added to the set of existing algorithms. The new techniques have been developed under a project supported by the Department of Science and Technology. The developed algorithms will eventually be added to the WAVES: an existing parallel seismic migration

and modeling package on PARAM 10000, to make it more comprehensive. The model has been run on 144 processor configuration of PARAM 10000.

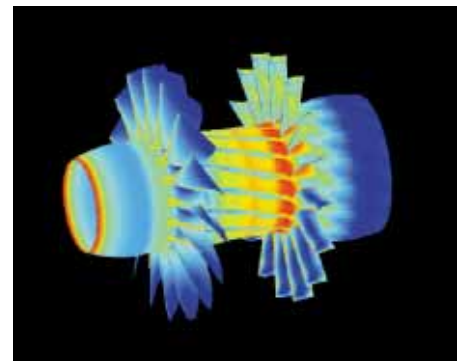
The migration and modeling algorithms developed at C-DAC have been utilized by Oil and Natural Gas Corporation Ltd. (ONGC) for processing oil explo-



ration data sets. National Geophysical Research Institute (NGRI), Hyderabad has also used the software for analyzing their deep crustal data sets. C-DAC is also in the process of formulating further joint research projects with ONGC.

Computational Fluid Dynamics

Parallel computing technologies offer researchers an unprecedented capability to solve many largescale, scientific and engineering problems critical to meeting national needs. An established area of application in this context is Computational Fluid Dynamics (CFD) which helps in designing new aerodynamically efficient vehicles. In the past, experiments had to be carried out in "windtunnels" for evolving new designs and models.



Howsoever rigorous, such experiments cannot emulate all possible conditions, and are therefore not exhaustive. With the advent of high speed computers, new algorithms for parallel unstructured mesh generation and the solution of "Navier-Stokes" equations have now made it possible to simulate the flow around any complex shaped objects in three space dimensions. This has significantly enhanced the accuracy, reduced the design cycle time and the cost. The CFD team in C-DAC has been engaged in the development of codes/packages for solving CFD problems as well as in porting and optimizing third party CFD codes on PARAM 10000.

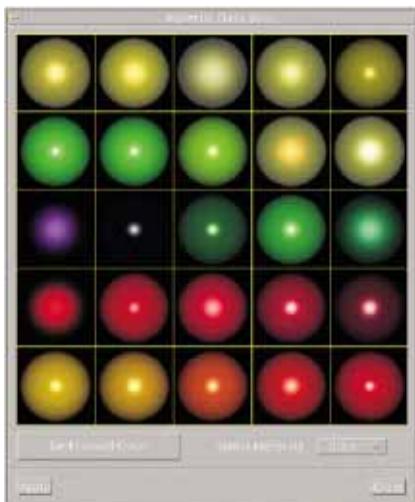
Parallel modeling and Visualization

Under the Integrated Long Term Programme (ILTP) of the Department of Science and Technology, Government of India, C-DAC has been progressing in the area of Parallel Modeling, specifically for Computational Fluid Dynamics and Finite Element Analysis. Institute for Computer Aided Design (ICAD), Moscow, Russia has been closely interacting and developing the software utilizing the PARAM 10000. Using Finite Difference / Finite Volume Analysis, Navier-Stokes equations were solved for typical configurations like circular cylinder, cavity and sphere. The study for turbulence modeling were also carried out to extract the best possible performance of PARAM 10000. Under the visiting scientists programme, scientists from Russia and India have exchanged visits and worked together to develop a visualization package to demonstrate the intricate interplay of involved fluid physics. The project has recently been successfully completed.

Parallel Flow Visualization Software

It is well known that the use of efficient parallel visualization techniques allow visual interpretation of data of increasing complexity, large in size and unstructured in shape. In particular, it allows researchers to tune and debug their models, observe and analyse the whole course of simulation in a more efficient manner. This helps to enhance design efficiency and is essential to ensure integrity of analysis, to provide insights and to communicate those insights with others.

Keeping these requirements in mind, a Parallel Flow Visualization Software Package, called FlowVis on PARAM was developed. FlowVis is meant for CFD data visualization on parallel machines using MPI and is capable of handling steady state data as well as time varying three dimensional data in both postprocessing and preprocessing modes. It also provides full support for structured and unstructured meshes.

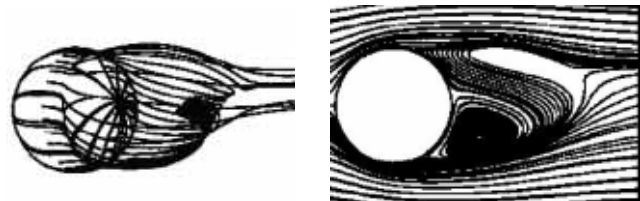


Enhancements in the Flow Vis model were carried out and the code was rewritten to incorporate internationally accepted standards under a sponsored project.

Reusable Vehicle Simulation

The management of heat generated on the nose part of an aerospace vehicle entering the atmosphere from outer space is a problem faced by the re-entry vehicle designers. These conditions cannot be easily simulated in wind tunnels and the designers have to resort to computational tools to estimate the conditions. In collaboration with specialists of the Institute for Computer Aided Design, Moscow, C-DAC has begun a project to generate solutions for tackling such problems through Reusable Vehicle Simulation. The project is being carried out in collaboration with the Vikram Sarabhai Space Centre (VSSC), Thiruvananthapuram of the Department of Space, Government of India. The VSSC plans to come out with a preliminary aerodynamic design of a reusable vehicle at the end of this project. The PARAM 10000 at the NPSF will power the simulations.

Simulation of Fluid Flows Around a Sphere



Unsteady 3D fluid flows are a very widespread phenomena in nature. The existence of an organized motion of turbulent flows has been observed in these flows. The dynamics of such flow is described by the Navier-Stokes equations. Special turbulence models need to be introduced in addition to Navier-Stokes equations, which are not general in nature. On the other hand, these equations can be solved on a very fine grid without any turbulent models, which is the philosophy of the direct numerical simulation.

An algorithm based on direct numerical simulation was developed for investigation of the viscous incompressible flow past the sphere placed in a uniform stream. Analysis for rotational flow in the wake region for different Reynolds number was subsequently carried out.

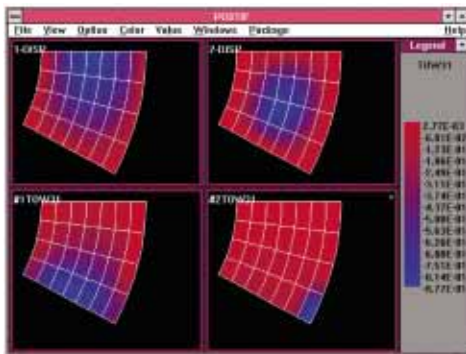
The algorithm was parallelized using the domain decomposition technique and was successfully implemented on PARAM 10000. The work was presented at an international conference held in Bangalore.

This work was carried out at the Institute for Computer Aided Design (ICAD), Moscow along with C-DAC members, and was supported by the Department of Science and Technology Visiting Fellowship Programme under the umbrella of the Integrated Long Term Programme (ILTP).

Structural Mechanics

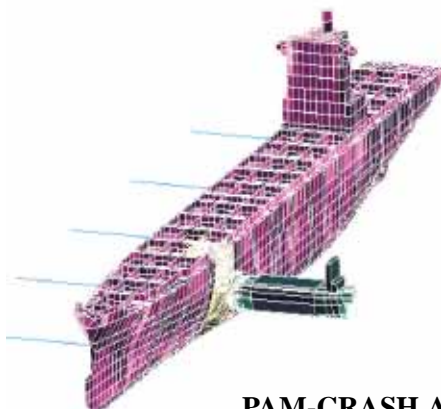
The **Structural Mechanics** team of C-DAC has carried out R&D activities and collaborations with national and international organizations.

The commercialization of the software FEMCOMP as a product was carried out during



FEMCOMP Application

the year with developments in analysis, modeling, visualization parts and packaging work. FEMCOMP is a result of a joint collaboration between C-DAC and IIT-Mumbai for composite materials analysis. As part of C-DAC's ongoing project for installation of a PARAM 10000 configuration at 12 premier institutes of India, all the institutes have selected FEMCOMP to aid in



PAM-CRASH Application

their research work on diverse structural mechanics problems. The bench-marking of FEMCOMP on PARAM 10000 has accordingly been successfully demonstrated. The installations at these institutes and interactions with them in this area are continuing.

Interaction with the Indian Institute of Science (IISc), Bangalore in fracture mechanics code development and parallelization and with the Indian Institute of Technology (IIT), Mumbai for composites materials analysis code development and parallelization, has led to formulation of specific projects.

C-DAC's collaboration with Engineering Systems International (ESI), France is continuing in PAMCRASH/SHOCK products.

Other activities include nonlinear structural analysis (domain decomposition part) and object oriented design of sequential solvers (cholesky and conjugate gradient method).

Geomatics

A third party software EASI/PACE of M/s. PCI, Canada has been ported on PARAM 10000 and is being supplied to the premier academic institutions. This product enables applications covering remote sensing and resource mapping. A number of projects are being initiated using this package.

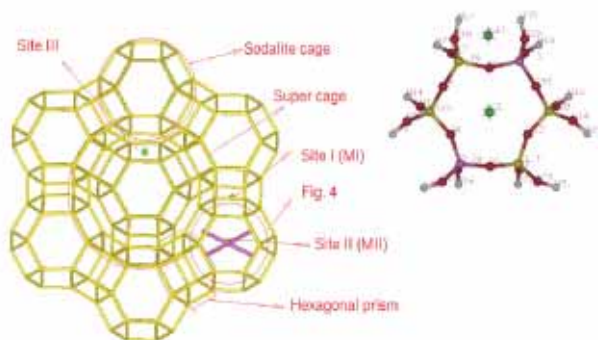
Basic Sciences

In the field of **Basic Sciences**, Materials and Molecular Modelling are challenging areas that not only require very high computing performance, but expertise in Biotechnology, Computational Chemistry and Physics as well, in order to tackle real life problems. C-DAC, in collaboration with the University of Pune, has been facilitating researchers in the above areas by providing the PARAM facility. A number of well-known codes have been ported on PARAM. Also, a set of codes has been developed indigenously.

C-DAC has also developed codes that use Genetic Algorithms (GA) for optimizing the structure of polypeptides and multiple sequence alignment. A tool known as Problem Solving Environment for Genetic Algorithms (PSEGA) has been developed to enable, the biotechnologists to use PARAM without going through the intricacies of parallel computing.

Electrostatic Potential for Intermolecular Complexation (EPIC) model has been added to the **INDMOL** suite of codes for optimization of geometries of binary complexes. The *ab initio* optimized wave function of each molecule in the complex along with the MESP-derived charges and the corresponding atomic van der Waals radii are to be supplied as input to EPIC model. This model has been tested for various weak binary complexes and found to be working satisfactorily.

The parallel version of **General Atomic and Molecular Electronic Structure System (GAMESS)** code has been ported and tested on PARAM 10000 for various molecular systems. Scientists of the National Chemical Laboratory (NCL), Pune are using GAMESS for designing reforming catalysts by accurate quantum chemical calculations using PARAM 10000 and for identifying the active sites in zeolite so that catalysts with higher conversion and selectivity are possible.



An *Ab initio* Molecular Dynamics (AbMD) code has further been parallelised by exploiting the shared memory of the individual nodes of PARAM 10000.

Scientists of the Indian Institute of AstroPhysics, (IAP) Bangalore have developed a few FORTRAN codes to perform large scale **Coupled Cluster (CC)** calculations on heavy atoms in order to investigate effects of Parity Non Conservation (PNC) in atomic systems. In order to reach the required accuracy, heavy systems have to be evaluated with a large basis set, which is possible only on a supercomputer. The parallel version of this code was developed to use the shared memory on PARAM machine. For the first time, a nonlinear calculation for the Tl_3 system has been performed. Twenty-eight nodes of PARAM 10000 in dedicated mode were used to run the shared memory Coupled Cluster Singles and Doubles (CCSD) on 112 processors.

Bioinformatics

The focus of C-DAC's Bioinformatics team is to establish a complete facility for computational biology and drug design at NPSF.

Some of the major activities carried out by this team during the year are briefly described below :

AMBER

AMBER (Assisted Model Building with Energy Refinement) is a suite of programs that allows users to carry out molecular dynamics simulations, particularly of biomolecules. Developed by Prof. Peter Kollman's group at the University of California, San Francisco, it is the most widely used program for molecular mechanics and dynamics.

At C-DAC, the AMBER package for molecular modeling has been ported on PARAM 10000. The package has also been tested for large molecules of the size of 19,000 atoms (box of water and addition of ions). Some of the real time simulations carried out on the PARAM 10000 are DNA molecules with explicit water and ions using the Particle Mesh Ewald method. To check the performance on PARAM 10000, the AMBER benchmark PROWAT was run on all nodes and compared with the other supercomputing systems all over the world. The code gave excellent benchmarking results on PARAM 10000 as compared to other supercomputing systems.

CHARMM

CHARMM is a general-purpose program for macro-molecular dynamics and mechanics. It performs standard molecular dynamics in many different ensembles (e.g., NVE, NVT, NPT) using state-of-the-art algorithms for time-stepping, long-range force calculation and periodic images. CHARMM can be used for energy minimization, normal modes and crystal optimizations. At C-DAC the parallel version of CHARMM has been optimized and ported on the PARAM 10000. CHARMM has been implemented both on the MPI and SOCKETS interface. Standard benchmarks of CHARMM were run on the PARAM 10000 and the timings indicated good performance of the parallel machine.

GROMACS

GROMACS is modeling and simulation tool developed by Prof. H.J.C Berendsen's group at the University of Groningen, The Netherlands. Some of its important simulation types are: Molecular Dynamics, steepest Descents and conjugate gradients energy minimizers, position langevin dynamics, normal mode analysis and essential dynamics sampling.

GROMACS has been ported on the PARAM 10000 and its benchmarking is in progress.

LANGUAGE TECHNOLOGY

C-DAC evolved and updated its popular Graphics and Intelligence based Script Technology (GIST), with a view to extend the benefits of Information Technology to the vast and diversified multilingual population of India.

C-DAC also continued its developments using Artificial Intelligence for bringing out new products for language learning and machine assisted translation.

The new products developed and brought out in this area during the year are :

LEAP OFFICE 2000, ISM 3.0, Pratibimb, Devanagri OCR, Quick MM Album, Multimedia Portal, Talash Search Engine, LILA Prabodh.

In order to continue to provide focus in this area, C-DAC has undertaken a number of development projects.



Some of the projects undertaken are :

GIST II Chip

Sponsored by the Department of Scientific and Industrial Research (DSIR), to develop an enhanced version of the earlier GIST – 9000 ASIC, the GIST II chip incorporates features like 16 bit interface to MC68000 family of processors, PC AT Keyboard, 2 MB DRAM support, colour and video genlocking support. The design has been completed and tested using Field Programmable Gate Arrays (FPGA) at C-DAC, and given for fabrication of an Application Specific Integrated Circuit (ASIC).

DVD Authoring

Sponsored by the Ministry of Information Technology, the DVD authoring project aims at developing an MPEG-II based DVD authoring and mastering system with multilingual subtitling for studio and broadcast applications. After a detailed study on the latest technology in the field of MPEG-II, the vendor was selected, and the schematic and PCB design has been completed. Using a vendor supplied board, the popular TV Serial “Bharat Ek Khoj” has also been made with twelve Indian language subtitles.

Multilingual Newsroom Automation System

The Multilingual Newsroom Automation Project jointly supported by the Ministry of Information Technology, Doordarshan and C-DAC, will provide a flexible newsroom network system to assist news makers to easily enter or edit news stories in Indian languages, find stories in the news wires, assemble news rundowns, run multi-prompts as well as captioning devices. The system will consist of four modules – News Text, News Graphics, News audio and video and News Controller. Each of these modules handle various functionalities of news production. The design for the modules of the News text and News Graphics has been implemented.

Enabling Indian Languages on Line Printers

The Indian Language support for the Line Printers has been jointly initiated with LIPI Data system. The aim of the project is to provide a facility to print in Indian languages on Line Printers. This requires specially designed fonts as well as programmes to render the fonts. Work on the implementation of the Devnagari, Gujarati, Kannada, Tamil and Telegu fonts has been completed.

Utrans

Based on the work carried out by C-DAC on Urdu fonts and transliteration, a package called Utrans is being developed to enable intelligent translation of texts from Hindi to Urdu to a very high degree of accuracy.

Multilingual Pager

C-DAC has provided its multilingual expertise under a project of the DSIR in extending the ISCLAP standard for paging in Malayalam, as was earlier done for Hindi and Bengali.

Perso-Arabic Resource Centre

C-DAC has been identified as one of the 13 Resource Centres set up all over India under the TDIL programme of the Ministry of Information Technology for development of Indian Language Computing solutions. Spanning over three years, the project aims at developing language tools and technology for the Perso-Arabic language family, namely Urdu, Sindhi and Kashmiri. Earlier, the National Council for the Promotion of Urdu Language initiated a seed project at C-DAC for the development of a word processor software package for Urdu. The project is in progress.

To lend support to the efforts of the Ministry of Information Technology to seed and promote wide usage of computers in Indian languages, C-DAC launched its selected language fonts and basic word processing software in the public domain on the TDIL website vishwabharat.tdil.gov.in

LILA – Learn Indian Languages through Artificial Intelligence

LILA Hindi Prabodh, the first in the series of Intelligent Self-tutoring software package for Indian languages, has been specially designed for government and corporate employees to enable them to learn and use Hindi in their official correspondence. The package is also useful for those who wish to learn Hindi



The Hon'ble President of India, Shri. K.R. Narayanan, released the MS Windows version of a self-learning Hindi software - **LILA HINDI PRABODH** in the presence of Hon'ble Prime Minister Shri Atal Behari Vajpayee (left) and Hon'ble Home Minister Shri L.K. Advani (right).

from the beginning. A teacher can use the package as an auxiliary aid for teaching pronunciation, grammar and inter-active exercises.

Two more advanced level software packages, called LILA Praveen (UNIX, Windows and DOS versions) and LILA Pragya (Windows version) are also under development in this series. These projects have been sponsored by the Department of Official Language, Ministry of Home Affairs, Government of India.

Computer-Assisted Translation System (CATS)

The objective of this project is to develop a system, which should provide an automatic computer assisted translation from English to Hindi in a domain of official correspondence, like gazette notifications, office orders and circulars pertaining to appointments, transfers and promotions. The system follows the architecture of the MANTRA, a core system developed by C-DAC for machine assisted translation.

The project, which is supported by the DOL, is to be completed in two phases. The first phase is complete and the system was demonstrated to the Evaluation Committee. While expressing satisfaction with the first phase, the committee approved the continuation of the project in the second phase. During the period under review, the system was put to user trials in five Ministries/ Departments. The feedback received from the user trial is being analyzed and used to expand the existing grammar and lexicon necessary for the translation of documents pertaining to areas like office orders and circulars.

MULTIMEDIA

The major activities of the National Multimedia Resource Centre (NMRC) of C-DAC during the year, were as follows :

QuickMM Album Authoring Software

The QuickMM Album Authoring software is a preauthored template designed to suit specific topics and applications presented in Multimedia. The basic authoring template structure is used for integrating multimedia contents. It has pre-defined locations and fields for integrating images, text, audio and video clips. This approach enables semi skilled professionals in delivering multimedia titles quickly.

Using this software, it is possible to create multimedia albums of events including family events, corporate events, multimedia conference proceedings, documentation, product catalogs, portfolios and presentations.

The event of ELITEX 2000 held in Delhi in February 2000 was documented and integrated using the QuickMM Album within a few hours.

Multimedia Repository (NMRC Portal)

The NMRC Portal is a client-server repository for hosting and disseminating multimedia content. It offers a feast of multimedia downloads and information about multimedia creations, products, skills, facilities and technologies. Multimedia information is presented in various categories, such as clipart collections, CD ROM titles, corporate, educational multimedia, and multimedia tools. It also hosts an archive of the academic projects done by the students trained at the centre.

The portal offers various features like profiles of resource persons and institutions, parametric searching, feedback, registration and content



uploading facilities, and is accessible from C-DAC's Web Site at www.cdacindia.com.

Kumar Vishwa Kosha CD Title

NMRC developed a Multimedia encyclopedia in Marathi, called Kumar Vishwa Kosha, with the help of Marathi Vishwa Kosha Mandal, Wai. The Government of Maharashtra sponsored the project. The encyclopedia is targeted for students of standard VIII to X.

A by-product of this effort is the printed version of the introductory volume, which is prepared with attractive layouts, legible type setting and colorful illustrations. Currently this volume is being printed at the Marathi Vishwa Kosha Mandal, Wai.

'Access' C-DAC's Multimedia and Multilingual Kiosk, provides an affordable and low cost configurable solution for information dissemination and e-business. The applications include point of information, information directories and interactive catalogues.



The current model, based on Intel Pentium III multimedia PC with Windows NT as the Operating System, and touch screen monitor, was launched during ELITEX 2000.

SPONSORED PROJECTS

C-DAC has undertaken a number of projects in the area of Electronics and Information Technology, assigned and sponsored by various Ministries and Departments of the Government of India, such as the Ministry of Information Technology, Department of Official Language (DOL), Department of Science and Technology (DST) and Department of Scientific and Industrial Research (DSIR).

The projects sponsored during the year were:

PARAM for Premier Academic Institutes

With a view to increase awareness about the use of parallel processing technology based supercomputing systems and consequently train quality manpower to develop scientific applications of wide interest and carry out further research in this area, the installation of PARAM 10000 at twelve premier academic institutes in the country was approved by the Ministry of Information Technology. These twelve institutes are : Indian Institutes of Technology - Mumbai, Delhi, Chennai, Kanpur, Kharagpur and Guwahati, Indian Institute of Science, Bangalore, Birla Institute of Technology, Ranchi; Birla Institute of Technology & Science, Pilani; University of Roorkee, Roorkee; Motilal Nehru Regional Engineering College, Allahabad and Karnataka Regional Engineering College, Surathkal.

C-DAC has prepared a detailed documentation covering course material for training, details of the system supplied and the software. Also, benchmarking carried out on the system has been documented. These are provided to all the institutes. C-DAC has also been interacting with the faculty of the premier institutes and identified eight major projects of research interests including one, of interest to the industry, at every institute. A four node SUN UltraSPARC based PARAM 10000 is being installed at each these premier institutes and a workshop is organized to familiarize the scientists, teachers and students with the system and the technology used. Two frequently used third party software, namely EASI / PACE and PHOENICS have been procured for porting on PARAM 10000 and to help researchers validate their scientific efforts in the areas of Remote Sensing and Computational Fluid Dynamics respectively. In addition, C-DAC's own application software, namely FEMCOMP are being supplied to these institutions.

Installations at two institutes have been completed and the others are being taken up in the following year.

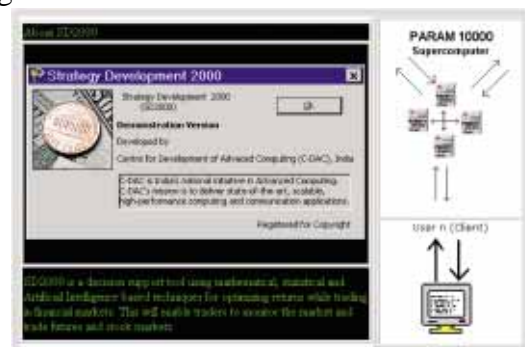
Data warehousing for the Government of Andhra Pradesh

C-DAC, in collaboration with the Andhra Pradesh Technology Services (APTS), is developing a multipurpose, multilingual, multimedia, information warehouse for aiding state level decision makers in their decision making process. The objective of this project is to organize the MultiPurpose Household Survey (MPHS) data and the land records data of Andhra Pradesh State, into a meaningful information warehouse to assist decision makers in taking informed decisions and assessing their impact over the intended section of the population. This project adopts technologies like data warehousing, multilingual interface, parallel database server and information warehouse access through web, kiosk and mobile terminals.

During the year, software development and testing of all the major modules including the Data Scrubbing and Loading module, the Thin Client module, the Thick Client module, and the Kiosk Interface module were completed. A four node PARAM 10000, on which the data warehousing solution is built, has been installed and commissioned at the Secretariat, Government of Andhra Pradesh, Hyderabad. The system along with the application is to be made operational at Hyderabad. The project is now in its last phase of field data loading by the user and the final touches to the site, training of the Government of Andhra Pradesh users, and some procurement activities are underway.

Financial Modeling

The Strategy Development (SD) 2000 project was successfully completed as a contract, and the final phase delivery was made to MAN-Drapeau-Research Ltd, Singapore in October 1999, on schedule. The client is currently using the system for their research activity related to Funds Management area.



Based on the experience gained in developing SD 2000, a project on Fundamental Analysis based Capital Enhancement Tool (**FACET**) was proposed to the Ministry of Information Technology. The project was approved in January 2000.

The main objective of the project is to build an Internet-based scalable platform to analyze and compare market movements of shares of leading Information Technology related companies with those of non IT companies that constitute the market index.

The use of high-end computers is of continuing importance especially in financial modeling due to the massive amount of data that needs to be processed for taking decisions related to stock selection and market timing.

Real Time Systems

The Real-time Fault Tolerant System project emphasises on providing software fault tolerance by implementing the replication of software servers. This enables the software servers to be removed from the system, without disrupting the activity of the users.

Telemedicine

Funded by the Ministry of Information Technology, the project aims at developing, enabling technologies for making Telemedicine a usable concept in the country. This is a multi-agency, multi-location project with an objective to develop and demonstrate a set of prototypes providing Telemedicine services. The development is being done at C-DAC, Pune, and the Center for Electronics Design and Technology (India), Mohali. The test bed will be provided by the three premier medical institutes of the country, viz. All India Institute of Medical Sciences (AIIMS), New Delhi, Sanjay Gandhi Post Graduate Institute of Medical Sciences (SGPGIMS), Lucknow and Post Graduate Institute (PGI), Chandigarh. These super-specialty hospitals will be connected over ISDN networks and will provide Tele-Consultation services.

This project started in April, 1999 and is in the implementation phase. An advance Prototype has been developed to demonstrate the core features of the Telemedicine system. This is a generic

prototype that allows transfer of Images, ECG, Patient data, Reports and Prescriptions. The X-ray, CT, MRI, Ultrasound celluloid films are scanned and transmitted to the specialist end for consultation. The ECG data in the digital form is also transmitted to the specialist end. Efforts are underway, to ready this prototype for field test.

As part of this project, C-DAC has developed a Protocol for Communication in Telemedicine Systems. The protocol addresses the stream format, the message exchange and the system parameters for communications in Telemedicine Systems.

The Prototype was demonstrated at the Elitex 2000 and the Swadeshi Vigyan Mela in Jan- Feb 2000.

Digital Library

The Digital Library project undertaken by C-DAC aims at the development of technology, tools and templates for the preservation and dissemination of India's rich heritage through the use of modern digital technology. The deliverables include providing the technology, contents and infrastructure for a digital library of Indian Heritage.

To address the infrastructure requirements of the project, C-DAC has procured the OmniScan Photo Imaging Equipment. The equipment, one of its kind in India, is a document scanner which recognises a large number of graphic formats such, that the scanned images can be stored in a format suited to the requirements of processing.

Towards content creation the following pilot projects have been completed :

Selected documents and manuscripts belonging to the Sarasvati Mahal Library at Thanjavur, Tamil Nadu were digitised and compiled. The content includes a series of palm leaf manuscripts containing some dance dramas written in old Tamil fonts.

Transliteration of the fonts was made using the Leap package of C-DAC.

A list of artifacts in the SalarJung museum at Hyderabad with a detailed description was stored in a database and a query-based search was enabled.



Some of the rare documents of Kepler's work belonging to the Indian Institute of Astrophysics, Bangalore were digitised and stored in compact disks to ensure protection and permanency of the documents.

Sanskrit Authoring System

The Sanskrit Authoring System project is almost complete, but for development for Samavedic fonts, Grantha Scripts and project documentation.

The Sanskrit Authoring System provides editor support, indexing, concordance facilities and knowledge-base insertion for effective authoring. Improved algorithm and search techniques are devised with ActiveX controls based on windows. This software uses the C-DAC GIST SDK product. The software converter from ISCII to ISFOC for the vedic text has also been developed. The product has been used for rendering some Indian epics, such as Bhagavadgita.

Some examples are given below :

Bhagavad-guṇa-Darpaṇam commentary by Śrī Parāśara Bhaṭṭar on Viṣṇu-sahasra-nāma-stotram
Sāyaṇa-bhāṣya on Ṛgveda-saṃhitā

Bhāradvāja-śikṣā-vyākhyāna on Taittirīya-saṃhitā

Yāska's Nirukta and Nighaṇṭu

Tiruppāvai Vyākhyānam by HH 45th Jeer of Ahobila
Mutt Śrīvaṇ ṣaṭhakopa śrī Nārāyaṇa Yatīndra
Mahādeśikan - multi-lingual sources - Sanskrit, Tamil, Prākṛtam

Mahabharatha DataBase Project

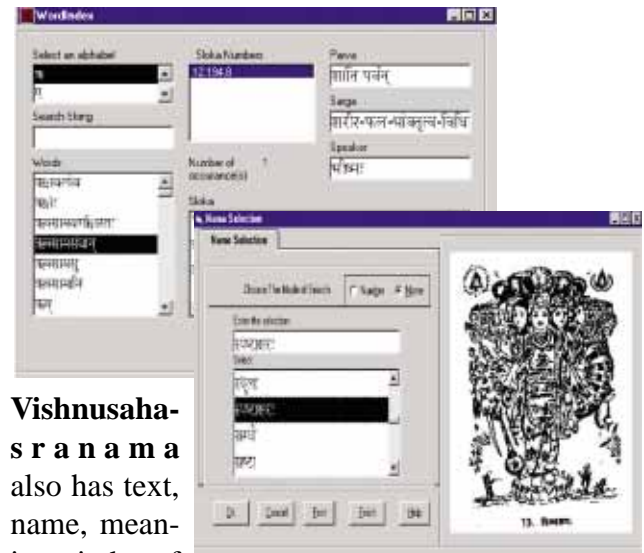
A pilot project to create a computational database of Shantiparva of Mahabharatha (consisting 18,000 slokas) was funded by the Ministry of Culture. This has been completed in a short span of two months. A prototype CD-ROM has been produced and sent to the Ministry of Culture for evaluation. This covers the Text, Sandhi Vicched (word split), Samasa Vighrah (dissolution of compounds), various retrieval keys like number, chapter name, speaker, topic, geographical, family name details, index of words, slokas, compound word. Transliteration is provided as a standard feature. This is also an application of GIST SDK ActiveX control.



The scheme for implementation of the Pune Deccan College Sanskrit Dictionary Project has been submitted to the Ministry of HRD. A sample application has been developed taking live examples from the dictionaries.

Among the Sanskrit content for the Internet, the **Bhagavad Gita Reader** and **Vishnusahasranama Reader** are completed for Internet access.

The **Bhagavadgita Reader** (multilingual, searchable, analysable) includes the text with translation in all Indian scripts and Roman, word, sloka index, English translation, Sanskrit commentary and many utilities. The fonts are downloadable to view them in different scripts. Conversion to ITRANS format is also provided.



Vishnusahasranama

also has text, name, meanings, index of topics, English translation, Sanskrit commentary, list of quotations like Ramayana, Mahabharatha, Bhagavadgita, Bhramasutra, Panini Grammar. A hyperlink to sources is also provided.

Utilities for porting the shastric application of the Authoring System are being developed under active server page using Java components. Porting of DESIKA to UNIX/LINUX has also been proposed.

Other projects

C-DAC has proposed to carry out development in two other areas which are of significant current interests. One, for core technologies for Network and Internet security to aid in e-commerce and related applications. The other, for Reusable Software Components to speed up the software development cycle. It has also proposed to offer Data warehousing and Data base solutions for various large data base applications in Government and Corporate Sectors.

BUSINESS OPERATIONS

With a view to extend and propagate its technologies to the academic, scientific and various other business sectors commercially, the Business Division of C-DAC provides marketing, customer support and consultancy to its esteemed clients in its various areas of expertise. These include High Performance Computing & Communication (HPCC) technologies, Networking solutions, Turnkey solutions, Language Technology, Artificial Intelligence, Education and Training, third party software, Data warehousing, Geomatics and e-Governance. C-DAC's business activities also cover IT solutions in many functional areas of the Government and utility sectors like Power, Telecom, Health, Education, Agriculture, and Rural Development.

In the area of **HPCC**, C-DAC operates on a two pronged strategy. That of marketing PARAM and allied technologies and providing the industry with solutions in different sectors. Development of know-how and expertise in a number of core areas has enabled C-DAC to provide comprehensive IT based solutions to a gamut of sectors. Some of the areas that are addressed by the HPCC segment of the business include, marketing and deployment of PARAM based computing systems and

applications software, as well as third party software to various key sectors.

The primary focus, during the year, has been to provide PARAM 10000-based solutions to twelve premier academic institutions. Two PARAM systems were successfully commissioned at BIT, Ranchi and BITS Pilani.

A four node system, with HPCC Software was installed at Regional Engineering College (REC) Trichy and an order for an 8 node PARAM 10000 was received from Institute for Computer Aided Design (ICAD), Moscow. A repeat order was also received from the National Informatics Centre (NIC), New Delhi and Sanjay Gandhi Post Graduate Institute of Medical Sciences (SGPGIMS), Lucknow for the augmentation of the PARAM and server installations at the respective institutes.

Telecom billing and customer care software was developed and supplied along with the server hardware to Pune Telecom for its operations in the Pune region.

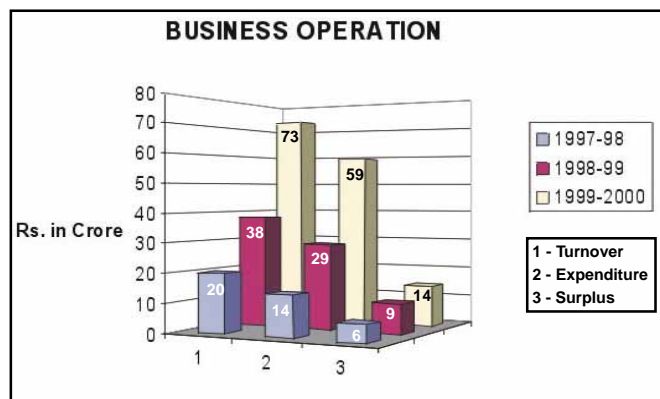
Amongst the **networking solutions** provided by C-DAC, was the networking of over 150 nodes at the Postal Directorate, New Delhi and about 35 nodes each at the offices of the Chief Post Master General, Guwahati and Shillong. The contract also includes the installation of servers at all the three locations and system integration, and configuring leased lines at New Delhi and Guwahati.

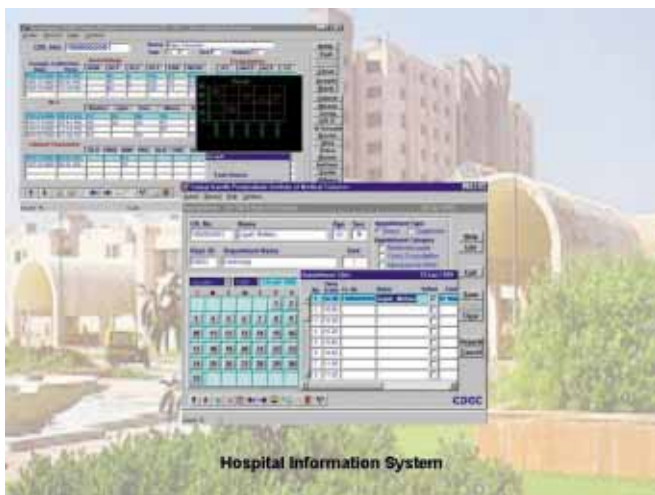
A contract for Phase II for campus-wide networking of the Punjab University was received.

C-DAC has also undertaken the networking of the various departments, with an ATM backbone for the University of Mysore as well as the Raman Research Institute (RRI), Bangalore for interconnecting all their laboratories at Bangalore.

A major order for networking was received from the Department of Technical Education (DTE), Government of Maharashtra as part of which, Campus Wide Network of seven Engineering Colleges and wide area connectivity of all these colleges in Maharashtra to the DTE is to be completed.

In the area of **Turnkey Solutions**, C-DAC has designed, developed and commissioned a Hospital Information System (HIS) at the SGPGIMS, Lucknow. The HIS software module includes modules for Masters, Registration, Appointment,





Billing, OPD, Inpatient (ward management), Operation Theater, Pharmacy, Central store department, Central sterile store department, Diet kitchen, Blood bank, Bio medical department, Patient medical record and Enquiry.

A turnkey contract for the design, development and installation of HIS at the Guru Tegh Bahadur Hospital (GTBH), Government of N.C.T Delhi, Delhi was undertaken. This includes a campus wide fiber optic/copper networking with over 30 nodes and supply and installation of server and client systems. The computerization at the Guru Tegh Bahadur Hospital, Delhi is to be completed in three phases.

The Central Power Research Institute (CPRI) Bangalore, a premier research organization, under the Ministry of Power, carries out applied research and testing in electrical power equipment.

Based on the functionality, the CPRI Automation System (CAST) has been classified into several systems and sub-modules.

The need to move towards a paperless office necessitates the exchange of data/information (data dependency) between these modules. The integration of these modules leads to a system that is highly complex and to meet this end state-of-the-art technologies need to be harnessed. The proposed system will serve as a management tool for decision support, workflow automation and MIS of all their laboratories at Bangalore. C-DAC has carried out automation of various laboratory functions in Phase I & II of the project.

The **Real Time Solution** for the Power sector in the form of the product, called COPS-90, is a totally indigenous development solution of C-DAC for Supervisory Control And Data Acquisition

(SCADA) . It has been deployed successfully at Northern & Eastern Load Despatch Centres (NRLDC & ERLDC) of Power Grid and Energy Management Systems at the major Steel Plants in India.

During the year, major achievements include, installation of the NRLDC Phase III project, successful completion of the NTPC, Calcutta project and Lab Automation for CPRI Phase I. A repeat order from CPRI for Phase II Lab Automation was received and partial installation & commissioning of Lab Automation modules at site have been completed. The complete software of SAIL Islanding & Load Shedding for Bokaro steel plant was installed and commissioned at site and the complete software of SAIL Islanding & Load Shedding for Rourkela was also completed and demonstrated to SAIL.

C-DAC has evolved plans to port the COPS-90



application package onto Intel processor based PARAM 10000 cluster to ensure cost effectiveness.

In the area of **language technology**, the GIST business operations continued to record a large turnover. During the year, it achieved a turnover of Rs. 13 crores. A major contract that GIST has secured is from Doordarshan for multilingual on-line video editing systems.

Continuing with the success of the past year, the GIST business division has bagged corporate license contracts for its popular product LEAP Office.

Other tie-ups include combining the iLEAP – ISP version with VSNL and ETH Internet subscription for supply of iLEAP on the Net. Localization projects taken up by GIST, which were executed successfully include the incorporation of Indian languages in Lipi and TVSE printers.

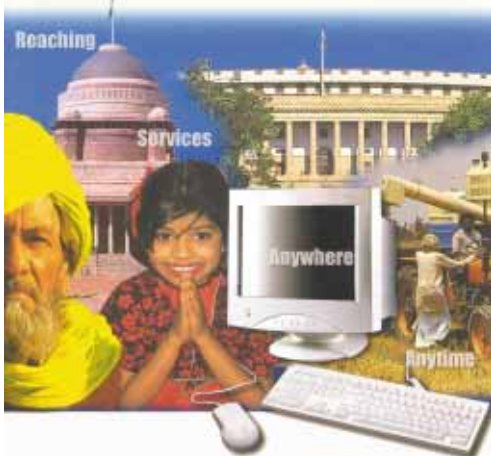
C-DAC also tied up with Indolink, a US based company for promoting iLEAP, to reach out to a large clientele in the USA.

In order to take the language technology developments to the various parts of the country, GIST organized roadshows and seminars in the cities of Andhra Pradesh, Karnataka, Tamil Nadu, Maharashtra and Madhya Pradesh.

The LILA software product for self learning Hindi was launched in the market and a large number of copies were sold.

A special drive was also taken up by C-DAC to commemorate the Rashtra Bhasha Golden Jubilee celebrations by conducting seminars in Mumbai, Bangalore and Delhi for government and public sector organizations, for promoting the use of Hindi on computers.

In the area of **Electronic Governance**, the projects for computerization of several departments of Maharashtra State were continued.

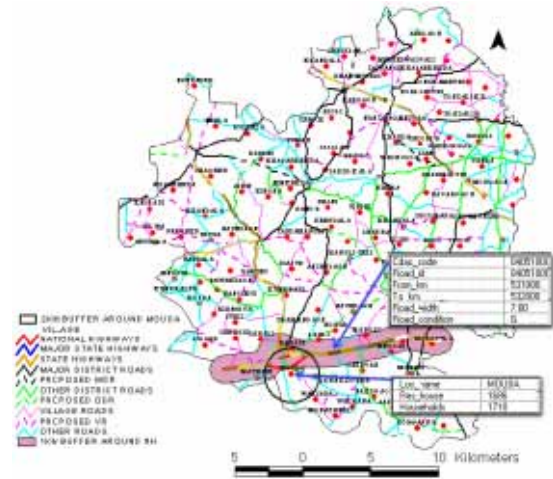


This included Stamp & Registration Department, PWD, Department of Archives and Maharashtra Industrial Development Corporation, Maharashtra Legislative Assembly Secretariat.

A major project from the State Election Commission, Mumbai was also secured. The objective of this project is to produce an integrated electoral roll as per Election Commission guidelines using the available computerized database of voters from Maharashtra.

Attempts are underway to offer similar e-Governance solutions for the governments of Madhya Pradesh, Andhra Pradesh, Tamil Nadu, Rajasthan, Gujarat and Uttar Pradesh.

C-DAC is also setting up the Centre for e-Governance at Electronics Niketan, Ministry of Information Technology. This Centre will showcase popular applications running in the country in the area of e-Governance and create awareness among decision makers in the Central and State



Governments on various aspects of e-Governance.

C-DAC has been offering GIS based products and solutions. It has accordingly offered these products and services covering PCI products and Radarsat to a number of State and Central agencies for their mapping and resource management applications.

C-DAC has actively participated in developing a project proposal on Early Warning System for forecasting for agricultural use based on Geomatics and Data Warehousing. It has been selected as a Consultant at the National Centre for Disaster Management (NCDM) of Indian Institute of Public Administration (IIPA). C-DAC has also worked for developing an application on Forest Management Information System at Forestry Department of Madhya Pradesh.



Bharatiya Agro Industries Foundation (BAIF) is an NGO involved in the development of watersheds in six states. C-DAC, with BAIF has worked to demonstrate the efficacy of remote sensing data in watershed development at Bundi District of Rajasthan.

GIS helps crime officers locate potential crime sites by examining complex seemingly unrelated criteria and displaying them in a graphical, layered, spatial interface or map. C-DAC has proposed the implementation of a project on crime analysis using GIS with the State Police Organisation.

EDUCATION AND TRAINING



Advanced Computing Training School

C-DAC's Advanced Computing Training School (ACTS) is dedicated to creating high quality manpower for C-DAC in particular and for the IT industry in general, by way of designing and delivering various courses. The courses are offered through a network of 64 Authorised Training Centres (ATCs) in India, besides C-DAC's own centers in Pune, Delhi, Hyderabad and Bangalore. These courses have been very popular and sought after by students across the country. This operation registered a business of Rs. 45 crores during the year.

The courses currently offered by ACTS are:

Diploma in Advanced Computing (DAC)

The DAC course prepares graduates for the software industry by providing them with skills in tools and methodologies of software development.

Diploma in Information Technology (DIT)

This course caters to those who wish to make intelligent use of computers in their profession.

The Government of Maharashtra has approved this course for their employees to get introduced to IT in pursuance of their IT Policy.

Advanced Diploma in Information Technology (ADIT)

The course is aimed at training those who are keen to venture into software development for small and medium size business applications.

Diploma in VLSI Design (DVLSI)

This is a specialised course designed to offer skills in various aspects of Very Large Scale Integrated (VLSI) circuits design covering both hardware and software tools.

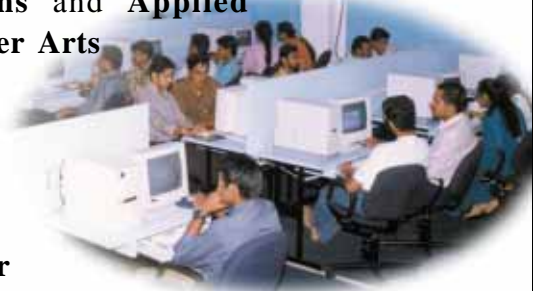
Cocurricular Diploma in Advanced Computing (CoDAC), is a newly introduced, three year part time course, which can be taken up by students while pursuing any degree course, and by working professionals while pursuing a career or profession. It aims at developing the learner to become directly employable as a world class software and application developer.

Preparatory Course for Diploma in Advanced Computing (PreDAC)

This offers an opportunity to students aiming to prepare for the Diploma in Advanced Computing course.

Multimedia & Computer Arts Training

C-DAC's National Multimedia Resource Centre (NMRC) launched the **Low Cost Multimedia Creations and Applied Computer Arts**



Courses and Number of Students registered during the year

<i>Sr.No</i>	<i>Name of the Course</i>	<i>No. of Students</i>
01	Diploma in Advanced Computing (DAC)	3055
02	Diploma in VLSI Design Course (DVLSI)	70
03	Diploma in Information Technology (DIT)	53860
04	Advanced Diploma in Information Technology (ADIT)	532
05	Cocurricular Diploma in Advanced Computing (CoDAC)	296
06	Diploma in Advanced Computer ARTS (DACA)	162
07	Low Cost Multimedia Creations	97
08	Applied Computer Arts	57
09	Pre-Diploma in Advanced Computing (PreDAC)	158
10	Diploma in Business Computing (DBC)	166



Certificate courses of duration of nine weeks each. The former is aimed at Photographers, Video Shooting Professionals, Fine Artists, Facilitators, Secretarial Staff and Event Managers. The latter, has been designed keeping in mind students, graduates, housewives and those who plan to work in the advertising and publishing industry.

Diploma in Advanced Computer Arts (DACA) has been redesigned as per the requirements of those who wish to seek to use multimedia technology in their profession, like Architecture, Fine Arts, Film production or TV Programming. Around 160 students were trained during the course conducted at centres in Mumbai, Ahmedabad, Coimbatore and Alandi near Pune.

A training program for the faculty members from eleven different Authorized Training Centres from Maharashtra state was also organized during June 1999.

The **Programme for Advancing Computer Education (PACE)** of C-DAC was developed to impart training in essential and basic computing using Indian languages.

Since April 2000, C-DAC has restructured the PACE programme to establish standard quality centers and has established a network of over 500 centers spread across India with the help of state level agencies in different states.

INFRASTRUCTURE AND FACILITIES

C-DAC's operations are spread over Pune, Bangalore, Delhi, Hyderabad as full fledged Centres, and cells at Chennai and Calcutta. The infrastructure and facilities available in an organization are of prime importance and significantly contribute to the productivity, efficiency and its work culture. At C-DAC key infrastructures are designed to be contemporary, comprehensive and cover the following :

National PARAM Supercomputing Facility (NPSF)



C-DAC has established the National PARAM Supercomputing Facility (NPSF) in the Pune University campus to provide supercomputing facility to industries and research and academic institutes in India that need such a facility to process their diverse applications. The PARAM 10000 has been installed at NPSF making this facility the largest supercomputing facility in India and one of the largest in Asia.

A small 4-node configuration of PARAM 10000 has also been set up at C-DAC's Centre at Bangalore.

NPSF Technical Affiliation Scheme

With the express objective of encouraging use of this system in a cost-effective way, a scheme called Technical Affiliation Scheme has been recently introduced. This scheme encourages users interested in using the NPSF resources to enroll as a Technical Affiliate of NPSF. The scheme has been devised to facilitate the users from various industries as well as academic and R & D institutions to use the NPSF resources at a nominal charge.

Newly Developed Utilities for PARAM 10000

The System Administration Team which is responsible for maintaining the NPSF computing resources has recently developed two important utilities for the facility, which are being used. They are:

1. Dedicated Slot Booking Package

The PARAM 10000 is a cluster of 40 multiprocessor workstations (nodes) interconnected together using high performance system area network. Although all the 40 nodes can be used together as a large single supercomputer system, most of the users need a

scaled down configuration of the system for testing and processing their applications. Based on this observation, the system administration team members designed a dedicated slot-booking package, to allow the users to book the desired configuration of the machine in a dedicated mode. Once booked, in the specified configuration, the system is logically set aside for use by the user for the duration specified in the request.

2. Accounting Package

All Operating Systems have an accounting facility inbuilt in them. However such accounting systems mainly work for stand-alone systems. The newly developed accounting package generates a user-wise summary of machine usage by each user on PARAM 10000.

Quality Training Material on Parallel Processing

As part of the project sponsored by the Ministry of Information Technology for popularizing the use of PARAM 10000 among twelve premier academic institutions in India for research/academic pursuits, a workshop on Parallel Computing and Training Program on PARAM 10000 at each of the twelve premier institutes is to be conducted.

For conducting this workshop in an effective manner, the NPSF team members have prepared a set of quality training material on parallel processing. The training material also includes an elaborate set of parallel programs for hands on session, which will help programmers of parallel processing systems in getting real insight into parallel programming.

Remote Connectivity to PARAM 10000

To enhance the user base of NPSF facility, C-DAC is working towards providing remote connectivity to users from their own organizations/institutions. Such a connectivity on ISDN line has been already offered to select institutions.

Kiosk Interface

A kiosk terminal was developed for installation at NPSF to provide a bird's eye-view of the NPSF resources and its activities to the visitors of NPSF. Using this facility, visitors on their own can surf

through the various resources and activities of NPSF, without the help of the technical staff member. The kiosk facility has been designed to provide a full-fledged multimedia presentation of the resources and activities. A similar Kiosk has been set up at C-DAC main building to present its various activities.

Information Centre

C-DAC has a well-equipped library covering a range of subjects including technical, managerial, Indian heritage and general interest. Information is available in the form of books, publications, manuals, conference proceedings, video tapes, CDs. The library currently subscribes to more than 100 periodicals and maintains bound volumes of as many as twelve hundred earlier issues of periodicals, which serve as reference material to the members. The library houses more than 6,500 books on a wide range of subjects.

An e-clippings service provided daily on the Intranet for the members of C-DAC, serves as a point of ready reference on the happenings in the area of Information Technology in the country and worldwide. The library also provides a newspaper alert service to its members on the topics of interest and relevance. This e-clipping service in the form of IT news is also offered on Intranet and posted to senior officials in the Ministry of Information Technology.

Canteen

C-DAC provides a regular and hygienic canteen facility to its members. Spread over an area of 5000 sq feet, at its Pune and Bangalore Centres, the canteen facility is extended at subsidized rates to the members and is used extensively by members across all levels in C-DAC, all through the day and throughout the week.

Facilitation

The facilitation cell of C-DAC ensures the smooth running of the organization by ensuring that facilities and infrastructure in the area of water, electricity, transport, travel, residential and guest house accommodation are maintained and are available at all times.



Vigilance

With a view to ensure strict vigilance, C-DAC has streamlined its procedures in the purchase, accounts and stores departments. As per the requirement, concerned members are rotated in these job functions.

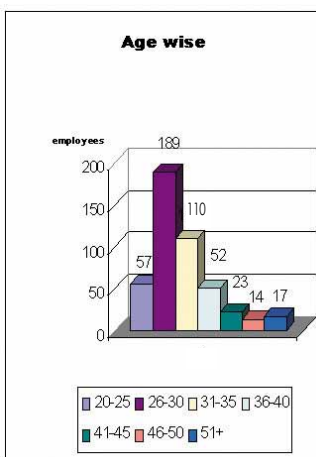
Hindi Cell

C-DAC's commitment to Hindi is manifest from the working of its Hindi cell, with a view to proliferate the use of Hindi in Information Technology. C-DAC has made pioneering contributions in developing tools and technologies to enable use of Hindi and other Indian languages on computers to diffuse Information Technology to the masses. Continuing this with tradition, a number of software packages have been developed in the year.

C-DAC also organizes workshops and seminars to promote the use of Hindi.

Intellectual Resource

An organisation is as good as its people. C-DAC's team of more than 450 professionals are committed to achieving the objectives it has set for itself. The open-door and employee friendly policies, unique work culture, exciting learning opportunities and cutting edge technology have largely been instrumental in retaining members and as compared to the trend in the IT companies, the rate of attrition in C-DAC has been around 10% which is well below the current rate in the industry.



CO-OPERATIVE VENTURES

In order to boost its R & D Business efforts and to build synergy among various activities of C-DAC and those of other related organisations, C-DAC signed Agreement / MoU with a number of organisations.

- Mindport of Netherland, a leading Media Commerce Technology provider for electronic pay media, Interactive applications and the Internet for collaborative development in the area of Multilingual Subtitling on DVB and Set-top-box based on the LIPS technology developed at C-DAC.
- Institute for Computer Aided Design (ICAD), Moscow, Russian Academy of Sciences - Programme of Co-operation in the area of high performance computing technology and applications.
- M/s PAM System International, France - Marketing Agreement for ESI Software Products
- Arthur C Clarke Institute for Modern Technologies of Sri Lanka - MoU for collaborative development programmes in the area of Information Technology.

WORKSHOPS, SEMINARS & EXHIBITIONS

C-DAC organised a number of national level workshops and seminars during the year.

- *Workshop on Parallel Computing Algorithms and Applications:* A five-day workshop was conducted from June 21 to June 25, 1999 at C-DAC, Pune. The objective of this workshop was to promote parallel computing for solving large-scale problems in science/engineering and commercial domains.
- Dr. V. Rajaraman of the Jawaharlal Nehru Centre for Advanced Scientific Research of the Indian Institute of Science, Bangalore delivered the Keynote address. During this workshop, C-DAC demonstrated a number of application projects that it has taken up to further achieve a leadership position in a critical technology like parallel processing.
- More than seventy-five participants from prestigious institutes like IIT-Mumbai, IIT-Kanpur, VSSC- Thiruvananthapuram, TIFR-Pune, IISc-Bangalore, ADA-Bangalore, NAL-Bangalore and several other research and development organizations attended the workshop.
- *Workshop on Bio-Informatics:* A one-day workshop was organized on December 17, 1999,

at C-DAC, Pune as a part of the “Biomolecular Structure and Modeling” by the Bioinformatics Centre, University of Pune. A number of participants from prestigious institutes like IIT-Mumbai, IIT-Kharagpur, CLRI-Chennai participated in the proceedings.

- *Workshop on CHARMM*: A four-day workshop on CHARMM (Chemistry at Harvard Molecular Mechanics) was organized during February 4 to 7, 2000 at C-DAC Pune.
- *Workshop on Computational Chemistry*: A national workshop on “Exploring Computational Chemistry, Ab initio Methodologies” was conducted during March 17-22, 2000 at Pune. It was well attended by several researchers/scientists from various Universities.
- C-DAC in association with the Indian Society of Geomatics (ISG) organised a *Geomatics in Electronic Governance* conference during January 21-22, 2000 and a pre-conference tutorial on “GIS in Utility Management” during January 18-20, 2000. Over 250 participants from all over the country attended the conference.
- An expert from Engineering Systems International (ESI), Malaysia conducted a workshop in March 1999 to demonstrate on PAM-CRASH. Another workshop was held in December to demonstrate PAM-CRASH and FEMCOMP.
- A Low Cost Multimedia Exhibition was organized at the National Multimedia Resource Centre. The Shaili CD ROM of decorative designs, Pre-authored multimedia templates and Dnyaneshwari CD ROM were the main exhibits on display.
- A research paper on ‘Multimedia Rendering of Spiritual Texts’ by Mr. Dinesh S. Katre was selected for presentation in ‘Virtual Systems and Multimedia’, an international conference organized in Dundee, UK
- Two Solaris Administration workshops for System Administrators from the IT Industry were conducted in April 1999 and December 1999.

C-DAC also showcased its products and expertise, in Pune IT.com, Bangalore IT.com

ELITEX 2000, Swadeshi Vigyan Mela, India World IT Comdex 1999 and IETF 1999 exhibitions.

AWARDS

- LEAP multilingual word processor received the PC Quest Users’ Choice Award as “the best Indian Language product” successively for the third year in 1999.
- iLEAP qualified as runners up for awards given by CSI for the category of “Best shrink wrapped product”.
- C-DAC was awarded the bronze medal by Sun Microsystems, South Asia for marketing the suite of Sun products in India.

FOUNDATION DAY

The Thirteenth Foundation Day of C-DAC was celebrated on April 4, 2000 on the auspicious occasion of Gudi Padwa, the Maharashtrian New Year day. Shri P. V. Jayakrishnan, Secretary, Ministry of Information Technology presided over the function. The Chief Guest, Dr F. C. Kohli, a well known software expert and Deputy Chairman of Tata Consultancy services, delivered the Foundation Day address and Dr R. A. Mashelkar, Director General, CSIR and Secretary Department of Scientific and Industrial Research, Government of India delivered the keynote address. They lauded the efforts of C-DAC in its various areas of activity and contribution in Information Technology. Shri R K Arora, Executive Director, C-DAC presented



Dr. F.C. Kohli releases the NMRC Portal CD, symbolizing its formal launch. Seen from, L to R : Shri R.K. Arora, Dr. N Chandrasekaran, Dr. R.A. Mashelkar and Shri P. V. Jayakrishnan.

the achievements of C-DAC during the year. A message received from Shri Pramod Mahajan, Hon'ble Minister of Parliamentary Affairs and Information Technology and Chairman, Governing Council of C-DAC was read out on the occasion. The Foundation Day witnessed the launch of a number of new products. On the occasion, C-DAC also organised a cultural evening, 'The Magic of Santoor', by Pandit Shiv Kumar Sharma.

Members who had completed a decade of service in C-DAC were recognized for their dedication to the organization. Sixteen other members were awarded certificates in recognition of their meritorious service to C-DAC.

WEB PRESENCE

C-DAC's web site can be accessed at www.cdacindia.com

The web site is highly interactive and is updated regularly. Information about C-DAC's activities, products, training programmes, workshops and seminars, achievements, awards received, press presence and career opportunities can be viewed on the web site. Details of admissions to the various training courses, results of students at the Training Centres and free downloads of software developed by C-DAC, preview of our products, is also available.

The Website recorded an average hit-rate of more than 100,000 hits per day, with more than 30,000 downloads recorded in the last calendar year.

Enterprise Wide Connectivity

C-DAC currently has four Centres located at Pune (Headquarters), Delhi, Bangalore and Hyderabad.

In addition to these, it has cells at Chennai and Calcutta each of which are individually networked.

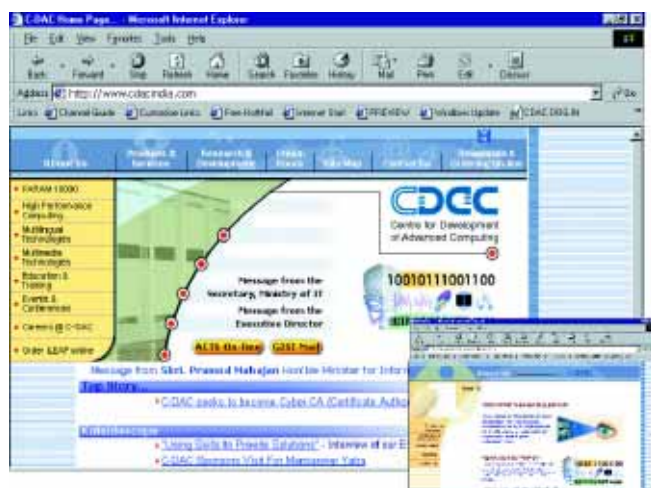
To maximally and efficiently harness the advantages of the resources, infrastructure and manpower at the four spatially located centres, they are being interconnected with a high-bandwidth, Wide Area Network (WAN). The design of the WAN has been completed and leased line connections at Bangalore and Delhi are already in place. The work of interconnecting the centres through a high-speed WAN is at an advanced stage of completion and a Video conferencing link is already established over ISDN between the Pune and Bangalore centers.

The main Network Operations and Command Center (NOCC) at Pune serves as the nerve center for inter-connectivity between leased line circuits and the Internet. To ensure adequacy of bandwidth and to prevent bottlenecks in data transmission, a 2Mbps Internet link is being established by upgrading from 512 kbps.

One of the major design features of this WAN is the comprehensive security to ensure the integrity and security of the servers and the information that is communicated through it. This will be achieved by establishing a Virtual Private Network (VPN), between the centres.

ACKNOWLEDGEMENTS

C-DAC would like to acknowledge and thank Shri Pramod Mahajan, Hon'ble Minister of Parliamentary Affairs and Information Technology and Chairman of the Governing Council; Shri P. V. Jayakrishnan, Secretary, Ministry of Information Technology and Vice Chairman of the Governing Council and Chairman of the Steering Committee for their continuous support, guidance and encouragement. C-DAC would also like to thank Dr. A.K. Chakravarti, Advisor, Dr. Om Vikas, Sr. Director, Shri W.R. Deshpande, Sr. Director, Shri J.S. Maini, Joint Secretary & Financial Advisor, and Smt. P.M. Singh, Jt. Secretary and other officials in the Ministry of Information Technology, Government of India, and the officials of Department of Official Language, Department of Science & Technology, Department of Scientific and Industrial Research for their co-operation and support. C-DAC would also like to take this opportunity to express its appreciation to all its valued clients and associates.





Shri P.V. Jayakrishnan, Dr. R.A. Mashelkar and Dr. F.C. Kohli light the inaugural lamp on the 13th Foundation Day of C-DAC. Shri R.K. Arora looks on.



The Hon'ble Minister of Parliamentary Affairs and Information Technology Shri Pramod Mahajan, visited C-DAC on December 12, 1999. Also seen from L to R : Dr. Ajit Karnik, Shri R.K. Arora & Dr. Pradeep Sinha.



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