National University of Sciences & Technology
International Collaboration Supporters

• Hafeez Hoorani
• Ian Willers
• Harvey Newman
• Richard McClatchey
• Diether Blechschdmit
Overview

• NUST and Its Programs
• NUST Institute of IT
• GRID Related Research at NUST
• Research Performance Analysis
• Future Vision
• Conclusion
BACKGROUND

- NUST Established 1991

- NUST Awarded Charter 1993
OBJECTIVES OF NUST

• To develop competent scientific and technical manpower having international level of higher education in order to meet the country’s public and private sector needs
OBJECTIVES OF NUST

• To help speedy attainment of capability in newly emerging fields of sciences, engineering and technologies, by coordinating technological/scientific areas of national interest

Contd.
OBJECTIVES OF NUST

• To provide a forum for exchange of knowledge amongst the elite from the world of sciences and technology, both within and outside Pakistan
BASED ON DECENTRALIZED MULTI-CAMPUS CONCEPT
<table>
<thead>
<tr>
<th>COLLEGE/INSTITUTE</th>
<th>SPECIALIZATION</th>
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</thead>
<tbody>
<tr>
<td>1. College Of Civil Engineering Risalpur</td>
<td>• Civil Engineering</td>
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| 2. College of Telecomm Rawalpindi                      | • Telecomm Engg  
• Computer Software Engg  
• Cryptology/ Information Security |
| 3. College of Electrical & Mechanical Engineering Rawalpindi | • Electrical Engg  
• Mechanical Engg  
• Computer Engg  
• Mechatronics |
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<tr>
<th>COLLEGE/INSTITUTE</th>
<th>SPECIALIZATION</th>
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<td>4. College of Marine Engineering</td>
<td>• Electrical &amp; Electronics Engg</td>
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<td>Karachi</td>
<td>• Mechanical Engg</td>
</tr>
<tr>
<td>5. College of Aeronautical</td>
<td>• Aerospace Engg</td>
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<td>Engineering Engineering</td>
<td>• Avionics Engg</td>
</tr>
<tr>
<td>Risalpur</td>
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<tr>
<td>6. College of Medicine Rawalpindi</td>
<td>• Medicine</td>
</tr>
<tr>
<td></td>
<td>• Surgery</td>
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<td>• Dentistry</td>
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<td>SPECIALIZATION</td>
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<tr>
<td>7. National Institute of Transportation Risalpur</td>
<td>• Geotechnical Engg</td>
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<tr>
<td></td>
<td>• Structural Engg</td>
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<td>• Transportation Engg</td>
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<tr>
<td>8. Institute of Environmental Science and Engineering</td>
<td>• Environmental Engg</td>
</tr>
<tr>
<td>Rawalpindi</td>
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</tr>
<tr>
<td>9. NUST Institute of Management Sciences Rawalpindi</td>
<td>• Technology Management</td>
</tr>
<tr>
<td></td>
<td>• International Business and Marketing</td>
</tr>
<tr>
<td></td>
<td>• Finance and Investment</td>
</tr>
<tr>
<td>10. NUST Institute of Information Technology Rawalpindi</td>
<td>• Object Oriented Technologies</td>
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<tr>
<td></td>
<td>• Network Technologies</td>
</tr>
<tr>
<td></td>
<td>• Databases</td>
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<td>• E-Commerce</td>
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NUST INSTITUTES BEING ESTABLISHED AT ISLAMABAD (SECTOR H-12)

- INSTITUTE OF APPLIED ELECTRONICS AND COMPUTING (IAEC)
- INSTITUTE OF TELECOMMUNICATIONS
- RESEARCH INSTITUTE OF MICROWAVE AND MILLIMETER WAVE STUDIES (RIMMS)
- RESEARCH CENTER OF MODELING AND SIMULATION (RCMS)
- INSTITUTE OF GEOGRAPHICAL INFORMATION SYSTEM (IGIS) INCLUDING REMOTE SENSING AND SATELLITE IMAGERY
- NUST INSTITUTE OF INFORMATION TECHNOLOGY AND MANAGEMENT SCIENCES (NIIT & MS)
NUST INSTITUTES BEING ESTABLISHED AT ISLAMABAD (SECTOR H-12)

- CENTER FOR CYBER TECHNOLOGY AND SPECTRUM MANAGEMENT (CCT & SM)
- INSTITUTE OF MANUFACTURING ENGINEERING (IME)
- CENTER FOR CHEMICAL ENGINEERING AND MATERIAL SCIENCES (CCE&MS)
- RELOCATION OF NATIONAL INSTITUTE OF TRANSPORTATION (NIT)
- RELOCATION OF INSTITUTE OF ENVIRONMENTAL SCIENCE AND ENGINEERING (IESE)
- TECHNOLOGY INCUBATION CENTER (TIC) FOR COMMERCIALIZATION OF R&D OUTPUT OF NUST
• Stone laying ceremony of NUST Campus at Sector H-12, Islamabad
• Held on September 23rd 2002
• Plaque unveiled by Gen Pervez Musharraf
An Institute with a PROGRESSIVE Vision
The NUST Institute of IT Aspires:

- To be a **center of excellence** for quality IT education, where ideas are challenged.
- To be an institution whose environment fosters **creativity** and **productivity** among all faculty, staff and students.
- To occupy a position of **unique leadership** among national universities in research and scholarly achievements.
Programs Offered
PROGRAMS OFFERED

Post Graduate Programs

- PhD
- MIT

Under Graduate Programs

- BIT
- BICSE

Professional Courses
Research Groups
Research Groups

- Distributed and Grid Computing Group (DGCG)
  (Principal Investigator: Dr. Arshad Ali, Dr. Farooq Ahmad)

- NIIT Network Research Group (NNRG)
  (Principal Investigator: Dr. S.M.H. Zaidi)

  - Object Oriented and Database Technologies (NOODBarG)
    (Principal Investigator: Dr. Abaidullah Anwar)

- Artificial Intelligence Research Group (AIRG)
  (Principal Investigator: Dr. Usama Hassan)
NUST-CERN Collaboration

- Dec 2000: CERN scientists visited NUST (Hafeez Hoorani, Ian Willers, Richard McClatchey)
- Feb 2001: WISDOM II Project started at NUST with CERN and University of West England (UWE) UK
- April 2001: Monalisa module development started with Caltech (Iosif Legrand)
GRID Research Group at NUST
Collaboration Projects

- Little Monalisa and Development for MonaLisa Auto-topology Discovery Module -- Caltech, USA
- IP Network Topology Discovery -- Caltech, USA
- Grid Enabled Analysis Application for Handheld Devices -- Caltech, USA
- Java Based Claren Server for Physics Analysis -- Caltech, USA
- Data Warehousing Services for Grid -- Caltech, USA
- Establishment of CMS Production Centre and LCG Grid deployment -- CMS CERN
- Integration of Agents and Web Services in Semantic Grid -- Comtec Japan
- FIPA Compliant Multi Agent System -- Comtec Japan
Little MonALISA
Little MonALISA

• **Introduction**
  – System Resource Monitoring Tool
  – Monitors End Hosts in a Network

• **Features**
  – Platform Independent
  – Easy Module Integration
  – Dynamic Loading of Modules
  – Static Information
  – Dynamic Information
  – Textual and Graphic representation of parameter values
  – Pie Charts for Value Comparison
  – Desktop Customization

• **Current Status**
  – Application for end host monitoring has been developed
LML Architecture

3-Layered Architecture
- Information Gathering
- Data Repository and Control Mechanism
- Graphical User Interface
Future Work

• Standalone Installable and Configurable Application

• Integration with MonALISA
  – Discovery, Reporting of Parameters (Repository)

• Enhanced Network Monitoring
  – Web100 for network monitoring and auto tuning

• Security Mechanisms
IP Network Topology Discovery
Architecture

**Display Algorithm**
- Display Algorithm Starts
- Get Information from the OODB
- Draw The Topology

**Discovery Algorithm**
- Discovery Algorithm Starts
- Update OODB with the new Nodes detected and New Connections
- Discover New Nodes and New Connections

**XML Based Data Base (Xindice)**
- Of The Nodes and Their connections. In the form of a Tree. It also provides a way of communication Between the discovery and display algorithms
Current Status

- Tested existing Algorithms
- Proposed a new Display and Discovery Algorithm.
- Working on XML Based Database (Xindice).
- Working on creating efficient implementation on ping, trace route, ARP and RARP.

Future Work: Database designing, Implementation of Display and Discovery Algorithms
Grid Enabled Physics Application for Handheld Devices
Grid Enabled Physics Application for Handheld Devices

Team Members

- Julian Bunn
- Conrad Steenberg
- Eric Aslakson
- Arshad Ali
- M H Zaidi
- Ashiq Anjum
- Ahsan Ikram
- Atiya Azim
- Haider Altaf
- Rizwan Haider
- Tahir Azim
- Waqas-ur-Rehman
Current Status

- Two popular analysis apps ported to PDAs
  - JASOnPDA
    - Displays histograms and scatter plots from data in ROOT files
    - ROOT IO rewritten entirely to make it PDA-compatible
    - Authenticates itself with a secure “Grid portal” (Clarens) before accessing the data
  - WiredOnPDA
    - 3D display of event data from HepRep2 files
    - Most functionality from WIRED ported including:
      - 2D Translation & Rotation
      - Scaling
      - 3D rotation
      - Projections
Future Directions

• Currently the analysis environment on the PDA is not so “interactive”
• Optimizing algorithms and code for better performance
• Looking at other non-conventional ways of analysing data for a richer, more interactive user experience
  – Remote data analysis
  – Agents
    • Can be transported to data servers, analyze data and return the results
    • Can coordinate to form a load balancing system for optimal performance
• Surveying other JVMs and handheld devices towards which we can extend our work
Grid analysis demo by Caltech, CERN, KEK (Japan), Sinica (Taiwan), NUST (Pakistan), UERJ (Rio de Janeiro), PUB (Bucharest).
Java Based Claren Server for Physics Analysis

JClarens
JClarens Architecture

GRID ENABLED PORTAL (GEP)

WEB SERVER

Grid Security Infrastructure

Monitoring Service

Data Access
Virtual Organization Group Manager
Job Submission

Credential repository
SQL2ROOT
Job Transfer

AXIS

JET SPEED
• Two Dimensions of work:
  – **New architecture and services**
    • Hosting two types of services on Axis (system and file services)
    • Integrated JetSpeed with Axis
    • GSI Layer is providing the security functionality
    • One complete cycle is functional
    • XtremWeb – A Java-based, Open Source P2P framework is ready.
  – **Support for existing Clarens clients**
    • System Methods
    • File Methods
    • Echo Method
    • Proxy methods (in progress)
    • All the above methods have been tested through both Python & Java clients
Future Direction

• Virtual Organization Group Management (VOGM) and Access Control List (ACL) implementation

• New Architecture Development
  – Concentrating on developing several services (SQL2ROOT) and integrating them with in the architecture
  – P2P platform for coordination between JClarens servers
  – Monitoring, Load balancing and Fault Tolerance

• Agents implementation to access the services in a P2P platform

• Integration of Agents and P2P in new architecture
Data Warehousing Services for Grid

Integration of Databases and Data warehouses in Grid using Grid framework/Web Services
Data Marts
Metadata
Monitoring Information
Data Retrieval
Data Administration & Management
Data Marts
Metadata Services
Lookup Services
Data Consumers
Data Analysts
Application Developers
Lookup Service is accessed.

Data Consumers
Data Analysts
Application Developers

Data Marts
Virtual Data Warehouse
Relational DB
XML-based DB
File-based Data
Virtual Data Transfer

Grid Services provide all the connections among components of the framework.

Metadata
Monitoring Information
Data Retrieval
Data Warehousing Services for Grid

Current Status:

– Problem Domain Study completed: including Grid, Web services, OGSA, Globus Toolkit, Data Warehousing
– Explored C/C++ Web Services Toolkits
– Web Services created to access, manage, administer data remotely using Apache Axis
– Working on Grid Data Services
• Future Work

– Building Web/Grid Services that handle multiple DB.
– Managing and accessing distributed & heterogeneous DB.
– Integrating Data Warehouses and Mediators.
– Integrating Monitoring Services.
– Integrating Metadata search and lookup services.
Establishment of CMS Production Centre at NUST
Team Members

- Dr. Arshad Ali
- Mr. Kamran Munir
- Fawad Nazir
- Tallal Rabani
- Atif Mehmood
- Adeel Zafar

CMS-CERN Coordinators

Hafeez Hoorani
Ian Willers
Asif Osman
Current Status:

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<th>Production Started:</th>
<th>Fri, October 3, 2003</th>
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<tr>
<td>jetmet Event Produced:</td>
<td>0.25 Million</td>
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<tr>
<td>Data Generated:</td>
<td>12.23 GB (approx)</td>
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<tr>
<td>Data Uploaded at CERN</td>
<td>8.6 GB (approx)</td>
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Current Hardware Setup:

<table>
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<tr>
<th>Number of CPUs</th>
<th>10</th>
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<tbody>
<tr>
<td>Storage Space</td>
<td>0.5 TB</td>
</tr>
<tr>
<td>Network speed</td>
<td>384kbps</td>
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</tbody>
</table>

P-4, 2.4GHz, 1 GB RAM, ISDN
Production assignment ID via Email from CERN

Request Data from Tier 1 with respect to assignment id

Download Data from Tier-1 to Local Production Server

NIIT

Analyze Production Assignment

- Assignment ID e.g. 3223
- Application Name e.g. CMKIN
- DAR File e.g. CMKIN_1_0_2

Production Server

Job Declaration

Job Creation

Job Submission

Production Server McJobRun

PBS Server

Job Execution

After job execution results submitted back to Production Server, then uploaded SRB at CERN
Future Work

Participation in LCG-1 development and deployment

Planning to have (Next Two Months)

| Number of CPUs | 30 | P-4, 2.4GHz, 1 GB RAM |
| Network speed  | 1 MB | ISDN |
| SCSI Tape Drive | 1 | 20/40GB SLR |
Integration of Agents and Web Services in Semantic Grid:
Integration of Agents and Web Services in Semantic Grid:

Team Members

- Dr. Farooq Ahmad
- Dr. Arshad Ali
- Kashif Iqbal
- Aatif Kamal
- Naveed Baqir
Proposed Architecture

Autonomous Decentralized Fault Tolerance
Scalable Directory Facilitator (Hold Services)
Reliable and Scalable Message Transport System
Multi Agent System

Current Status

• Complete Analysis and Design by using UML and XP paradigm.
• Identified Work Packages (AMS, DF etc.)
• Used different design patterns for flexible design
  – Agent Design Patterns (Master/Slave)
    » Observer Pattern
    » Command Pattern
    » Singleton Pattern etc

Development phase: 40% completed
Multi Agent System

Future Work

• Designing and Development of distributed architecture of MAS

• Autonomous Decentralized Fault Tolerant MAS Architecture

• Scalable DF Architecture

• Lightweight MAS Architecture
Collaboration With Keyung Hee University
Seoul Korea

Context-aware Self-Managing Component Frameworks
Research Area

Context-awareness

- the presentation of information and services to a user
- the automatic execution of a service and/or
- the tagging of context to information for later retrieval

According to Szyperski, a software component can be deployed independently and is subject to composition by third parties. [Szyperski98]

Self-Managing

An application knows it’s in need of a functionality to perform a task, given by the user, and it’s able to adapt to somehow accept the interaction of a set of components.

Component Frameworks
Architecture

Generic Server Interfaces

Factory

Middleware Autonomous Component Framework

Request Broker Framework

Mobile Network

Client A
Laptop

Client B
Mobile Device

Client C
PDA

Client D
Laser Range Finder

reflect config instructions
Future Work

• Architecture similar to Open ORB
• The application would replace the component in dynamic environment
• Personality definition/change to make the application adopt new behaviors
Performance Measures

- Need to look at measures of research group success to assess potential
  - No of Research Students (MS/PhD Completed)
  - Research Funding
  - Research Papers Published
Total: 1.69 Mil USD

- Ms/PhD funding
- Students visits
- Lab equipment
- CERN fellowship
- PC-1 Govt of Pakistan
<table>
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<th>Years</th>
<th>International Publications</th>
<th>Internal Papers &amp; Report</th>
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<td>2001</td>
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<td>2002</td>
<td>3</td>
<td>8</td>
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<td>2003</td>
<td>4</td>
<td>10</td>
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<td>Total</td>
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SWOT Analysis
Strengths, Weaknesses, Opportunities, Threats

🌟 Strengths:
- Good research enthusiasm among faculty /students
- Building strong collaboration with CERN, Caltech, UWE UK, UoS France, BIT China and Comtec Japan
- Faculty Expertise development in cutting edge technologies
- Web presence with acclaimed scientific organizations
- Participation in international projects and funding from international agencies
SWOT Analysis
Strengths, Weaknesses, Opportunities, Threats

• Weaknesses:

🌟 General lack of research culture – Require extra ordinary efforts in generating research interests
🌟 Low BW connectivity – serious bottleneck
🌟 Funding constraints
🌟 No post doctoral fellows- Major research strength
🌟 Limited expertise in writing research proposals etc
• **Opportunities:**
  - International level research exposure through:
    - CERN
    - Caltech
    - UWE UK
    - UoS France, BIT China, Comtec Japan
  - Getting more involved with EU and US funded projects
  - International funding for MS/PhD students
  - Financial revenue
• Threats:

- Bureaucratic procedures
- Limited internal/external funding
- Little or No incentives for researchers
- Acquisition & retention of high quality researchers

Our strengths are focused research, good international collaboration and boundless enthusiasm!
Future Vision
Future Vision - Five years

- Strong research culture-- Develop independent research groups
- Enhance the scientific profile of NUST among international scientific community
- 15+ conference / journal papers per year
- Expand local/external funding opportunities
- Enhance the PhD output in IT
Conclusion

- Six students undergoing PhD studies (UWE, CERN, KOREA) as continuation of their initial CERN related research conducted at NUST

  Nine students benefited from visits to CERN

  A rich research culture has been established at NUST

  The knowledge gained is being applied in developing a PTCL network monitoring application for real time performance monitoring, fault reporting and congestion control

  A Grid enabled knowledge management system being developed at NUST for Heart Diseases Diagnostics
Thanks

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URL: www.niit.edu.pk