



2006-2007

# Research Booklet

**NUST Institute of Information Technology (NIIT)**

A Center of Excellence for Quality Education and Research

# CONTENTS:

|         |   |    |
|---------|---|----|
| 1.1     | <b>NIIT Networks Research Group (NNRG)</b> .....                                  | 8  |
| 1.1.1   | Theme.....  | 8  |
| 1.1.2   | Overall Objectives.....   | 8  |
| 1.1.3   | Application domain .....  | 8  |
| 1.1.4   | Group Members (Academic and administrative) .....                                 | 8  |
| 1.1.5   | Publications during period 2006-07 .....  | 9  |
| 1.1.6   | Organization of conferences and workshops in 2006-07 .....                        | 9  |
| 1.1.7   | Associated Labs.....  | 10 |
| 1.1.8   | Research Projects .....   | 10 |
| 1.2     | <b>Data Engineering for Large Scale Applications (DELSA) Research Group</b> ..... | 20 |
| 1.2.1   | Theme.....  | 20 |
| 1.2.2   | Overall Objective .....   | 20 |
| 1.2.3   | Application Domain .....  | 20 |
| 1.2.4   | Group Members.....  | 20 |
| 1.2.5   | Associated Labs.....  | 21 |
| 1.2.6   | Research Projects .....   | 21 |
| 1.2.6.2 | <i>Past Projects</i> .....  | 22 |
| 1.2.7   | International Collaboration.....  | 22 |
| 1.2.8   | Publications .....  | 23 |
| 1.3     | <b>Group for Research in ASIC and FPGA (GRAF)</b> .....                           | 24 |
| 1.3.1   | Theme.....  | 24 |
| 1.3.2   | Overall Objectives.....   | 24 |
| 1.3.3   | Application domain .....  | 24 |
| 1.3.4   | Group Members.....  | 24 |

|            |   |           |
|------------|---|-----------|
| 1.3.5      | Publications .....  | 25        |
| 1.3.6      | Organization of Conferences and Workshops in 2006-07 .....  | 25        |
| 1.3.7      | Associated Research lab .....   | 25        |
| 1.3.8      | Research Projects .....   | 26        |
| 1.3.9      | Projects with the industry .....  | 29        |
| 1.3.10     | Contracts and Grants obtained .....   | 29        |
| <b>1.4</b> | <b>Group for Research in Reconfigurable Architectures for Security in Communication (GRASiC).....</b> | <b>30</b> |
| 1.4.1      | Theme.....  | 30        |
| 1.4.2      | Overall Group Objective .....   | 30        |
| 1.4.3      | Application Domain .....  | 30        |
| 1.4.4      | Group Members.....  | 30        |
| 1.4.5      | Publications during period 2006-2007 .....  | 31        |
| 1.4.6      | Associated Labs.....  | 31        |
| 1.4.7      | Research Projects .....   | 31        |
| 1.4.7.1    | Projects with Industry .....  | 31        |
| 1.4.8      | Contract and Grants Obtained .....  | 31        |
| <b>1.5</b> | <b>Wireless Network Research Lab (WisNeT) .....</b>   | <b>32</b> |
| 1.5.1      | Theme.....  | 32        |
| 1.5.2      | Group Objective .....   | 32        |
| 1.5.3      | Application Domain .....  | 32        |
| 1.5.4      | Members.....  | 32        |
| 1.5.5      | Publications .....  | 33        |
| 1.5.6      | Organization of Conferences and Workshops .....   | 34        |
| 1.5.7      | Associated Labs with WisNet .....   | 34        |
| 1.5.8      | Research projects.....  | 35        |
| 1.5.9      | Projects with Industry.....   | 37        |

|            |  |           |
|------------|--|-----------|
| 1.5.10     | Contracts and grants obtained.....   | 37        |
| <b>1.6</b> | <b>RFID Research Group .....</b>   | <b>39</b> |
| 1.6.1      | Theme.....   | 39        |
| 1.6.2      | Overall Objectives.....  | 39        |
| 1.6.3      | Application Domain .....   | 39        |
| 1.6.4      | Group Members.....   | 39        |
| 1.6.5      | Associated Labs.....   | 39        |
| 1.6.6      | Projects with the industry .....   | 39        |
| <b>1.7</b> | <b>NIIT Distributed &amp; Grid Computing Group.....</b>                      | <b>40</b> |
| 1.7.1      | Theme.....   | 40        |
| 1.7.2      | Overall objectives.....  | 40        |
| 1.7.3      | Application domain .....   | 40        |
| 1.7.4      | Group Members.....   | 40        |
| 1.7.5      | Publications .....   | 41        |
| 1.7.6      | Associated Labs.....   | 41        |
| 1.7.7      | Research Projects .....  | 41        |
| 1.7.8      | International Collaboration.....   | 42        |
| 1.7.9      | Contracts and Grants Obtained.....   | 43        |
| <b>1.8</b> | <b>Center for High Performance Scientific Computing Research Group .....</b> | <b>44</b> |
| 1.8.1      | Theme.....   | 44        |
| 1.8.2      | Group Objectives.....  | 44        |
| 1.8.3      | Application Domain .....   | 44        |
| 1.8.6      | Organization of conferences and workshop in 2006-2007 .....                  | 45        |
| 1.8.7      | Associated Labs.....   | 45        |
| 1.8.8      | Research Projects .....  | 45        |

|             |   |           |
|-------------|---|-----------|
| 1.8.9       | Grants Obtained.....                                  | 46        |
| <b>1.9</b>  | <b>Nanotechnology Research Group .....</b>            | <b>47</b> |
| 1.9.1       | Theme.....  | 47        |
| 1.9.2       | Overall Objectives.....                               | 47        |
| 1.9.3       | Application Domain .....                              | 47        |
| 1.9.4       | Group Members.....                                    | 47        |
| 1.9.5       | Publication.....                                      | 47        |
| 1.9.6       | Associated Labs.....                                  | 48        |
| 1.9.7       | National Collaboration.....                           | 48        |
| 1.9.8       | Research Projects.....                                | 48        |
| 1.9.9       | Grants Obtained.....                                  | 49        |
| <b>1.10</b> | <b>Industrial Automation &amp; Control Group.....</b> | <b>50</b> |
| 1.10.1      | Theme .....   | 50        |
| 1.10.2      | Overall Objectives .....                              | 50        |
| 1.10.3      | Application Domain .....                              | 50        |
| 1.10.4      | Group Members.....                                    | 50        |
| 1.10.5      | Associated Labs.....                                  | 51        |
| 1.10.6      | Research Projects.....                                | 51        |
| <b>1.11</b> | <b>Embedded System Research Group .....</b>           | <b>52</b> |
| 1.11.1      | Theme .....   | 52        |
| 1.11.2      | Overall Objectives .....                              | 52        |
| 1.11.3      | Application domain .....                              | 52        |
| 1.11.4      | Group Members (Academic and administrative).....      | 52        |
| 1.11.5      | International Conferences and Workshops.....          | 53        |
| 1.11.6      | Labs associated with your research group .....        | 53        |

|        |   |    |
|--------|---|----|
| 1.11.7 | Projects with the industry .....                            | 53 |
| 1.12   | <b>Reconfigurable Computing Research Group</b> .....        | 56 |
| 1.12.1 | Theme .....   | 56 |
| 1.12.2 | Overall Objectives .....                                    | 56 |
| 1.12.3 | Application domain .....                                    | 56 |
| 1.12.4 | Group Members (Academic and administrative).....            | 56 |
| 1.12.5 | International Conferences and Workshops .....               | 57 |
| 1.12.6 | Associated Labs .....                                       | 57 |
| 1.13   | <b>Muhaqiq</b> .....  | 57 |
| 1.13.1 | Theme .....   | 57 |
| 1.13.2 | Group Objectives .....                                      | 58 |
| 1.13.3 | Application Domain .....                                    | 58 |
| 1.13.6 | Organization of conferences and workshop in 2006-2007 ..... | 59 |
| 1.13.7 | Associated Labs .....                                       | 59 |
| 1.13.8 | Research Projects.....                                      | 59 |
| 1.13.9 | Grants Obtained.....  | 61 |
| 1.14   | <b>Information Security Research Group</b> .....            | 62 |
| 1.14.1 | Theme .....   | 62 |
| 1.14.2 | Objectives .....  | 62 |
| 1.14.3 | Application Domain .....                                    | 62 |
| 1.14.4 | Group Members.....  | 62 |
| 1.14.5 | Labs associated with the research group.....                | 63 |
| 1.14.6 | Research Projects.....                                      | 63 |
| 1.15   | <b>Autonomous Semantic Grid Research Group</b> .....        | 65 |
| 1.15.1 | Theme .....   | 65 |

|        |  |    |
|--------|--|----|
| 1.15.2 | Overall Objectives .....                         | 65 |
| 1.15.3 | Application domain .....                         | 65 |
| 1.15.4 | Group Members (Academic and administrative)..... | 65 |
| 1.15.5 | Publications 2006-07 .....                       | 67 |
| 1.15.6 | Associated Labs.....                             | 71 |
| 1.15.7 | Research projects.....                           | 71 |
| 1.16   | <b>3G Communication Research Group</b> .....     | 72 |
| 1.16.1 | Theme.....                                       | 72 |
| 1.16.2 | Overall Objectives.....                          | 72 |
| 1.16.3 | Application Domain .....                         | 72 |
| 1.16.4 | Group Members.....                               | 72 |
| 1.16.5 | Associated Lab .....                             | 73 |
| 1.16.6 | Research Projects.....                           | 73 |
| 1.16.7 | Grants Obtained.....                             | 75 |

## 1.1 NIIT Networks Research Group (NNRG)

### 1.1.1 Theme

NIIT Network Research Group (NNRG) was established in 1999 by Dr. S. M. Hassan Zaidi. NNRG promotes education, research and outreach in the field of computer networks, and ultra-high speed data communications including photonics/wireless communications.

### 1.1.2 Overall Objectives

Its mission is to prepare the next-generation of researchers and developers in these areas by investigating challenging, high-impact research projects and building production-quality systems. It aims to represent a complementary mix of both theoretical and applied experimental research.

### 1.1.3 Application domain

- Passive Optical Networks
- Switching in Optical Networks
- Radio Over Fiber
- Bandwidth Allocation in Optical Networks

### 1.1.4 Group Members (Academic and administrative)

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## Students

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- Ms. Raqeema Akhter, *MS by research*
- Mr. Faaiz Hussain, *MS by research*
- Mr. Haider Raza, *MS by research*
- Mr. Amar Rafiq, *MS by research*
- Ms. Maryam Multani, *MS by research*

### 1.1.5 Publications during period 2006-07

- Muhammad Kamran, Dr. S. M. H. Zaidi, Muhammad Ramzan, "Dynamic Bandwidth Allocation Algorithms in TDM Ethernet Passive Optical Networks: A Review", ICOCN 2007, Islamabad
- Mansoor Gul Toor, Dr S.M.H Zaidi, Kamran Hussain Zaidi, "Dynamic Bandwidth Allocation in WDM Ethernet Passive Optical Networks: A Review", ICOCN 2007, Islamabad
- Ammar Rafiq, Muhammad Ramzan, S. M. H. Zaidi, "Comparative Analysis of scheduling frameworks for efficient wavelength utilization in WDM EPON", ICEE 2007, UET Lahore
- Fawad Khan, S. M. H. Zaidi, "Ethernet Passive Optical Network (EPON) System with Triple Tray Support for NUST Access Network" December 16, 2006, 4th International Workshop on Multi Agent Systems and Semantic Grid (MASSG 2006)
- Fawad Khan, S. M. H Zaidi, Kamran Hussain Zaidi, "Triple Play Over FTTX – Challenges and Resolutions (A Review), April 26 2007, One day International Workshop on Connection Oriented Networks, MPLS, GMPLS and Optical Networks.
- "Dynamic Bandwidth Allocation Algorithms for Hybrid EPONs: A Review", M. K. Multani, S. M. Hassan Zaidi, HONET 2006

### 1.1.6 Organization of conferences and workshops in 2006-07

#### 1.1.6.1 International Conferences and Workshops

- **HONET 07, Dubai, UAE:** Co-organized by NIIT and UNCC
- **One day International Workshop on Connection Oriented Networks, MPLS, GMPLS and Optical Networks:** NNRG organized a one day International Workshop on 27<sup>th</sup> April 2007. Dr. Harry G Perros, from North Carolina State University, was one of the keynote speakers. He also delivered lecture to students on consecutive days after the workshop.
- **HONET 06, Charlotte, USA:** Co-organized by NIIT and UNCC

- **One day International Workshop on Broadband Networks:** NNRG organized a one day International Workshop on Broadband Networks on 9<sup>th</sup> May 2002 in collaboration with ZTE Corporation of China at HQ NUST. Speakers at the workshop included 3 group members of NNRG:
  - Dr. M. H. Zaidi presented “IP over DWDM”
  - Mr. Nadeem Ahmed presented “IP over ATM”
  - Mr. Ali Hammad presented “Optical Filter Design”
  
- **One day International Workshop on Advanced Network Technologies:** NNRG organized a One day International Workshop on Advanced Network Technologies. The focus of the workshop was mainly on *Mobile Communication Technologies* and *Network Security*. The key note speakers included:
  - Mr. Jhanzaib Mailk (Motorola USA)
  - Dr. S.M.H. Zaidi (NIIT)
  - Mr. Nadeem Ahmed (NIIT)
  - Mr. Ali Hammad Akber (NIIT)
  - Mr. Kamran Shafi (NIIT)
  - Mr. Kashif Sharif (NIIT)
  - Ms. Madiha Zafar (NIIT)

### 1.1.7 Associated Labs

Photonic Networks Research Lab

### 1.1.8 Research Projects

#### 1.1.8.1 International Collaboration

##### 1.1.8.1.1 Current projects

#### a) NUST Survivable Ethernet Passive Optical Network (EPON )based Optical Access Network with Triple Play Support

**Researcher:** Mr. Fawad Khan

**Advisor:** Dr. S M H Zaidi

**Co-Advisor:** Mr. Kamran Hussain

**Committee 1:**

**Committee 2:**

**Committee 3:**

Lt. Col. Naveed Khatak

Maj. Ather Mohsin Zaidi

Asst. Prof. Tauseeq Ahmed

#### Motivation

Currently available technologies such as dial-up, Integrated Services for Digital Network (ISDN), cable modems and Digital Subscriber Line (DSL) are inadequate to support bandwidth intensive applications like telephony, Video On Demand (VOD),

grid computing and video conferencing (triple play applications) etc. This problem is termed as “access bottleneck”.

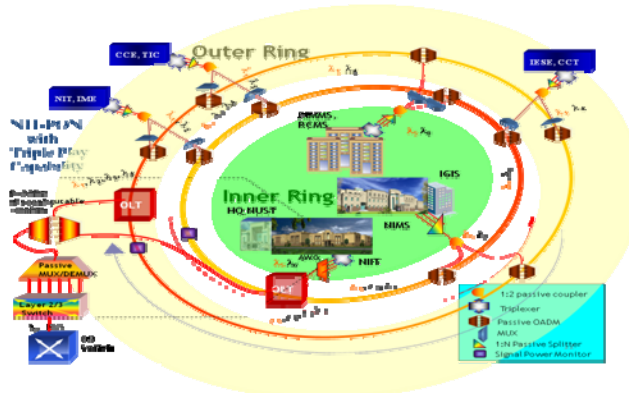
Integration and delivery of next generation services of data, voice and video (triple play) at acceptable BER values for digital transmission and Signal to Noise Ratio (SNR) in case of video, is a great challenge. Another aspect is to accomplish this challenge cost effectively. Passive Optical Networks (PONs) address the shortcomings of currently available technologies. Objective is to design a high capacity, cost effective and resilient hybrid (Time Division Multiplexing (TDM) and Wavelength Division Multiplexing (WDM)) dual ring access solution for H-12 university campus for NUST based on PON technology.

### Current Progress

The proposed architecture employs Ethernet Passive Optical Network (EPON) within last mile to address the access bottleneck issue. It uses digital transmission for data and voice service. Analog video service is realized using Radio Frequency (RF) overlay model. It utilizes sub carrier multiplexing scheme to provide analog video broadcast. Its low cost because existing schematics are used and the components are readily available. It uses standard wavelengths of 1490nm and 1550nm, set by ITU-T in accordance with IEEE 802.3ah (Ethernet in the First Mile (EFM) - EPON), for transmission of digital data, voice and analog video overlay respectively for downstream. Similarly, standard wavelength of 1310nm is used for upstream. Downstream is broadcast to ONUs from OLT whereas Time Division Multiple Access (TDMA) scheme is used for upstream.

The proposed architecture is capable to deliver triple play applications efficiently by validating through simulation technique considering different performance parameters. Validation of said architecture depicts that it is capable to achieve optimum performance attributes (BER, SNR) along with restoration model to ensure resiliency within the network for new H-12 NUST campus. Because of the fact, proposed solution makes use of passive components and existing schematics therefore it is cost effective. Hence, the proposed solution not only fulfils the desired requirement for availing triple play services efficiently but also achieves its objective cost effectively with network reliability support in the form of resilience.

In addition to that, architecture employs hybrid (TDM/WDM) scheme so that with growing bandwidth requirements, it can be scaled by adding WDM PONs with few modifications.



## **b) Dynamic Bandwidth Management for hybrid TDM/WDM EPONs**

**Researcher:** Ms. Raqeema Akhter

**Advisor:** Dr. S M H Zaidi

**Co-Advisor:** W/C Muhammad Ramzan

### **Problem Statement**

“To design a DBA/DWBA algorithm that can provide fair bandwidth and channel Allocation for different classes-of-Service at the expected or negotiated level to the heterogeneous ONU set”.

### **Introduction**

If we consider TDM PONs only, efficient dynamic bandwidth allocation is required that can resourcefully distribute the available bandwidth among the contending ONUs (for upstream data communication), as all ONUs share the common bandwidth.

In case of WDM PONs effective channel allocation and scheduling is required, as each ONU (ideally) support a unique wavelength. But for hybrid TDM/WDM PON an efficient and effective solution should take care of bandwidth scheduling and channel allocation. Similarly traffic management is necessary for providing differentiated class-of-services support. Therefore the proposed Dynamic Bandwidth Management (DBM) scheme for hybrid TDM/WDM with differentiated class-of-service provisioning consists of

- 1) Traffic Management
- 2) Bandwidth Management
- 3) Channel Management

#### **1. Traffic Management**

Traffic management entails differentiated services support by dividing the transmission cycle into :

- Fixed-cycle

Fixed-cycle is mainly for the EF traffic and its duration depends on the reported SLA requirements for EF traffic. Guaranteeing fixed bandwidth for EF traffic would result in reduced jitter, lower packet delays and lesser control messages.

- Variable-cycle

The variable-cycle is shared by AF and BE data traffic.

#### **2. Bandwidth Management**

Bandwidth should be properly managed between the ONUs that share same TX/RX channel. As EF bandwidth assigned to each ONU in Fixed-cycle is based on SLA , so remain constant in each transmission cycle.

But for non-EF traffic, DBM assigns bandwidth on two values:

- Adaptive Threshold

- Time.

### 3. Channel Management

Hybrid TDM/WDM PON can consist of both TDM and WDM ONU set. WDM-ONUs can support multiple channels simultaneously; so channel management is necessary to effectively exploit the available wavelength and bandwidth and load balancing. Wavelength channels are assigned to each WDM-ONU either on the basis of least supported wavelength or on the basis of minimum duration Fixed-cycle.

#### Conclusion

All in all the project assures a better , efficient and effective solution that should take care of bandwidth scheduling and channel allocation by considering traffic management that is necessary for providing differentiated class-of-services support. Therefore, the proposed Dynamic Bandwidth Management (DBM) scheme for hybrid TDM/WDM with differentiated class-of-service provisioning consists of

- 1) Traffic Management
- 2) Bandwidth Management
- 3) Channel Management

#### c) Performance Analysis of Optical Burst Switching (OBS) Networks

**Researcher:** Mr. Faaiz Hussain

**Advisor:** Dr. S M H Zaidi

**Committee 1:**

Dr. Nazar Abbas

**Co-Advisor:** Mr. Ali Haider

**Committee 2:**

W/C Muhammed Ramzan

#### Motivation

Optical Burst Switching (OBS) is a promising technology that has attracted a lot of the research interest in past few years. In OBS networks, contention resolution is one of the key factors in achieving low burst loss. With the efficient utilization of available resources we can minimize the burst loss probability which ultimately helps in improving overall system performance.

#### Current Progress

This work is focused at formulating an effective contention resolution scheme to achieve minimum burst loss. Algorithm of zero burst loss for bimodal burst switching is extended form single node star network topology to two node star topology and then a small mesh network of up to 3 nodes.

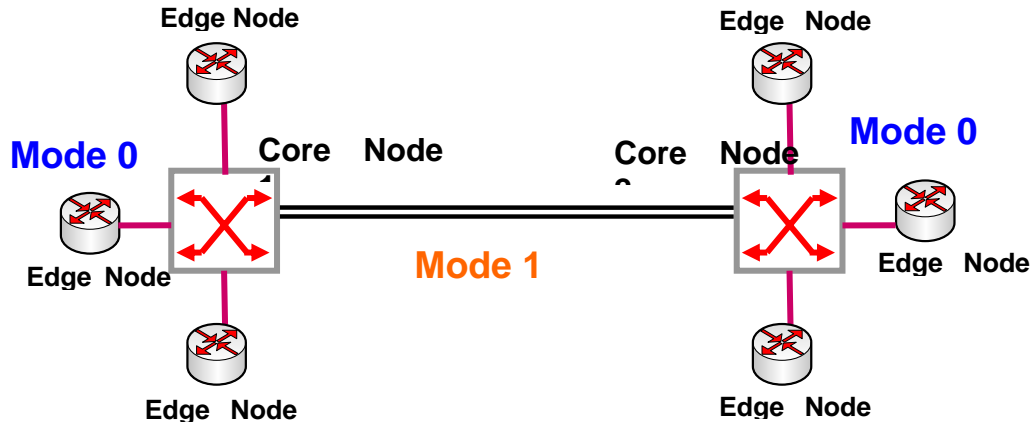


Figure: Two-node Star Network Topology

Interrupted Poisson process (IPP) is used for burst aggregation algorithm. Performance Analysis of the proposed architecture on the Pakistan Educational & Research Network (PERN) will be carried out by simulations.

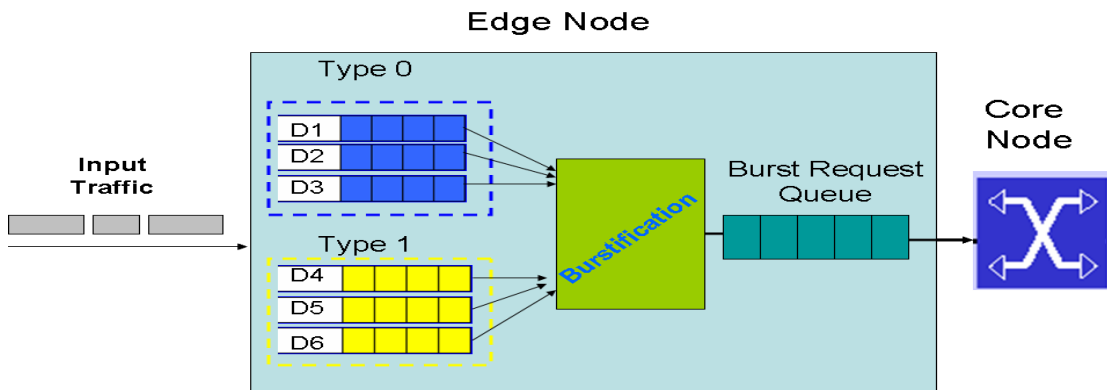


Figure: Burst Aggregation at Edge Node

#### D) FULL-DUPLEX WDM COMPATIBLE RADIO-OVER-FIBER SYSTEM ARCHITECTURE

**Researcher:** Mr. Haider Raza

**Advisor:** Dr. S M H Zaidi

**Committee 1:**

Dr. Yasin A Raja (UNCC)

**Co-Advisor:** Mr. Kamran Hussain

**Committee 2:**

W/C Muhammad Ramzan

#### Motivation

Radio-over-Fiber (RoF), 'integration of Optical/Wireless worlds' is a promising technology with a number of benefits including huge bandwidth, high reliability, transparency and flexibility that make it attractive to fulfill the future broadband bandwidth requirements.

The technology has three main features that include: use of higher frequencies (operating at microwave and millimeter-wave frequency band), deployment of smaller cells and centralized architecture. For a cost-effective solution proposed architecture and employed techniques are of foremost importance. We propose to design a cost-effective RoF system architecture with emphasis on two aspects namely full-duplex support and WDM compatibility.

### Current Progress

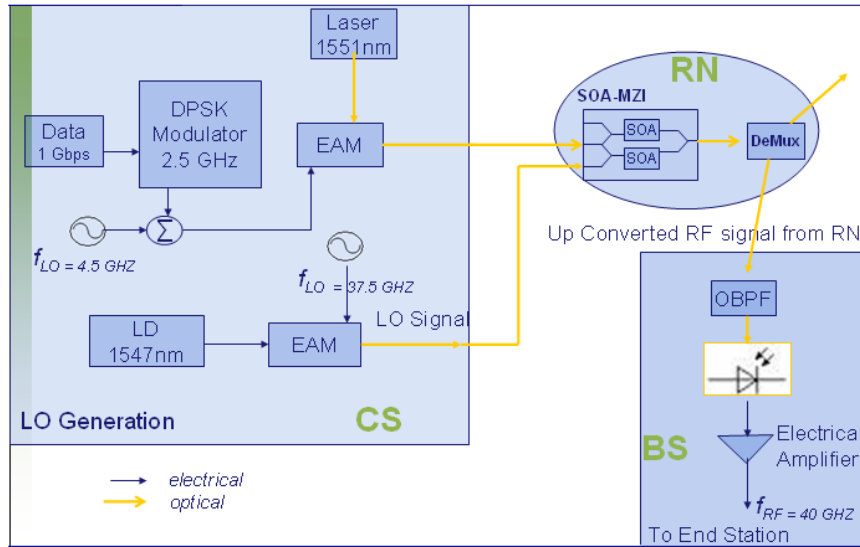


Figure: Proposed Downlink: Simultaneous All-Optical Up-conversion of Signals

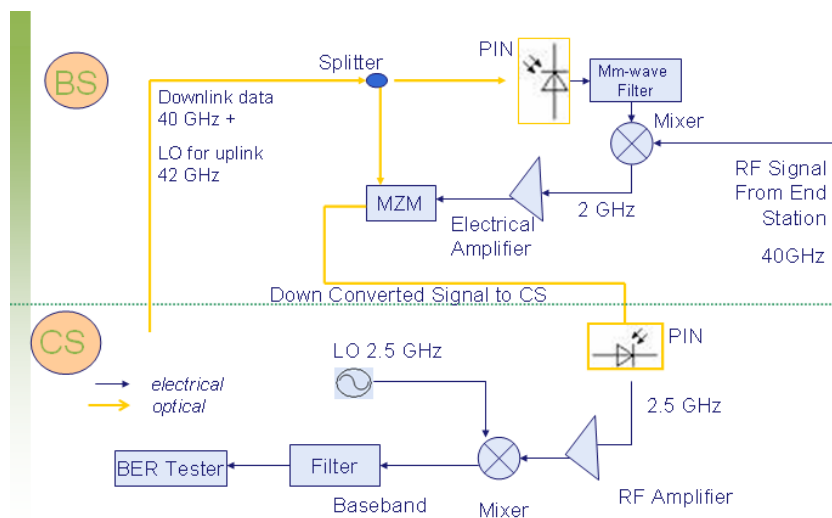


Figure: Proposed Uplink: Down-conversion of high RF to IF at BS

For a full-duplex WDM RoF solution, the proposed downlink scheme is based on simultaneous all-optical upconversion of signals. Where signals in intermediate frequency (IF) band along with local oscillator (LO) are generated in Control Station (CS) and upconverted to high RF at remote node (RN). For downlink transmission, photo-diode and an amplifier would be required at each Base Station (BS). For uplink, we propose to downconvert high RF signal to IF at BS. Local oscillator signal will be served by CS which is used to downconvert RF signal for uplink. Downlink optical carrier is extracted and reused for uplink data transmission. The above stated architecture is currently being simulated using OptSim™.

### **Future Directions**

- mm-wave generation techniques
- mm-wave transportation techniques
  - Optical Frequency Multiplexing (OFM), for WLAN applications using RoF approach
- Integration of RoF with WDM-PON system
- IPTV and HDTV over optical wireless
- Applications of radio-over-fiber technique in new areas other than in telecommunication

### **e) Time Quantum based Online Scheduler (TQOS)**

**Researcher:** Mr. Ammar Rafiq

**Advisor:** Dr. S M H Zaidi

**Committee 1:**

Mr. Umar Kalim

**Co-Advisor:** W/C Muhammad Ramzan

**Committee 2:**

Dr. Nasir Ghani

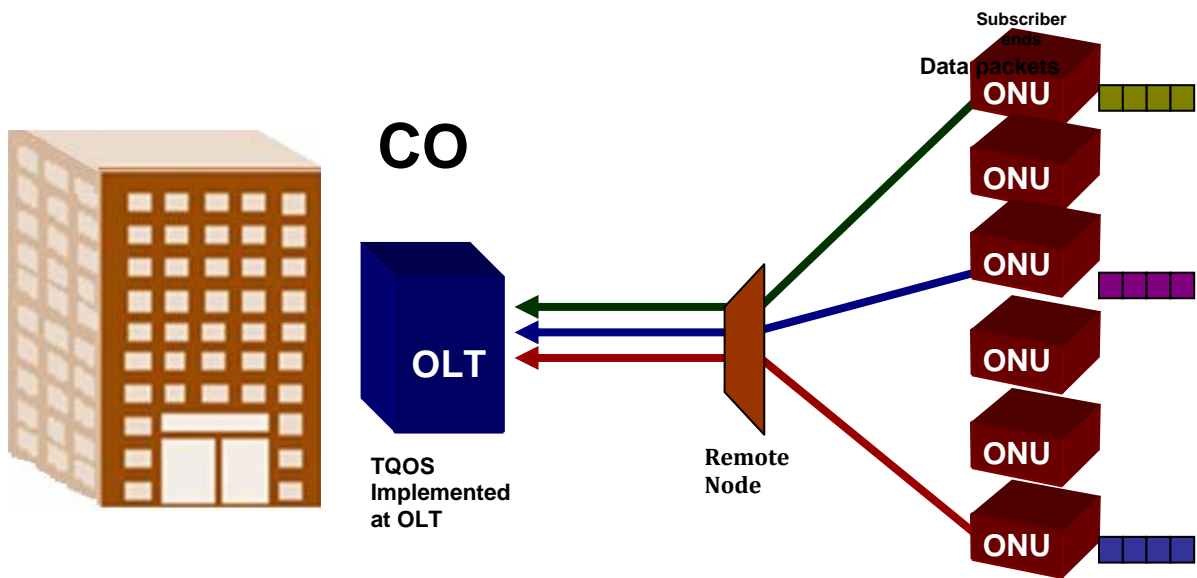
### **Motivation**

There is an increase in networks, computer users and bandwidth requirement by different bandwidth hungry applications like Video-on-Demand, Telemedicine, Distance Learning, E-Gaming etc. We have WDM EPON as a promising access solution that takes the evolutionary advantage of number of available optical transmission channels in an optical spectrum. As in WDM EPON we have multiple wavelengths available to transmit the traffic from ONU to OLT. We propose an algorithm for efficient wavelength utilization which provides lesser Average Delays than the existing algorithms like Online Interval Scheduler, Online NASC etc.

### **Current Progress**

Our simulation model is comprised of an OLT which is situated at the central office and ONUs situated at the subscriber ends. TQOS is implemented at the OLT whose job is, to schedule ONUs requests for utilizing a wavelength to transmit data from ONU to OLT. The other simulation parameters are given in the parameter table below.





| Parameter Description        | Value            |
|------------------------------|------------------|
| Number of ONUs               | 6                |
| Number of Wavelengths        | 3                |
| Link Speed                   | 1 Gbps           |
| Distance between OLT and ONU | 30 Km            |
| Round Trip Time              | 100 micro second |
| Control message length       | 64 Bytes         |
| Inter packet gap             | Nil              |
| Preamble                     | Nil              |

Three ONUs (1, 2 & 3) support single wavelength and are known as lightly loaded ONUs, while the remaining three ONUs (4, 5 & 6) support three wavelengths and are known as heavily loaded ONUs. Lightly loaded single channel ONUs support 1/3 of the traffic load and heavily loaded multiple channel ONUs support 2/3 of the traffic load.

### Future Directions

Already existing schemes are for a single fiber strand having multiple available wavelengths. We can work to implement these schemes for multiple fiber strands with the different scenarios of wavelength availability. Secondly, we have worked for the Gated grant sizing scheme, only catering for the scheduling part of the problem. More work to develop scheduler which caters for the grant sizing part of the problem along with grant scheduling sub-problem could be done, to achieve betterment in results in terms of average delays.

## f) Partially online dynamic bandwidth allocation (DBA) algorithm for Hybrid TDM/WDM EPON

**Researcher:** Ms. Maryam Multani

**Advisor:** Dr. S M H Zaidi

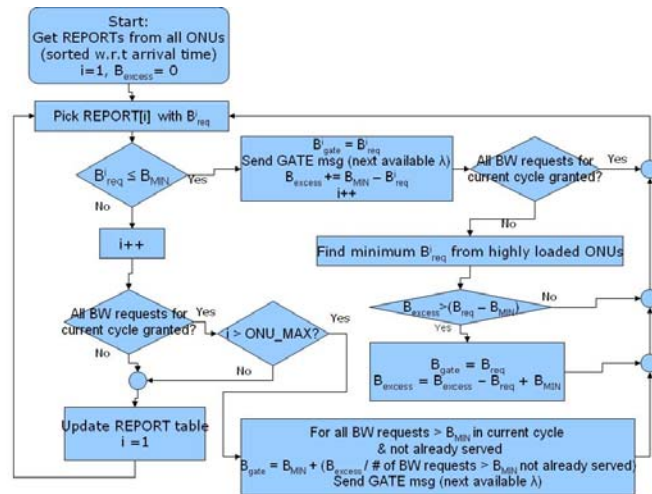
**Co-Advisor:** W/C Muhammad Ramzan

### Motivation

The aim of this research is to design a dynamic bandwidth and wavelength allocation algorithm that provides reduced delay and lesser queue size in Hybrid TDM/WDM EPON.

### Current Progress

The proposed algorithm makes use of Bandwidth Threshold for immediate (online) BW allocation for lightly loaded ONUs using aggregated bandwidth grants and aims for ASAP allocation to least loaded ONU among highly loaded ONUs, instead of waiting till all REPORTS are received, using the excess bandwidth accumulated from lightly loaded ONUs.



#### 1.1.8.1.2 Past projects

- Wavelength Assignment Using Closest Wavelength Tuning
- Dynamic Routing through Spontaneous Resource Reservation
- Minimizing the Effect of imprecise network state information through the reduction in Communication and Storage Overheads
- Mitigating effects of Denial of Service (DoS) Attacks on E-Commerce Sites and Networks
- TCP SYN Flood Sensor for Internet Backbone
- Enterprise Application Security Framework
- Design and Implementation of Security mechanism for NUST Intranet
- Performance Evaluation and Enhancement of Mobile Adhoc Routing Protocols

- Performance Evaluation of TCP in Mobile Ad hoc Networks
- Bandwidth constrained QoS routing with mobility management in ad hoc networks
- Network Traffic Generator
- Design and Implementation of Intranet for NUST and its constituent colleges
- Automation of Network Labs
- Building and Performance Evaluation of an MPLS Domain
- Implementation and Analysis of Ameliorated Cells in Frames Architecture
- Mitigating Denial-of-Service Attacks using Dynamic Ingress Filtering Mechanism
- Routing and Wavelength Assignment algorithms in IP over DWDM Networks

## 1.2 Data Engineering for Large Scale Applications (DELSA) Research Group

### 1.2.1 Theme

Data Integration among autonomous, distributed, heterogeneous data sources

### 1.2.2 Overall Objective

DELSA research group explores heterogeneity especially semantic heterogeneity in databases, and interoperable systems in scientific and business domains. The group aims at broadening the focus of database techniques beyond their traditional scope.

### 1.2.3 Application Domain

The DELSA research group focuses on semantic heterogeneity in integrating autonomous, distributed and heterogeneous data sources in business, academia, health, agriculture, and biomedicine. Moreover the group has interest in data warehousing, view materialization, OLAP, multiple query optimization, semantic and web caching, and E-technologies.

### 1.2.4 Group Members

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### **1.2.5 Associated Labs**

Database Research Lab

### **1.2.6 Research Projects**

#### ***1.2.6.1 Current Projects***

##### **a) Integrating Biomedical Data Sources on the Internet**

Hundreds of biomedical data sources are publicly available on the Internet. These data sources maintain closely related data, but the decentralized, autonomous and heterogeneous nature of the data have made very difficult its accessibility and integration by scientists for innovative synthesis. A real challenge is to locate and select relevant and quality data and to integrate them. The project is concerned with locating and selecting sources that are relevant to the given user query and integrating them to answer the query. Its salient feature is quality-driven semantic similarity matching. The similarity between the user query and data sources is acquired through the domain ontology and source models. Currently we work on the following main themes in this research.

- Developing local ontologies from source metadata.
- Ontology driven user query expansion for obtaining meaningful results.
- Semantic based information retrieval in digital documents.
- Selection of semantically relevant sources among heterogeneous data sources.
- Ontology driven query translation for data integration among heterogeneous data sources.

##### **Members**

- Dr. Sharifullah Khan
- Mr. Waris Ali
- Muhammad Bilal
- Ms. Kiran Sonia
- Mr. Jibran Mustafa

- Ms. Ammara Aslam
- Mr. Iqbal Qasim
- Mr. Muhammad Sufyan

### **1.2.6.2 Past Projects**

#### **a) Scalable Triggering System Using dynamic Indexing**

In a CQ system, data sources need to pass changes to the CQ system that are related to a large number of continual queries. This project employs R+ tree for providing a scalable triggering technique in data sources. This system passes the changes in data sources to the CQ system. The technique reduces the overhead of data sources in triggering the changes. It also caters for dynamic insertion and deletion of queries in the triggering system.

#### **b) Efficient Data Storage for Dynamically Grouped CQs in XML Databases**

Globalization of the Web made it difficult, if not impossible, to retrieve data in structured format because data are not available in a single format over the Web. This project enhances the existing CQ optimization techniques from structured data to semi structured data for efficient retrieval of the data over the Web. The project proposes a technique to handles the proliferation of CQs' results that happen due to dynamic grouping.

#### **c) Optimization of Semantic Caching in XML Databases**

This project is extending the matching technique of grouped continual queries to semantic caching of semi structured data in XML databases.

#### **d) Optimization of Web Caching**

This project classifies a Webpage contents into categories such as static, periodic and dynamic. The project distributes the contents along with the webpage template in the hierarchical architecture of the Web caching in order to improve network bandwidth, save storage consumption in caches and maintain load balance in caching system.

#### **e) Mobile Databases**

The project proposes a model for mobile transaction management. It assumes a mobile transaction to be a long lived job and location based. The project handles the mobility and disconnection of the mobile devices. Currently we are extending it to a context-aware system.

### **1.2.7 International Collaboration**

- **Grid Geno-Medicine (GGM)**, Institute de Recherche en Informatique de Toulouse (IRIT), Universite Paul Sabatier, Toulouse, France.
- **Health E-Child**, University of West England (UWE), Bristol, UK.

### **1.2.8Publications**

#### **2007**

- S. Khan and F. Marvon. Scalable Integration of Biomedical Sources. In the proceedings of the Workshop on Ontology, Grid and Semantic Integration for Biology (OGSB), July, 2006. Bordeaux, France.
- S. Khan and F. Marvon. Integrating Biomedical Sources on the Internet. In the proceedings of ISCA 19th International Conference on Parallel and Distributed Computing Systems (PDCS), San Francisco, California, USA, September, 2006.
- S. Khan and F. Marvon. Identifying Relevant Sources in Query Reformulation. In the proceedings of the 8th International Conference on Information Integration and Web-based Applications & Services (iiWAS2006), Yogyakarta, Indonesia, December 2006.
- S. Khan. The Role of Ontology in Query Mediation, In the proceedings of the 4th International Workshop on Multi-Agent Systems and Semantic Grid (MASSG06) Rawalpindi, Pakistan, December 2006.
- S. Khan. Data Acquisition from Semantically Heterogeneous Data Sources, In the proceedings of the Workshop Data Warehousing and Data Mining, Islamabad, Pakistan, February 2007.

# Centre of Excellence for FPGAs/ASIC Research (CEFAR)

## Overall Group Objective

The mission of the Center of Excellence (CoE) is to sit at the critical interface between the academic and commercial engineering worlds. The main objective of CoE is to produce highly skilled design engineers and researchers to meet the needs of the rapidly changing global semiconductor industry. The research scope of this center includes FPGAs in particular and its applications from the domain of Cryptographic Hardware, Video and Image Processing, DSP and Networks-on-Chip

## 1.3 Group for Research in ASIC and FPGA (GRAF)

### 1.3.1 Theme

The aim of GRAF is to develop an environment for research in FPGAs, FPGA Based System Design and SoC/SoPC. The group conducts research in many aspects of FPGAs including FPGA architecture exploration, high level design tools, reconfigurable computer architectures, and applications of FPGAs and reconfigurable hardware in a number of domains such as Video and Image Processing, DSP and Communication System Engineering and Networks-on-Chip. We are also keen in collaborative research with companies and academic groups who share common interest in state-of-the-art research in the area of digital integrated circuit design and implementation.

### 1.3.2 Overall Objectives

- Provide students the opportunity to work in advanced technological domain.
- Develop linkages with industry and to provide them with the highly motivated hardware engineers with diverse technical experience
- Design efficient and reliable FPGA based systems
- Provide highly innovative and Cost-effective FPGA based solutions to the local industry

### 1.3.3 Application domain

- FPGA and ASIC

### 1.3.4 Group Members

| Name                | Qualification     | Research Area   | Contact              |
|---------------------|-------------------|---|----------------------|
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| Mr. Jamshaid Sarwar | MS,<br>KTH,Sweden | ASIC/FPGA   | jamshaid47@yahoo.com |



|                       |                |                                  |                             |
|-----------------------|----------------|----------------------------------|-----------------------------|
| Ms.Aroosa Jamshaid    | MS, KTH,Sweden | ASIC/FPGA/Embedded System Design | -                           |
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| Mr. Haroon Ghafoor    | MSc, QAU,PK    | FPGA                             | haroon@nextekservice.com    |
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### 1.3.5 Publications

- Muhammad Taqi Raza H. M., **N. D. Gohar**, Tashfeen Khan, Zille Huma Kamal, Michael A. Fiddy, "Distributive Target Localization and Tracking in Sensor Networks", Proceedings of 3<sup>rd</sup> International Workshop of High-Speed Optical Networks and Enabling Technologies (HONET-2006), UNCC, Charlotte, USA, September 6-8, 2006.
- Asma Latif, **N. D. Gohar**, "A Hybrid MQAM-LFSK OFDM Transceiver with Low PAPR", *Proceedings of 2<sup>nd</sup> International Conference on Wireless Communications, Networking and Mobile Computing (WiCOM-2006)*, Wuhan, China, September 22-24, 2006.
- Asma Latif, **N. D. Gohar**, "BER Performance Evaluation and PSD Analysis of Non-Coherent Hybrid MQAM-LFSK OFDM Transmission System", *Proceedings of 2<sup>nd</sup> International Conference on Emerging Technologies (ICET-2006)*, Peshawar, November 13-14, 2006.
- Shafqaat A., **N. D. Gohar**, Atif K., "A Dynamic Congestion Control Mechanism for Real-Time Streams over RTP", Proceedings of IEEE 9<sup>th</sup> Int. Conference on Advance Communication Technologies, Pheonix Parks, Republic of Korea, Feb. 2007.

### 1.3.6 Organization of Conferences and Workshops in 2006-07

- Two day international Workshop on "SoCware Design For Communication Systems" held on 7<sup>th</sup> & 8<sup>th</sup> June 2007 at Seminar Hall, NIIT Rawalpindi.
- One day workshop on "PCB Design and Manufacturing" held on 6<sup>th</sup> November, 2006 at Seminar Hall, NIIT, Rawalpindi.

### 1.3.7 Associated Research lab

- FPGA and ASIC Research Lab

#### 1.3.7.1 Hardware

- 2 x PowerPC & MicroBlaze Development Kit Virtex-4 FX12 Edition
- 2 x FPGA Development Kit (virtex-MIL401 Evaluation platform)
- 8 x NexTek FPGA Training Kit with 200,000 gate Spartan-2 FPGA
- 8 x XSA-200 Prototyping Board with 200,000 gate Spartan-2 FPGA
- 2 x XSA-3S1000 Prototyping Board with 1,000,000 gate Spartan-3 FPGA
- 4 x XST-3.0 XSTend Board
- 1553 Interface Cards
- W2012 100MHz Oscilloscope

#### **1.3.7.2 Software**

- Simulation: ModelSim XE III v6.2c
- Synthesis: Xilinx ISE v9.1i
- PCB Design: OrCAD 9.2

### **1.3.8 Research Projects**

#### **1.3.8.1 International Collaboration**

##### ***1.3.8.1.1 Current projects***

#### **a) Digitally Assisted Analogue Circuits**

##### **Introduction**

During the last 15 years increase in the performance of digital ICs has become 150 times more than their analog counterparts. Since any real world system must compose of analog components, slow advancement of analog integrated circuits is now actually hindering the development of digital electronics. If these trends continue to occur, this problem is likely to become worse in the near future. Digitally Assisted Analog Circuits is a recently proposed method that has tremendous potential to nullify this effect. Basic idea is to simplify the analog circuits at the cost of decreased precision. This loss in precision is then modeled and compensated in the digital domain.

##### **Members**

- Dr. N. D. Gohar
- Mr. Jamshaid Sarwar

##### **Motivation**

The gap between digital and analog integrated circuits is increasing very rapidly with performance of digital circuits improving much faster than their analog counterparts. Digitally Assisted Analog Circuits is the latest research area (started in 2004) that attempts to reduce this increasing gap between the two domains. Researchers in universities like Stanford and UC Berkeley have already demonstrated the tremendous potential of this research area.

##### **Progress**

NUST has approved complete funding for this research project. KTH has also agreed to work on this project. Mr. Jamshaid Malik and Dr. Gohar are going to visit KTH starting from March 2008 to expedite the work on this project.

## **b) Software Defined Radio Development using a Network-On-Chip based Rapid Prototyping Platform**

### **Introduction**

Major objective of the proposed project is to enable, enhance and expedite development of SDR targeting 4G technologies and beyond. For this purpose a Network on Chip based generic baseband processing and MAC layer processing platform will be developed.

### **Members**

- Dr. N. D. Gohar
- Mr. Jamshaid Sarwar
- Ms. Aroosa Jamshaid
- Mr. Bilal Saqib
- Ms. Saba Zia
- Mr. Fayyaz Rasool

### **Progress**

Project proposal has been submitted to National ICT R&D Fund for approval. We have revised and resubmitted the proposal (Revision 4.0) to the Fund in the light of their initial comments.

## **1.3.8.2 National Collaboration**

### **1.3.8.2.1 Current projects**

#### **a) FPGA based Portable Spectrum Analyzer**

##### **Introduction**

FPGA based Spectrum Analyzer will be a signal analysis gadget with the maximum input signal frequency of 100 MHz. The offshoots of the project include

- Vibration Spectrum analysis in mechanical Testing
- Video Spectrum Analysis for various defense and commercial applications
- Spectral analysis of defense communications by Intel agencies
- Lab usage by various universities and developers

##### **Members**

- Dr. N. D. Gohar
- Mr. Bilal Saqib
- Ms. Saba Zia
- Mr. Fayyaz Rasool

##### **Motivation**

With the progress of Field programmable gate arrays (FPGAs) in performance efficiency and effective utilization of resources, they can be efficiently used for

the applications that require real time response. One such application is FPGA based spectrum analyzer that is

- Portable
- Allows short duration signals to be analyzed in more detail
- Cost- effective

The use of an FPGA provides a flexible instrument as desired for use in testing of integrated circuits that sweeps over a wide range of frequencies up to several GHz range to observe the maximum amplitude frequency component and the corresponding power component for the signal under test. Observation of vibration spectrum will help to detect vibrations that may cause fault or danger, making it possible to troubleshoot engines.

### **Progress**

FPGA based portable Spectrum Analyzer was developed for lower frequencies.

### **Results**

There were some discrepancies in the results.

### **Further Directions**

Work is being carried out to remove the errors and make it functional for higher frequencies.

## **b) FPGA Based Remotely Controlled Internet Enabled Billboard System**

### **Introduction**

FPGA based Remote Advertisement System will be connected to the internet through which it will receive the configurations and data which will then be stored in EEPROM. The system will then access this data, decode it and display it onto an LCD monitor or an electronic billboard.

### **Members**

- Dr. N. D. Gohar
- Mr. Bilal Saqib
- Ms. Saba Zia
- Mr.Fayyaz Rasool

### **Progress**

A functional block-diagram has been developed and work has started on the VGA-interface.

### **1.3.8.2.2 Past Projects**

## **a) FPGA Based MIL-STD-1553 Remote Terminal/Bus Controller/ Bus Monitor**

### **Introduction**

FPGA based MIL-STD-1553 Remote Terminal(RT)/Bus Controller(BC)/Bus Monitor(MT) implements the MIL-STD-1553 protocol on FPGA and allows the system to be configured as RT, BC or MT. This protocol is widely used in avionics especially the modern day fighter aircrafts like F-16 and Mirage.

### **Members**

- Dr. N. D. Gohar
- Mr. Mahboob Ali
- Mr. Bilal Saqib
- Mr. Haroon Ghafoor
- Ms. Saba Zia
- Mr. Fayyaz Rasool

### **Progress**

FPGA based MIL-STD-1553 RT, MT and BC has been developed. The outcome of this project is a HW version as well as IP core for this standard.

### **Results**

The system works accurately in correspondence with the MIL-STD-1553 protocol.

### **Further Directions**

Future work can be done to implement the Notice-5 of 1553 protocol.

### **1.3.9 Projects with the industry**

- FPGA based MIL-STD-1553 remote terminal/bus controller/ bus monitor
- FPGA based portable Spectrum Analyzer

### **1.3.10 Contracts and Grants obtained**

- Won Rs. 4.23 Million Funding from HEC under its University-Industry Technology Support Program (UITSP) for a Project “ MIL-STD-1553 FPGA BASED REMOTE TERMINAL / BUS CONTROLLER / BUS MONITOR”

## **1.4 Group for Research in Reconfigurable Architectures for Security in Communication (GRASiC)**

### **1.4.1 Theme**

The group for Research in Reconfigurable Architectures for Security in Communication (**GRASiC**) mainly focus on designing and developing optimized coprocessors for diverse security applications in FPGAs that ranges from secure telephone to secure satellite communication. The group also investigates optimal techniques for the security in constrained environments (e.g. Smart cards, RFIDs, etc.). The group also investigates application specific architectures based on FPGAs (e.g. Network on FPGAs). The main research themes therefore are:

- Optimized Coprocessors for Communication Security
- Application Specific Architectures based on FPGAs
- Security in Constrained Environments
- Cryptology

### **1.4.2 Overall Group Objective**

The overall objective of this group is to promote research in areas of FPGA technology and FPGAs based system designs particularly for large number of security applications which are either highly time sensitive (speed is vital) or they are highly area sensitive (resources are minimal). That poses a challenge to the researchers to first investigate security mechanisms highly suitable for that particular application and to optimize its logic or its circuit to fulfill the required specifications.

### **1.4.3 Application Domain**

- Embedded systems for Communication Security
- Cryptographic hardware
- RFID Encryption
- FPGAs based system design
- Digital Watermarking

### **1.4.4 Group Members**

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Ms Freeha Azmat

#### **1.4.5 Publications during period 2006-2007**

- Francisco Rodríguez-Henríquez, Guillermo Morales-Luna, **Nazar A. Saqib** and Nareli Cruz-Cortés, "A Parallel Version of the Itoh-Tsujii Multiplicative Inversion Algorithm", **Design, Codes and Cryptography**, Pages 19-37, Volume 45, Issue 1, October 2007
- Francisco Rodríguez-Henríquez, Guillermo Morales-Luna, **Nazar A. Saqib** and Nareli Cruz-Cortés, "A Parallel Version of the Itoh-Tsujii Multiplicative Inversion Algorithm", Lecture Notes in Computer Sciences (LNCS), Pages 226-237, Volume 4419/2007, June 2007

#### **1.4.6 Associated Labs**

- FPGAs/ASIC Training Lab
- FPGAs/ASIC Research Lab

#### **1.4.7 Research Projects**

##### **1.4.7.1 Projects with Industry**

###### **1.4.7.1.1 Current Projects**

- a) **Bulk Encryptor with Selected Multiplexing Combinations and Transmission Support for Multiple Platforms**

#### **1.4.8 Contract and Grants Obtained**

Rs. 1.983 Million

## 1.5 Wireless Network Research Lab (WisNeT)

### 1.5.1 Theme

WisNet is mainly focusing on four types of wireless networks:

- Personal area wireless sensor networks
- High-throughput local and metropolitan area networks
- Cellular and last mile wireless access networks
- Mobile ad hoc networks

Within these four broad domains, WisNet is investigating projects pertaining to performance evaluation and enhancement, network interoperability, high-throughput communication, fair and efficient medium access, resilient and energy-efficient routing, and wireless multimedia.

In addition to the above areas, WisNet is also pursuing research problems in network security. Two active projects in network security are:

- Security of On-the-Air Content in Wireless Networks
- Network-based Approaches to Malware Detection

### 1.5.2 Group Objective

After the unprecedented success of IP networks, most emerging access and edge wireless networks are migrating to an IP-based protocol stack. The Wireless Networks (WisNet) Research Lab at the NUST Institute of Information Technology (NIIT), National University of Sciences & Technology (NUST) has been established to investigate the performance of IP-based wireless technologies at different layers of the protocol stack.

WisNet's objective is to carry out international-quality research in the area of Wireless networks. Our group aims at train and produce quality graduate and undergraduate students who can perform high quality theoretical and practical research in the wireless networks domain.

### 1.5.3 Application Domain

Wireless Networks, Network Security

### 1.5.4 Members

#### Faculty

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## Students

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- Ayesha Binte Ashfaq
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- Waqas Bukhari
- Zubair Shafiq
- Mona Farroq
- Zubia Naz
- Maria Robert Joseph
- Umar Mushtaq
- Fatima Tanveer
- Priya Ashok
- Hasna Tahir
- Saba Batool Miyan

## 1.5.5 Publications

### 1.5.5.1 Journal Publications

- Syed Ali Khayam and Hayder Radha, "Maximum-Likelihood Header Estimation: A Cross-Layer Methodology for Wireless Multimedia," to appear in *IEEE Transactions on Wireless Communications*.
- Syed Ali Khayam, Hayder Radha, Selin Aviyente, and John R. Deller, Jr., "Markov and Multifractal Wavelet Models for Wireless MAC-to-MAC Channels," *Elsevier Performance Evaluation*, vol. 64, no. 4, pp. 298-314, May 2007.
- Syed Ali Khayam, Shirish Karande, Muhammad Usman Ilyas, and Hayder Radha, "Header Detection to Improve Multimedia Quality over Wireless Networks," *IEEE Transactions on Multimedia*, vol. 9, no. 2, pp. 377-385, February 2007.

### 1.5.5.2 Conference Publications

- Syed Ali Khayam and Hayder Radha, "Comparison of Multimedia Transport Schemes over Markovian Wireless Channels," *Asilomar Conference on Signals, Systems, and Computers*, November 2007.

- Syed Ali Khayam and Hayder Radha, "Using Session-Keystroke Mutual Information to Detect Self-Propagating Malicious Codes," *IEEE International Conference on Communications (ICC)*, June 2007.
- Syed Ali Khayam and Hayder Radha, "On the Impact of Ignoring Markovian Channel Memory on the Analysis of Wireless Systems," *IEEE International Conference on Communications (ICC)*, June 2007.
- Shirish Karande, Syed Ali Khayam, Yongju Cho, Kiran Misra, Hayder Radha, Jae-Gon Kim, and Jin-Woo Hong, "On Channel State Inference and Prediction using Observable Variables in 802.11b Networks," *IEEE International Conference on Communications (ICC)*, June 2007.
- Yongju Cho, Syed Ali Khayam, and Hayder Radha, "A Multi-Tier Model for BER Prediction over Wireless Residual Channels," *International Conference on Information Sciences and Systems (CISS)*, March 2007.

#### **1.5.5.3 Submitted Papers**

- Adnan Iqbal, Syed Ali Khayam, "Improving WSN Simulation and Analysis Accuracy Using Two-Tier Channel Models," submitted to IEEE ICC 08.
- Adnan Iqbal, Khurram Shahzad, Syed Ali Khayam, "SRVF: An Energy-Efficient Link Layer Protocol for Reliable Transmission over Wireless Sensor Networks," submitted to IEEE ICC 08.
- Waqas Bukhari, Syed Ali Khayam, "Equitable MAC Layer Performance Comparison of Cooperative Diversity Techniques for Wireless Networks," submitted to IEEE ICC 08.
- Syed Ali Khayam, Hayder Radha, and Dmitri Loguinov, "Worm Detection at Network Endpoint using Information-Theoretic Traffic Perturbations," submitted to IEEE ICC 08.
- Hassan Khan, Fauzan Mirza, and Syed Ali Khayam, "Low-Complexity Malicious Executable Detection using Discriminant File Attributes," submitted to IEEE ICC 08.
- M. Zubair Shafiq, Syed Ali Khayam, and Mudassar Farooq, "ADAIS: A Bio-Inspired Framework for Anomaly Detection," submitted to Infocom 08.

#### **1.5.6 Organization of Conferences and Workshops**

- Workshop on Mobile Ad Hoc Network in June 2006.

#### **1.5.7 Associated Labs with WisNet**

- Internet Lab, AJOU University, South Korea
- Wireless and Video Communications (WAVES) Lab, Michigan State University, USA

## **1.5.8 Research projects**

### **1.5.8.1 International Collaboration: AJOU University**

#### **a) IPv6 based Wireless Sensor Network Test Bed**

This is a collaborative project between NIIT and Ajou University and funding is granted by The South Korean Research Foundation (KRF). This project promises to be the world's first operational IPv6-enabled sensor network. In this project, students at NIIT will work in close collaboration with Ajou students to design and develop underlying sensor hardware and networking protocols for IPv6-enabled operation.

*Principal Investigators Dr. Arshad Ali & Ki-hung Kim*

### **1.5.8.2 National Collaboration / Indigenous at WisNeT Lab**

#### **a) Energy Efficient Reliability in Sensor Networks**

Many mission-critical sensor network deployment scenarios require reliable transmission of the acquired data. The 802.15.4 standard provides reliability through positive acknowledgments. However, there is room for improvement in the energy usage of reliable 802.15.4. Under this project, we are investigating new approaches to improve the reliability of WSN transmissions. This project is advised by Dr. Ali Khayam and student members are Mr. Adnan Iqbal and Mr. Khurram Shahzad.

#### **b) Channel Modeling to improve WSN Simulations**

Accurate simulation and analysis of wireless networks are inherently dependent on an accurate model of the underlying channel. Therefore, it is important to develop models that capture a wireless channel's behavior accurately. In this project, we have shown that residual MAC layer wireless sensor network (WSN) channels cannot be characterized using the commonly-used high-order Markov channel models. We are currently developing new statistical models that can accurately capture residual WSN channels. This project is supervised by Dr. Ali Khayam and Mr. Adnan Iqbal is the student member working on this project.

#### **c) Cooperative Diversity to Resolve Fading Problems in Sensor Networks**

Fading problems effect MAC layer performance severely. These problems can be resolved using Cooperative Diversity techniques. In this project, we are performing equitable performance comparison of Cooperative diversity techniques over multihop wireless networks. This project is supervised by Dr. Ali Khayam and Mr. Waqas Bukhari is working with him.

#### **d) Energy Efficient Time Synchronization in Sensor Networks**

A fundamental design issue for wireless sensor network (WSN) protocols, applications and services is to introduce energy-efficiency to extend network life time. In this project, we have proposed an Energy-efficient Time

Synchronization Protocol (ETSP) that provides significant energy improvements over existing time synchronization protocols, namely Reference Broadcast Synchronization (RBS) and Time-sync Protocol for Sensor Networks (TPSN). ETSP switches between RBS and TPSN based on the network density. Performance analysis confirms that the combination of RBS and TPSN works better than using these techniques separately. Project is collaboratively supervised by Dr. Ali Khayam and Dr. Arshad Ali. Mr. Khurram Shahzad is the student member of this team.

#### **e) Enhancements to WiFi Security**

Since the standardization of 802.11-based WiFi networks in 1999, many key design weaknesses have been identified in the 802.11 Wired Equivalent Privacy (WEP) protocol. While new security protocols have since been proposed to improve WiFi security, a large number of public-domain and legacy wireless networks continue to use WEP. Therefore, it is important that practical solutions to mitigate WEP's vulnerabilities be developed. In this project, we are developing security enhancements to WEP without making any modifications to already-deployed hardware, the standardized 802.11 protocol and/or network policies. Project is jointly supervised by Dr. Ali Khayam and Dr. Fauzan. Mr. Fida Hussain Gilani and Mr. Qasim Ali are the student members of this team.

#### **f) Bio-Inspired Anomaly Detection**

Over the last few years, many robust anomaly detectors have been proposed to combat the dramatic increase in the volume and sophistication of network attacks. Existing network-based anomaly detectors are designed to leverage one or a combination of related traffic features for anomaly detection. Due to their feature specific nature, these detectors generally do not have the flexibility to incorporate new features or to scale their complexity in accordance with their point-of-deployment. In this project we are developing a scalable, feature independent Artificial Immune System (AIS) based anomaly detection framework called Anomaly Detection AIS (ADAIS) that utilizes bio-inspired immunology algorithms to seamlessly incorporate multiple traffic features to detect zero-day attacks at different points in the network. Project is jointly supervised by Dr. Ali Khayam and Dr. Mudassar Farooq. Mr. M. Zubair Shafiq is the student member of this team.

#### **g) Distributed BlackHole Monitoring System**

Basic idea of this project is to detect worms, port scans and DoS attacks by monitoring a baseline of captured packets directed to unused or unknown ports. Its architecture consists of distributed sensors which monitor a range of IP addresses. The captured packets are saved into a database at the server and then analyzed on the basis of their frequency, connection establishment methods and port numbers. The ones that fit into the category of attacks are pointed out and blocked. This project is jointly supervised by Dr. Fauzan Mirza and Dr. Ali Khayam. Maria Robert Joseph is the student member working on this project.

#### **h) Performance Comparison of Anomaly Detectors on Network Endpoints**

Since network endpoints comprising home and office computers are now serving as extremely potent and viable launch pads and carriers of malware infections, it is important that real-time and effective defenses be developed specifically for network endpoints. Under this project, we are comparing existing anomaly detectors. We are also developing a new endpoint-based anomaly detector that leverages the positive aspects of different anomaly detectors. Project is supervised by Dr. Ali Khayam. Ms. Ayesha Binte Ashfaq is the student member of this team.

#### **i) Real Time video streaming on cellular networks**

Cellular networks have experienced unprecedented worldwide deployment in the last decade. In view of the ubiquity of cellular networks, service providers are now actively exploring opportunities to expand the scope of their services beyond the standard voice services. These new services, generally referred to as Valued Added Services (VASs), presently include SMS, MMS, and video services. While the use of SMS and MMS has increased manifolds since their inception, real-time video streaming services over a GPRS core are still not widespread. We argue that there exists a significant market for real-time video capture and transmission over cellular networks. However, these services are not widespread because freely-available and easy to use video capture and streaming applications are not available. The aim of this project is to develop an open standards based mobile video streaming application that can capture, communicate and playback real-time video content on a GPRS-enabled cellular network. In this document, we describe existing network technologies, architectures and protocols that can be used to support the proposed application. We also draw comparisons and justifications between different technology options. Three undergraduate students Hasna Tahir, Saba Batool and Adeel Arshad are working on this project. This work is supervised by Dr. Ali Khayam.

#### **1.5.9 Projects with Industry**

The cellular video project described above is being conducted jointly with Tricastmedia.

#### **1.5.10 Contracts and grants obtained**

- NUST Seed Money Funding to Initiate Wireless Networks Research at NUST
- Proposal for Design and Development of an Open-Source Enterprise Network Security Solution.



## 1.6 RFID Research Group

### 1.6.1 Theme

To exploit RFID technology for state of the art applications

### 1.6.2 Overall Objectives

We plan to pursue our research in four relevant areas

- Hardware design and manufacture
- Application Development
- Security enhancement
- Privacy Issues
- We plan to work on these projects in collaboration with our industry partners.

### 1.6.3 Application Domain

Wireless Communication

### 1.6.4 Group Members

| Name                  | Qualifications | Area of research    | Contact (tel. and e-mail)   |
|-----------------------|----------------|---------------------|---|
| Dr. Ijaz Qureshi      | PhD            | Information Systems | <a href="mailto:ijaz@niit.edu.pk">ijaz@niit.edu.pk</a><br>+92 51 928 0658                     |
| Dr. Mohammad Saddique | PhD            |                     | saddique@niit.edu.pk<br>+92 51 928 0658   |
| Dr. Amir Hayat        | PhD            | Information Systems | <a href="mailto:amir@niit.edu.pk">amir@niit.edu.pk</a><br>+92 51 928 0658                     |
| Mujtaba Haider        | MS             | Information Systems | <a href="mailto:mujtaba.haider@niit.edu.pk">mujtaba.haider@niit.edu.pk</a><br>+92 51 928 0658 |

### 1.6.5 Associated Labs

Embedded Systems Research Centre

### 1.6.6 Projects with the industry

The RFID Research Group is currently working with two industry partners:

- Computers & Networking Services (CNS)
- Islambad and Electro Control Industry, Islambad.

We are working on projects related to design and manufacture of hardware and use of RFID for access control

## 1.7 NIIT Distributed & Grid Computing Group

### 1.7.1 Theme

Research in distributed computing problems and infrastructure, in particular related to grid computing, distributed data mining, web services, handheld devices and distributed databases & storage.

### 1.7.2 Overall objectives

The objectives of the group are two fold: firstly, carry out advanced research in distributed computing software, infrastructure and tools; and secondly, to establish collaborations with international research institutes of repute in this area, to enable transfer of knowledge and technology to NIIT and Pakistan.

### 1.7.3 Application domain

#### *i. Grid computing*

Projects in this direction include Grid-enabled Knowledge Management System (2001-2002), Distributed Agents for Mobile and Dynamic Services (2002-2003), Heterogeneous Relational Databases for Grid Environments (2004-2005), Grid-enabled analysis on Handheld Devices (2003-2004) and Grid-enabled Analysis Environment (2004-2005), DIANA Grid Scheduler (2005-2007) and Grid-enabled Data Mining (2006-now).

#### *ii. Distributed Operating Systems*

The main project being undertaken in this area is PhantomOS (2005-now).

#### *iii. Web Services*

Projects in this area include JClarens (2003-2005) and its many associated services.

### 1.7.4 Group Members

|  |
|--|
| Name: Dr Arshad Ali<br>Qualification: PhD Electrical Engineering<br>Area of research: Opto-electronics, Distributed computing, Network Monitoring<br>Contact: 9280658, arshad.ali@niit.edu.pk  |
| Name: Tahir Azim<br>Qualification: MS Computer Science<br>Area of research: Distributed computing, Web 2.0 and sensor networks<br>Contact(telephone and email): 0344-5314869, <a href="mailto:tazim@niit.edu.pk">tazim@niit.edu.pk</a> |
| Name: Faisal Khan<br>Qualification: Bachelors in Information Technology<br>Area of research: Web services and distributed computing<br>Contact: <a href="mailto:faisal_ieee@yahoo.co.uk">faisal_ieee@yahoo.co.uk</a>                   |



|  |
|--|
| Name: Kamran Soomro<br>Qualification: BE Software Engineering<br>Area of research: Distributed operating systems<br>Contact: kamran.soomro@gmail.com             |
| Name: Shuaib Khan<br>Qualification: BE Software Engineering (underway)<br>Area of research: Distributed operating systems  |
| Name: Usman Ajmal<br>Qualification: BE Software Engineering (underway)<br>Area of research: Distributed operating systems  |
| Names: Sheroz Aftab, Saeed Akhter, Momina Waqar, Omar Mukhtar<br>Qualification: BE Software Engineering (underway)<br>Area of research: Grid-enabled Data Mining |
| Name: Badar Ahmed<br>Qualification: Bachelors in Information Technology (underway)<br>Area of research: Web services, peer to peer systems                       |

### 1.7.5 Publications

- Arshad Ali, Richard McClatchey, Ashiq Anjum, Irfan Habib, Kamran Soomro, "From Grid Middleware to Grid Operating System", International Conference on Grid and Cooperative Computing 2006, GCC 2006.
- Irfan Habib, Kamran Soomro, Ashiq Anjum, Richard McClatchey, Arshad Ali, Peter Bloodsworth, "PhantomOS: A Next Generation Grid Operating System", UK eScience All Hands Meeting 2007 (AHM07), Nottingham, UK, September 2007
- Arshad Ali, Ashiq Anjum, Julian Bunn, Faisal Khan, Richard McClatchey, Harvey Newman, Conrad Steenberg, Michael Thomas, Ian Willers. "A Multi Interface Grid Discovery System.". 7th IEEE/ACM International Conference on Grid Computing, September 2006.

### 1.7.6 Associated Labs

- Caltech lab (NIIT)

### 1.7.7 Research Projects

- PhantomOS  
*Irfan Habib (UWE/CERN), Shuaib Khan, Usman Ajmal, Kamran Soomro.*
- Superpeer Discovery Service  
*Mudassir, Shoaib, Ammarah Kahlon*
- Grid Data Mining  
*Sheroz Aftab, Saeed Akhter, Momina Waqar, Omar Mukhtar*
- Tourist P2P implementation  
*Faisal Khan, Badar Ahmed*
- CMS Mirror Server  
*Faisal Khan, Kamran Soomro.*

### **1.7.8 International Collaboration**

We have international collaborations with UWE, CERN and Caltech.

#### ***1.7.8.1 Current projects***

##### **a) PhantomOS**

###### **Introduction**

The aim of PhantomOS (internal development name is GridOS) is to target those barriers to adoption in user oriented fields. PhantomOS is an operating system which aims to migrate Grid computing from the Middleware to the operating system level. With this we will target the most profound technical barriers to the adoption of Grid computing and make it relevant to the day-to-day user. We believe this proposed transition to a Grid operating system will drive more pervasive Grid computing research and application development and deployment in future.

###### **Members**

Irfan Habib (UWE/CERN), Shuaib Khan, Usman Ajmal, Kamran Soomro.

###### **Problem statement**

To create a system that can provide operating system-level support for Grid applications.

###### **Motivation**

Grid computing has made substantial advances during the last decade. Various developments have contributed to this, which include the advancements in high-speed networking technologies and the adoption of standardized Grid Middleware (Globus, gLite, UNICORE etc). There are, however, significant barriers to the more pervasive adoption of Grid computing in other fields, most notably day-to-day user computing environments. We believe these barriers can be broken if we provide operating system-level support for Grid environments.

###### **Progress**

Most of the modules for this system have been built. However, the system is in a prototype phase, and needs substantial amount of work to make it useful in real-world applications.

###### **Results**

Results from the prototypes developed so far show that a Grid-enabled operating system can significantly improve on the performance of Grid applications.

### **Future directions**

We are aiming in two main directions. Firstly, we want to complete the current prototype into a production phase. Secondly, we are hoping to convert the existing prototype to use virtual machine migration capabilities to make the system more useful for the scientific community.

### **b) CMS Mirror Server**

#### **Introduction**

'CMS Mirror Server' is an integrated tool to let scientists download distributed physics datasets by resolving their locations using official CMS catalogs – Data Bookkeeping System (DBS) and Data Location Service (DLS). The mirror server work is part of larger project that aims at integrating official CMS data management tools with Ultralight's [4] high speed data transfer utilities.

#### **Members**

Faisal Khan, Kamran Soomro.

#### **Motivation**

One significant task which physics community wants to achieve is to gain access to their desired data before everyone else. Currently they use official storage management / transfer tools provided by CMS collaboration. Following this approach they will have to compete in terms of resources with other peers looking for similar kind of data. We suggest that the more effective way of doing this is by using the specially written software which the scientists could tweak easily based on his requirements and priorities.

#### **Progress & Results**

Its first version is complete including its integration with our high speed data transfer tools called FDT (Fast Data Transfer).

#### **Future Direction**

We need to update the existing version in order to incorporate changes to DBS/DLS.

### **1.7.8.2 Past Projects**

- Grid-enabled Knowledge Management System (2001-2002)
- Distributed Agents for Mobile and Dynamic Services (2002-2003)
- Heterogeneous Relational Databases for Grid Environments (2004-2005)
- Grid-enabled analysis on Handheld Devices (2003-2004)
- Grid-enabled Analysis Environment (2004-2005)
- JClarens (2003-2005) and its many associated services

### **1.7.9 Contracts and Grants Obtained**

A grant worth \$100,000 was received from the US State Department/Ministry of Science and Technology Pakistan in 2004-05.

## 1.8 Center for High Performance Scientific Computing Research Group

### 1.8.1 Theme

To conduct research in parallel computing paradigms and applications

### 1.8.2 Group Objectives

- Support cutting edge scientific and engineering projects
- Conduct research, development, and evaluation of parallel programming languages, libraries, paradigms
- Produce HPC experts capable of doing development for innovative science and engineering

### 1.8.3 Application Domain

Parallel Computing, High Performance Computing, Grid Computing, Computational Science, Computational Electrodynamics, and Computational neuroscience, Computational Astrophysics

### 1.8.4 Group Members

- Aamir Shafi, Group lead, Ph.D., [aamir.shafi@niit.edu.pk](mailto:aamir.shafi@niit.edu.pk)
- Jamil Raza, Group co-lead, Ph.D., [jamil.raza@niit.edu.pk](mailto:jamil.raza@niit.edu.pk)
- Hammad Siddiqi, Researcher, Masters, [hammad.siddiqi@niit.edu.pk](mailto:hammad.siddiqi@niit.edu.pk)
- Umar Butt, Sun certified System Administrator, Masters [umar.butt@niit.edu.pk](mailto:umar.butt@niit.edu.pk)
- Aftab Hussain, Research Assistant, [45aftab@niit.edu.pk](mailto:45aftab@niit.edu.pk)
- Yasir Mehmood, Research Assistant
- Ammar Ahmad Awan, BIT-6 Student, [45ammar@niit.edu.pk](mailto:45ammar@niit.edu.pk)
- Jawad, BIT-6 Student, [45jawad@niit.edu.pk](mailto:45jawad@niit.edu.pk)
- Faisal Zahid, BIT-6 Student, [faisal.zahid@niit.edu.pk](mailto:faisal.zahid@niit.edu.pk)
- Ahmed Ali Gul, BIT-6 Student, [ahmad.gul@niit.edu.pk](mailto:ahmad.gul@niit.edu.pk)
- Zafar Gillani, BIT-6 Student, [zafar.hussan@niit.edu.pk](mailto:zafar.hussan@niit.edu.pk)

### 1.8.5 Publications

- Aftab Hussain, Jamil Raza, and Aamir Shafi, Comparative Performance Study of Message Passing and Distributed Shared Memory Implementations of the Finite-Difference Time-Domain Algorithm, 22nd IEEE International Parallel and Distributed Processing Symposium, Submitted for review, 2007.
- Aftab Hussain, Jamil Raza, and Aamir Shafi, Experiences in using UPC to Parallelize the FDTD method for Computational Electrodynamics The IASTED International Conference on Parallel and Distributed Computing and Networks, Submitted for review, 2007.
- Aamir Shafi, Bryan Carpenter, and Mark Baker, Nested Parallelism for Multi-core HPC Systems Using Java, Journal of Parallel and Distributed Computing, Submitted for review, 2007.

- Mark Baker, Bryan Carpenter, and Aamir Shafi, A Buffering Layer to Support Derived Types and Proprietary Networks for Java HPC, Scalable Computing: Practice and Experience, ISSN 1895-1767, 2007.
- Mark Baker, Bryan Carpenter, and Aamir Shafi, MPJ Express Meets Gadget: Towards a Java Code for Cosmological Simulations, In Proceedings of the 13th European PVM/MPI Users' Group Meeting (EuroPVM/MPI 2006), Bonn, Germany, September 17-20, 2006.
- Mark Baker, Bryan Carpenter, and Aamir Shafi, MPJ Express: Towards Thread Safe Java HPC, In Proceeding of the IEEE International Conference on Cluster Computing (Cluster 2006), Barcelona, Spain, September 25-28, 2006.
- Mark Baker, Matthew Grove, and Aamir Shafi, Parallel and Distributed Computing with Java, In Proceedings of the 5th International Symposium on Parallel and Distributed Computing (ISPDC 06), Timisoara, Romania, CS Press, July 6-9, 2006.
- Mark Baker, Bryan Carpenter, and Aamir Shafi, An Approach to Buffer Management in Java HPC Messaging, V. Alexandrov, D. van Albada, P. Sloot, and J. Dongarra (Eds), In Proceedings of the International Conference on Computational Science (ICCS 2006), LNCS. Springer, May 28-31, 2006.

#### **1.8.6 Organization of conferences and workshop in 2006-2007**

- Three days workshop on "High Performance Scientific Computing", 27<sup>th</sup> February – 1<sup>st</sup> March, 2007

#### **1.8.7 Associated Labs**

High Performance Scientific Computing Lab

#### **1.8.8 Research Projects**

- a) Exploring and comparing parallel programming paradigms  
**Members:** Aftab Hussain, Jamil Raza, Aamir Shafi  
**Progress:** Currently, we have submitted two conferences and writing a journal paper is in progress.
- b) Virtualization for HPC  
**Members:** Ahmad Ali Gul, Aamir Shafi  
**Collaborators:** Hong Ong (Oak Ridge National Lab, USA), Box Leangsuksun (Louisiana Tech University, USA)  
**Progress:** The project is in early stages and currently the stakeholders are holding virtual meetings to come up with a problem statement
- c) Exploiting low-latency networks for HPC  
**Members:** Zafar Gillani, Aamir Shafi  
**Progress:** Performing initial reading and testing on our testbed.
- d) Porting N-body simulation code to multi-core systems  
**Members:** Ammar Ahmad Awan, Aamir Shafi, Jamil Raza  
**Progress:** Writing project proposal

- e) Implementing a MPI library with C#  
**Members:** Jawad, Aamir Shafi  
**Progress:** Writing project proposal
- f) Establishing a Blue Brain Node at NIIT  
**Members:** Yasir Mehmood, Raihan-ul-Rasool, Aamir Shafi  
**Progress:** Writing a PC-1 to get funding for this purpose
- g) Maintaining and enhancing MPJ Express  
**Members:** Aamir Shafi  
**Collaborators:** Prof. Mark Baker (University of Reading, UK), and Dr. Bryan Carpenter (University of Southampton, UK)  
**Progress:** Released version 0.27 of MPJ Express in September, 2007
- h) Implementing a computer game using Torque  
**Members:** Faisal Zahid, Aamir Shafi  
**Progress:** Learning torque

### 1.8.9 Grants Obtained

#### **1. Title: "Establishment of Grid Node at NIIT"**

Funding Body: Higher Education Commission (HEC)

Role: Project Director.

Approved Funding: 34.82 Million Rs.

Duration: Jan 2006 to July 2008.

Executing Body: National University of Sciences and Technology (NUST)

#### **2. Title: "Seed Money to Initiate High Performance Computing Research and Development"**

Funding Body: National University of Sciences and Technology (NUST)

Role: Principal Investigator.

Approved Funding: 2.0 Million Rs.

Duration: August 2007 to July 2008

Executing Body: National University of Sciences and Technology (NUST)

## 1.9 Nanotechnology Research Group

### 1.9.1 Theme

To overcome the national needs and initiate real research in the emerging technology

### 1.9.2 Overall Objectives

The main objective of this Research Group is to carry out intensive research in following areas

- Synthesis and characterization of nanostructures and thin films by utilizing simple and environmentally friendly techniques.
- Synthesis of nano particles and thin films which will be capable to purify water and environment upon irradiation with visible light

Exploration of physical properties of nano particles and their applications to novel electronic and photonic devices technology

### 1.9.3 Application Domain

- Water Purification
- Solar Cell Development
- Electronic Devices

### 1.9.4 Group Members

| Name               | Qualifications  | Area of research                                  | Email  |
|--------------------|---|---|--|
| Ruh Ullah          | MS (Microelectronic/<br>Nanotechnology), MSc<br>(Physics) | Synthesis and<br>applications on<br>nanoparticles | <a href="mailto:ruhullah@niit.edu.pk">ruhullah@niit.edu.pk</a>               |
| Mansoor<br>Shaukat | MS, UK  | Microelectronics                                  | <a href="mailto:mansoor.shaukat@niit.edu.pk">mansoor.shaukat@niit.edu.pk</a> |
| Dr. N. D.<br>Gohar | PhD electrical<br>Engineering                             | VLSI(CAD)   | <a href="mailto:ndgohar@niit.edu.pk">ndgohar@niit.edu.pk</a>                 |
| Dr. Jamil Raza     | PhD, UK   | Photonic Crystals                                 | <a href="mailto:jamil.raza@niit.edu.pk">jamil.raza@niit.edu.pk</a>           |

### 1.9.5 Publication

- Ruh Ullah, Joydeep Dutta, "Photodegradation of Organic Dyes With Manganese Doped ZnO Nanoparticles" manuscript submitted to the Journal of Hazardous Materials
- Ruh Ullah and Dr. Joydeep Dutta, "Photocatalytic activities of ZnO nanoparticles synthesized by wet chemical techniques", Proceedings of Second International Conference on Emerging Technologies Peshawar, November 2006 (ICET -2006 Peshawar)

- Ruh Ullah, Joydeep Dutta, “Synthesis and Optical Properties of Transition Metal Doped ZnO Nanoparticles” Accepted for International Conference on Emerging Technologies Islamabad, November 2007
- Photocatalysis with Mn-doped ZnO nanoparticles (Presented at nano-2006 international conference, Bangalore, India)
- Invited talk on “Nanotechnology to Clean” Presented in an International Symposium on Nanotechnology held at UET Peshawar on November 15th 2006

### **1.9.6 Associated Labs**

- Electronics Lab
- Nano Technologies Lab

### **1.9.7 National Collaboration**

- Quid-e-Azam University Islamabad
- Peshawar university Peshawar
- Ghulam Ishaq Khan Institute of Engineering Sciences and Technology Topy
- Pakistan Council of Research in Water Resources Islamabad

### **1.9.8 Research Projects**

#### ***1.9.8.1 Current Projects***

#### **a) Design and Development of Water Purification Technologies using Nanotechnology**

##### **Introduction**

Nanotech water-purification technologies include photocatalytic materials, where water passing through a nanomaterial is also subjected to ultraviolet light, leading to the destruction of contaminants such as pesticides, industrial solvents and germs. Since Fujishima & Honda obtained H<sub>2</sub> by decomposition of H<sub>2</sub>O using TiO<sub>2</sub> as a photocatalyst in the 1970s, the techniques has attracted substantial attention as a potential process for photo-electrochemical energy production and photocatalytic removal of various organic and inorganic venoms from air and water. The basic principle of semiconductor photocatalysis involves the migration of photo-generated electrons and holes to exposed surfaces where they can react with adsorbed reactants (O<sub>2</sub> and H<sub>2</sub>O) as redox sources, leading to the production of high oxidant reagent (Hydroxyl radical and super-oxide ) and subsequently the decomposition of pollutants. Photocatalysis can be extended by using various techniques that enable ceramic/other membranes to photo-plate heavy metals onto a counter electrode making this process favorable for remediating mixed waste streams, naturally polluted water. Compared with other water purification technologies, photocatalysis has excellent capability of removal of volatile organic compounds and inorganic compounds, chemical stability, is not toxic, and is



applicable in air and environment purification as well. In recent years, researchers and engineers have paid special attention to nano-sized ZnO/TiO<sub>2</sub>, using as a photocatalyst which has several advantages compared to the bulk material.

### **Members**

Ruh Ullah (PI)

Dr. N. D. Gohar (Co-PI)

### **Problem Statement**

Photocatalysis via metal oxide semiconductor (such as TiO<sub>2</sub> and ZnO) and UV/visible light has been used for last two decades as purification tool. Self cleaning through super hydrophilicity and decomposition of volatile organic compounds in to carbon dioxide, water and mineral salt are its two precious practical applications. This research will based upon the decomposition of volatile organic compounds and inorganic compounds along with bacteria killing via photocatalytic techniques from drinking water using visible light as energy source. Up till now photocatalysis techniques have been commercialized (e.g. Self cleaning window glass, in/outdoor environment purification etc...) that make use TiO<sub>2</sub> nanoparticles coated on surfaces and irradiated with UV light. Solar spectrum on the earth surface has only 5% to 7% of the UV light while the remaining spectrum has 46% of visible light and 47% infrared radiation. This smaller amount of UV light in the solar spectrum has lessened the practical utilization of photocatalysis for purification of water and environment. We will develop a techniques with which semiconductor photocatalyst be able to generate electron hole pair upon exposing only to visible light and can subsequently decompose volatile organic compounds and might also be capable to destroy bacteria from drinking water.

### **Progress and Result**

The project has been successfully approved for funding worth Rupees 6.76M by Ministry of Science and Technology Pakistan. Intellectual work is continue since the date of submission, while experimental work will start on the arrival of funds from funding agency.

### **Future Directions**

The project may be extended for bacteria disinfection and solar cell development.

### **1.9.9 Grants Obtained**

Funding worth Rupees 6.76M from Ministry of Science and Technology Pakistan.

## 1.10 Industrial Automation & Control Group

### 1.10.1 Theme

To design and implement the microprocessor based digital control for automation of industrial and power utility processes.

### 1.10.2 Overall Objectives

The group is concerned with computational intelligence, systems control and analysis, information processing and management and their applications to industrial and engineering systems.

The main objective of this Research Group is to carry out intensive research in following areas

- Analysis, design and implementation of control systems for different real world processes.
- Applications of micro-processors, PLDs, micro-controllers, and PLC for the industrial processes.

Design and development of programmable controllers, using digital and analog techniques

### 1.10.3 Application Domain

Industrial Automation and control

Design and interface of hardware and development of software for specific control problems and Robotics

### 1.10.4 Group Members

| Name                 | Degree                           | Area of research                        | Contacts                            | Email  |
|----------------------|----------------------------------|---|-------------------------------------|--|
| Dr. Syed M. Saddique | Ph D<br>(ElectronicEng.)<br>, UK | Industrial automation and robotics      | 92519280658 Ext 103<br>0333-9596055 | <a href="mailto:saddique@niit.edu.pk">saddique@niit.edu.pk</a>         |
| Nasir Mahmood        | MS, China                        | Automatic control,<br>Automatic testing | 051-9280744<br>0321-5160554         | <a href="mailto:nasir@niit.edu.pk">nasir@niit.edu.pk</a>               |
| Muhammad Ramzan      | MS, Australia                    | Communication & DSP                     | 051-9280046<br>0300-5260446         | <a href="mailto:mramzan@niit.edu.pk">mramzan@niit.edu.pk</a>           |
| Arshad Nazir         | MS (Electrical Eng.) Pak         | Telecommunicati on                      | 051-5590546,<br>0300-5527590        | <a href="mailto:Arshad.nazir@niit.edu.pk">Arshad.nazir@niit.edu.pk</a> |
| Syed Hasan Raza      | MS. Sweden                       | Antenna Analysis and Design             | 051-4444847<br>0322-5360093         | <a href="mailto:hasan@niit.edu.pk">hasan@niit.edu.pk</a>               |

### **1.10.5 Associated Labs**

- Embedded Systems Lab
- Electronics Lab
- Control Lab

### **1.10.6 Research Projects**

#### ***1.10.6.1 Past Projects***

A project entitled “Web Based SCADA”, has been complete in partnership with HEC and AH Automation to undertake research in network-based industrial automation systems for information management, condition monitoring and the real-time control of a wide range of distributed industrial systems using networking and agent technologies.

## 1.11 Embedded System Research Group

### 1.11.1 Theme

To develop methods and tools for the specification, design, analysis and testing of embedded systems

### 1.11.2 Overall Objectives

- System-level specification, design and synthesis of Embedded Systems
- Systems-on-Chip (SoC) for embedded systems
- Rapid Systems prototyping
- Design tools and environments
- Formal and other verification techniques

### 1.11.3 Application domain

- Digital signal processing for wireless and data communications
- Image and video processing
- Speech processing and recognition
- Control systems techniques
- Intelligent sensors and measurement systems

### 1.11.4 Group Members (Academic and administrative)

#### Group Leader

- Nasir Mahmood  
MS, China  
Embedded Systems Design, Reconfigurable computing, Automatic Testing  
92519280744, 92513215160554, [nasir@niit.edu.pk](mailto:nasir@niit.edu.pk)

#### Members

- Dr. Saddique  
PhD, UK  
Industrial Automation & Robotic  
0333-9596055, [saddique@niit.edu.pk](mailto:saddique@niit.edu.pk)
- Kamran Zaidi  
MS, UK  
Telecommunication  
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- Muhammad Ali Awan  
MS, Sweden  
ASIC and Embedded System  
0966-714411, 0345-5127323, [ali.awan@niit.edu.pk](mailto:ali.awan@niit.edu.pk)

### **1.11.5 International Conferences and Workshops**

HONET 2006, USA

### **1.11.6 Labs associated with your research group**

Embedded System Research Lab, Electronics Lab

### **1.11.7 Projects with the industry**

#### ***1.11.7.1 Past projects***

#### **a) An Offline Remote Data Monitoring & Acquisition for Discrete Manufacturing (using ZILOG eZ80F91)**

Supervised by: Dr. Waqar Mehmood, Muhammad Atif

Team Members: Mujtaba Haider (RA), Talha Yasin (BICSE-2), Syed Ali Raza Zaidi (BICSE-2)

#### **Abstract**

This project is aimed at providing an efficient data monitoring and acquisition solution for manufacturing environments where discrete components are manufactured in a factory line. There is main server that is connected to the CNC machines. Each CNC machine of different vendors has their own OPC data server. The OPC server provides a modular layer logically above the software applications. The SCADA software package provides the visual tools to monitor the processes running in the factory. The data is gathered by respective OPC data servers for each of the CNC machine of one model and stores in a data store that is attached with the main server. The analytical queries can be executed on the data store that will help in good business decisions. It is sophisticated enough to provide any kind of information required by the top management.

#### **b) Loom Machine Monitoring Developed on ZILOG eZ80F91**

Delivered to: Genesis Solutions (Karachi)

Supervised by: Muhammad Atif

Team Members: Mujtaba Haider (RA), Savera Tanveer (RA), Taimoor Ali (BIT-4), Huda Abdul Aziz (BIT-4), Talha Yasin (BICSE-2)

#### **Abstract**

A loom is a machine for weaving thread or yarn into textiles. Since, there is a heavy loss in production due to manual human monitoring. There is a need to

constantly monitor the process as any fault may stop the whole process. The overall goal of this project is to create the information integration technology required for fabric monitoring and inspection, analysis of loom stops, quick-response in manufacturing environment in the textile industry. The machine is designed exclusively for weaving glass fabrics at a higher quality level. It is provided with various systems like the enhanced filling control, stretch nozzle and automatic tail exhaustion to contribute to labor savings and important of fabric quality.

The main idea behind the project is to monitor all the loom machines on a single server. Loom machine will generate interrupts on several events (heating of a fan, breaking of thread etc...)



## 1.12 Reconfigurable Computing Research Group

### 1.12.1 Theme

To do research and development of product using this new computing paradigm so as to adapt the hardware during runtime by "loading" a new circuit on the reconfigurable fabric

### 1.12.2 Overall Objectives

- Adaptive implementations of communication coding in reconfigurable hardware.
- Adaptive systems on a chip
- Reconfigurable Architectures
- Networks Applications

### 1.12.3 Application domain

- Satellite communications
- Cryptography
- Signal processing
- Image and video processing
- Intelligent sensors and measurement systems
- Software radio

### 1.12.4 Group Members (Academic and administrative)

#### Group Leader

- Nasir Mahmood  
MS, China  
Embedded Systems Design, Reconfigurable computing, Automatic Testing  
92519280744, 92513215160554, [nasir@niit.edu.pk](mailto:nasir@niit.edu.pk)

#### Members

- Muhammad Ramzan  
MS, Australia  
Communication and DSP  
051-9280046, 0300-5260446, [mramzan@niit.edu.pk](mailto:mramzan@niit.edu.pk)
- Arshad Nazir  
MS, NUST Pk  
Telecommunication  
051-5590546, 0300-5527590, [arshad.nazir@niit.edu.pk](mailto:arshad.nazir@niit.edu.pk)
- Muhammad Ali Awan  
MS, Sweden  
ASIC and Embedded System  
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### **1.12.5 International Conferences and Workshops**

HONET 2006, USA

### **1.12.6 Associated Labs**

Embedded System Research Lab, Electronics Lab

## **1.13 Muhaqiq**

**Centre for Measurement and Analysis of the Global Grid and  
Internet End-to-End Performance**

### **1.13.1 Theme**

To conduct research and development in the domain of Computer Network End-to-End Performance Monitoring

### 1.13.2 Group Objectives

- Conduct research, development, and evaluation of computer network end-to-end performance measurement techniques.
- Develop analytical procedures to derive reliable results from the performance statistics gathered by the measurement infrastructure developed.
- Support collaborative research projects by measuring the network performance of the platform used for communication.
- Produce computer network experts capable of doing development for innovative and large scale computer network applications.

### 1.13.3 Application Domain

Internet Performance Measurement, Internet Communications, Computer Network Performance Measurement, Network Event Detection and Diagnosis, Network Performance Forecasting and Distributed Systems.

### 1.13.4 Group Members

- Arshad Ali, Group lead, Ph.D., [arshad.ali@niit.edu.pk](mailto:arshad.ali@niit.edu.pk)
- Umar Kalim, Coordinator & Supervisor, MS, [umar.kalim@niit.edu.pk](mailto:umar.kalim@niit.edu.pk)
- Asif Khan, Research Assistant, BS, [mak@slac.stanford.edu](mailto:mak@slac.stanford.edu)
- Shahryar Khan, Research Assistant, BS, [shahryar@slac.stanford.edu](mailto:shahryar@slac.stanford.edu)
- Qasim Bilal, Research Assistant, BS, [37bilal@niit.edu.pk](mailto:37bilal@niit.edu.pk)
- Fahad Ahmad Satti, BIT6 Student, [45fahad@niit.edu.pk](mailto:45fahad@niit.edu.pk)
- Arslan Qammar, BIT6 Student, [45arslan@niit.edu.pk](mailto:45arslan@niit.edu.pk)
- Noman Shah, BIT6 Student, [45noman@niit.edu.pk](mailto:45noman@niit.edu.pk)
- Farhan ur Rehman, BIT7 Student, [45farhan@niit.edu.pk](mailto:45farhan@niit.edu.pk)
- Nauman Shah, BIT6 Student, [45nauman@niit.edu.pk](mailto:45nauman@niit.edu.pk)

### 1.13.5 Publications

- Shahryar Khan, Les Cottrell, Umar Kalim, Arshad Ali, "Quantifying the Digital Divide: A Scientific Overview of Network Connectivity and Grid Infrastructure in South Asian Countries", in the proc. of CHEP 2007.
- International Committee for Future Accelerators – Standing Committee for Inter-Regional Connectivity (ICFA-SCIC) Network Monitoring Report 2007 compiled by Les Cottrell and Shahryar Khan.
- "Quantifying and Mapping the Digital Divide from an Internet Point of View", accepted for publication in Proc of 4th International Conference on Bridging the Digital Divide - Asian Applied Computing Conference (AACC 2007)
- Aziz A. Rehmatullah, R. Les. Cottrell, Jerrod D. Williams, Arshad Ali "Quantifying the Digital Divide: A Scientific Overview of the Connectivity of South Asian and African Countries" CHEP.06, Bombay, India
- R. L. Cottrell, M. Chhaparia, F. Haro, F. Nazir, M. "Evaluation of Techniques to Detect Significant Network Performance Problems using End-to-end Active Network Measurements", Standford, NOMS 2006, April 2006.
- Fareena Saqib, Umar Kalim, Arshad Ali, "Network Weather Forecasting in Gird systems", in proc. of HONET 2006.

- Asif Khan, Arshad Ali, “MoMon: single ended, plug n play Grid Monitoring tool” in proc. of GridNets 2006.





### 1.13.6 Organization of conferences and workshop in 2006-2007

- Best practices for programming – design patterns - 31<sup>st</sup> May, 2006.
- Code profiling and optimization, 7<sup>th</sup> June, 2006
- Linux Help session - 14<sup>th</sup> October, 2006
- Linux Hands on Workshop - 16<sup>th</sup> October, 2006
- Hands on Workshop on Perl – November 2007
- Hands on Workshop on Perl – 22<sup>nd</sup>, 23<sup>rd</sup> October 2007






### 1.13.7 Associated Labs

Research Lab, NIIT

### 1.13.8 Research Projects

|   |   |   |
|---|---|---|
| <b>Project title</b>  | TULIP: Trilateration Utility for Locating IP hosts  | 1 |
| <b>Team members</b>   | Mr. Faran Javed (BIT 5)   |   |
| <b>Supervised by</b>  | Dr. Arshad Ali, Dr. Les Cottrell, Mr. Ejaz Ahmed, Mr. Umar Kalim  |   |
| <b>Started in</b>   | Late 2004   |   |
| <b>Current status</b>    | In progress   |   |
| <b>Reference</b>  | <a href="http://www.slac.stanford.edu/comp/net/wan-mon/tulip/">http://www.slac.stanford.edu/comp/net/wan-mon/tulip/</a>     |   |
| <b>Project title</b>  | ViPER: Visualization for PingER   | 2 |
| <b>Team members</b>   | Mr. Shehryar Khan (BIT 4)   |   |
| <b>Supervised by</b>  | Dr. Arshad Ali, Dr. Les Cottrell, Mr. Umar Kalim  |   |
| <b>Started in</b>   | Early 2006  |   |
| <b>Current status</b>  | Completed   |   |
| <b>Reference</b>  | <a href="http://pinger2.niit.edu.pk/~sheryar/">http://pinger2.niit.edu.pk/~sheryar/</a>                                     |   |
| <b>Project title</b>  | NWF: Network Weather Forecasting (using ARMA/ARIMA)   | 3 |
| <b>Team members</b>   | Ms. Fareena Saqib (BIT 4)   |   |
| <b>Supervised by</b>  | Dr. Arshad Ali, Dr. Les Cottrell, Mr. Umar Kalim  |   |
| <b>Started in</b>   | Early 2006  |   |
| <b>Current status</b>  | Completed   |   |
| <b>Reference</b>  | <a href="http://maggie.niit.edu.pk/nwf_projectdesc.html">http://maggie.niit.edu.pk/nwf_projectdesc.html</a>                 |   |
| <b>Project title</b>  | Federation: SmokePing, PingER Integration   | 4 |
| <b>Team members</b>   | Ms. Asma Shamshad (BIT 4)   |   |
| <b>Supervised by</b>  | Dr. Arshad Ali, Dr. Les Cottrell, Mr. Umar Kalim  |   |
| <b>Started in</b>   | Early 2006  |   |
| <b>Current status</b>  | Completed   |   |
| <b>Reference</b>  | <a href="http://maggie.niit.edu.pk/federation_projectdesc2.html">http://maggie.niit.edu.pk/federation_projectdesc2.html</a> |   |
| <b>Project title</b>  | Topological Analysis and Network Performance Visualization  | 5 |
| <b>Team members</b>   | Mr. Asif Khan (BIT 4)   |   |
| <b>Supervised by</b>  | Dr. Arshad Ali, Dr. Yee Ting Lee, Mr. Umar Kalim  |   |
| <b>Started in</b>   | Early 2005  |   |

|                         |  |    |
|-------------------------|--|----|
| <b>Current status</b> ■ | Completed  |    |
| <b>Reference</b>        | <a href="http://maggie.niit.edu.pk/topoanalysis_projectdesc.html">http://maggie.niit.edu.pk/topoanalysis_projectdesc.html</a>  |    |
| <b>Project title</b>    | AMP PingER Integration   | 6  |
| <b>Team members</b>     | Mr. Abdullah Jan   |    |
| <b>Supervised by</b>    | Dr. Arshad Ali, Dr. Les Cottrell, Mr. Jerrod Williams, Mr. Umar Kalim  |    |
| <b>Started in</b>       | Early 2005   |    |
| <b>Current status</b> ■ | Completed  |    |
| <b>Reference</b>        | <a href="http://maggie.niit.edu.pk/pingerampint_projectdesc.html">http://maggie.niit.edu.pk/pingerampint_projectdesc.html</a>  |    |
| <b>Project title</b>    | Anomaly Detection Using Principal Component Analysis   | 7  |
| <b>Team members</b>     | Mr. Adnan Iqbal (Ph.D. student)  |    |
| <b>Supervised by</b>    | Dr. Arshad Ali, Dr. Les Cottrell   |    |
| <b>Started in</b>       | Early 2005   |    |
| <b>Current status</b> ■ | In progress  |    |
| <b>Reference</b>        | <a href="http://maggie.niit.edu.pk/netandet_projectdesc.html">http://maggie.niit.edu.pk/netandet_projectdesc.html</a>  |    |
| <b>Project title</b>    | PingER Visualization   | 8  |
| <b>Team members</b>     | Ms. Rabail Javed (BIT 5)   |    |
| <b>Supervised by</b>    | Dr. Arshad Ali, Dr. Les Cottrell, Mr. Ejaz Ahmed, Mr. Umar Kalim   |    |
| <b>Started in</b>       | Early 2005   |    |
| <b>Current status</b> ■ | Completed  |    |
| <b>Reference</b>        | <a href="http://maggie.niit.edu.pk/newwebsite/pingervisualization_projectdesc.html">http://maggie.niit.edu.pk/newwebsite/pingervisualization_projectdesc.html</a>  |    |
| <b>Project title</b>    | PingER Executive Plots   | 9  |
| <b>Team members</b>     | Mr. Akbar Mehdi  |    |
| <b>Supervised by</b>    | Dr. Arshad Ali, Dr. Les Cottrell, Mr. Umar Kalim   |    |
| <b>Started in</b>       | Early 2006   |    |
| <b>Current status</b> ■ | Completed  |    |
| <b>Reference</b>        | <a href="http://maggie.niit.edu.pk/newwebsite/pingerexecplot_projectdesc.html">http://maggie.niit.edu.pk/newwebsite/pingerexecplot_projectdesc.html</a><br><a href="http://pinger2.niit.edu.pk/~akbar/">http://pinger2.niit.edu.pk/~akbar/</a> |    |
| <b>Project title</b>    | PingER Management  | 10 |
| <b>Team members</b>     | Mr. Waqar Ali  |    |
| <b>Supervised by</b>    | Dr. Arshad Ali, Dr. Les Cottrell, Mr. Jerrod Williams, Mr. Umar Kalim  |    |
| <b>Started in</b>       | Early 2006   |    |
| <b>Current status</b> ■ | Completed  |    |
| <b>Reference</b>        | <a href="http://maggie.niit.edu.pk/newwebsite/pingermanagement_projectdesc.html">http://maggie.niit.edu.pk/newwebsite/pingermanagement_projectdesc.html</a>  |    |
| <b>Project title</b>    | Evaluation of Techniques to Detect Significant Network Performance Problems using End-to-End Active Network Measurement  | 11 |
| <b>Team members</b>     | Mr. Fawad Nazir  |    |
| <b>Supervised by</b>    | Dr. Arshad Ali, Dr. Les Cottrell, Mr. Jerrod Williams, Mr. Umar Kalim  |    |
| <b>Started in</b>       | Early 2005   |    |
| <b>Current status</b> ■ | Completed  |    |

|   |   |    |
|---|---|----|
| <b>Reference</b>  | <a href="http://maggie.niit.edu.pk/documents/fawad-nazir.pdf">http://maggie.niit.edu.pk/documents/fawad-nazir.pdf</a> |    |
| <b>Project title</b>  | NWF: Network Weather Forecasting (using Holts-Winter)   | 12 |
| <b>Team members</b>   | Mr. Asher Shoukat   |    |
| <b>Supervised by</b>  | Dr. Arshad Ali, Dr. Les Cottrell, Mr. Ejaz Ahmed  |    |
| <b>Started in</b>   | Early 2005  |    |
| <b>Current status</b>    | Completed   |    |
| <b>Project title</b>  | Traceanal: Trace route analysis   | 13 |
| <b>Team members</b>   | Mr. Qasim Bilal (BIT 4)   |    |
| <b>Supervised by</b>  | Dr. Arshad Ali, Ms. Connie Logg, Mr. Ejaz Ahmed   |    |
| <b>Started in</b>   | Early 2005  |    |
| <b>Current status</b>    | Pending   |    |
| <b>Project title</b>  | Internet End-to-End Performance Monitoring  | 14 |
| <b>Team members</b>   | Mr. Fahad Ahmad Satti (BIT 6)   |    |
| <b>Supervised by</b>  | Dr. Arshad Ali, Les Cottrell, Umar Kalim  |    |
| <b>Started in</b>   | Early 2007  |    |
| <b>Current status</b>    | In progress   |    |
| <b>Project title</b>  | Network Event Detection and Diagnosis   | 15 |
| <b>Team members</b>   | Mr. Noman Latif (BIT 6)   |    |
| <b>Supervised by</b>  | Dr. Arshad Ali, Les Cottrell, Umar Kalim  |    |
| <b>Started in</b>   | Fall 2007   |    |
| <b>Current status</b>  | In progress   |    |
| <b>Project title</b>  | API for perfSONAR Measurement Points  | 16 |
| <b>Team members</b>   | Mr. Arslan Qammar (BIT 6)   |    |
| <b>Supervised by</b>  | Dr. Arshad Ali, Les Cottrell, Umar Kalim  |    |
| <b>Started in</b>   | Fall 2007   |    |
| <b>Current status</b>  | In progress   |    |

### 1.13.9 Grants Obtained

#### 1. Title: “Network Performance Monitoring for PERN”

Funding Body: Higher Education Commission (HEC)

Role: Project Director.

Approved Funding: 36.853 Million Rupees

Duration: Jan 2008 to July 2010.

Executing Body: National University of Sciences and Technology (NUST)-NIIT

## 1.14 Information Security Research Group

### 1.14.1 Theme

Information Security

### 1.14.2 Objectives

The NIIT Information Security Research Group (ISRG) conducts research and development of ideas and products in the broad field of information security. The research scope of this group includes cryptology, digital evidence analysis (computer forensics), network security (including intrusion detection), digital watermarking and malicious software analysis.

Moreover, research may be conducted in any aspect of information security that has high-quality research potential (i.e., cutting-edge research that may lead to publications in reputed international conferences or journals) and/or practical applications (i.e., research that may lead to patents and subsequent commercialization).

The ISRG also collaborates with other research groups within NIIT when there is an overlap in research interests (e.g., security of multi-agent grid networks).

In order to increase information security awareness and interest among faculty and students, the ISRG also arranges seminars and presentations by ISRG members open to all NIIT faculty and students addressing both research and commercial (practical) aspects of information security.

### 1.14.3 Application Domain

Information Security

### 1.14.4 Group Members

- **Dr Syed Mohammad Hassan Zaidi**  
PhD (Elect. Eng), University of South Florida, USA  
Area of Research: Optical Networks, Network Security  
[drzaidi@niit.edu.pk](mailto:drzaidi@niit.edu.pk)
- **Dr Nasir ud Din Gohar**  
PhD (Elect. Eng.), Imperial College, University of London, UK  
Area of Research: Communication Systems  
[ndgohar@niit.edu.pk](mailto:ndgohar@niit.edu.pk)
- **Dr Hafiz Farooq Ahmed**  
Phd

Semantic Web, Autonomous Semantic Grid, Formalism in Software engineering, Mobile Agents, Software Development  
[drfarooq@niit.edu.pk](mailto:drfarooq@niit.edu.pk)

- **Dr Fauzan Mirza**  
PhD (Information Security), Royal Holloway, University of London, UK  
Area of Research: Cryptology, Malware Analysis, Digital Evidence, Network Security  
[ndgohar@niit.edu.pk](mailto:ndgohar@niit.edu.pk)
- **Dr Syed Ali Khayam**  
PhD (Elect. Eng.), Michigan State University, USA  
Area of Research: Network Security, Wireless Networks  
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- **Dr Nazar Abbas Saqib**  
PhD (Elect. Eng.), CINVESTAV-IPN, Mexico  
Area of Research: Cryptology, Algorithm Design for FPGA Implementation  
[nazar@niit.edu.pk](mailto:nazar@niit.edu.pk)

### 1.14.5 Labs associated with the research group

Information Security Lab

### 1.14.6 Research Projects

#### a) Malicious Software Detection

PI: Dr. Fauzan Mirza

Co-PI: Dr. Syed Ali Khayam

Members: M. Hassan Khan (BIT-5), Amna Hamed (BIT-6), Arkam Uzair (BICSE-2)

This project aims to find a mechanism for the automatic detection and removal of viruses and other malicious software that needs minimal maintenance. This system that can automatically detect and possibly remove malware without human intervention. This system could be deployed in mail servers or Internet routers to scan traffic in real-time, thereby ensuring that new malware is automatically detected and blocked before it has a chance to propagate.

#### b) Program Code Watermarking

PI: Dr. Hafiz Farooq Ahmed

Co-PI: Dr. Fauzan Mirza

This project investigates methods of watermarking software to detect the source of illegitimately-used (pirated) software. The watermark is embedded within a compiled executable in some manner that evades detection except from the software developer (which planted the watermark).

**c) Bulk Encryption Unit**

PI: Dr. Nazar Abbas  
Co-PI: Dr. Fauzan Mirza

This project is concerned with the study and implementation of cryptographic techniques in the application of a commercial bulk-encryption unit (BEU) device, comprising: bulk encryption unit, optimised crypto co-processor, secure key generation module, and key management & distribution system. This device may be used on network endpoints to secure all communication (e.g., data, VoIP) over an insecure channel (e.g., Internet). Specific aspects of this project include: Design of a symmetric-key cipher for bulk encryption application; Cryptanalysis of symmetric-key ciphers for security evaluation; Selection and evaluation of secure key distribution protocols; Design and evaluation of a cryptographically-secure key generator; Security evaluation of a complete communication security system.

**d) Digital Evidence Investigation**

PI: Dr. Fauzan Mirza  
Co-PI: Dr. Syed Ali Khayam  
Members: Abeer Khan (BIT-6), Hira Qamar (BIT-6), Yousra Javed (BICSE-2), Mubeen Javed (BICSE-2)

Microsoft Windows is the most popular consumer operating system in the world. When a person uses Windows, digital evidence of their activity is recorded by various applications and other programs. This project investigates Microsoft Windows, Microsoft Office, and other common applications, to determine what digital evidence is stored and how it may be extracted for forensic presentation.

**e) Network Security**

PI: Dr. Syed Ali Khayam  
Co-PI: Dr. Fauzan Mirza  
Members: Maria Joseph (BICSE-2), M. Arshad (BICSE-2), Asma Mumtaz (BIT-6)

This project investigates techniques of detection and generation of various attacks on Internet hosts. Two contemporary areas of network security research are studied in particular: (1) Denial of Service attacks; and (2) OS fingerprinting.



## 1.15 Autonomous Semantic Grid Research Group

### 1.15.1 Theme

- Practical strength in the students for SE/ Distributed Computing/Multi Agent System.
- Quality in OOSE
- and Formal methods in SE and Distributed Computing

### 1.15.2 Overall Objectives

- Advanced research in IT in the areas of Multi agent Systems and Semantic Grid.
- Produce research of high quality and impact

### 1.15.3 Application domain

- Autonomous Semantic Grid
- Multi Agent Systems
- Advanced Telcom and Networks

### 1.15.4 Group Members (Academic and administrative)

#### PhD Students Supervision/ Co-supervision (topic of research)

| No. | Name                | Topic of Research   | Qualification | Contact |
|-----|---------------------|---|---------------|---------|
| 1   | Sarmad Sadik        | Policy based mobile agents  |               |         |
| 2   | Rabia Iqbal         | Security in sensors networks  |               |         |
| 3   | Maruf Pasha:        | Autonomous Semantic Grid: Interoperability between Agent and Web services | MSIT          |         |
| 4   | Awais Shibli        | Security in software agents   |               |         |
| 5   | Abdul Ghafoor       | Grid computing  | MSIT          |         |
| 6   | Rahman-Visiting PhD | Autonomous Semantic Grid  |               |         |

#### MS Students supervision/ co supervision (MSIT 6: 2006-2007)

| No. | Name          | Topic of Research                                  | Qualification | Contact |
|-----|---------------|--|---------------|---------|
| 1   | Umer Uzair    | (MIT 3: 2006-2007): Network topology discovery     |               |         |
| 2   | Naeem Khalid: | Autonomous Semantic Grid: Interoperability between |               |         |

|    |                 |  |                              |   |
|----|-----------------|--|------------------------------|---|
|    |                 | Agent and Semantic Web services  |                              |   |
| 3  | Saman Iftikhar; | Autonomous Semantic Grid: Interoperability between Agents and OWL and WSML                           |                              |   |
| 4  | Ambreen:        | Integration of software agents with P2P systems.   |                              |   |
| 5  | Atif Nazir      | Enhancing Webs services for semantic and intelligent behaviour                                       |                              |   |
| 6  | Falak Nawaz:    | Semantic registries for realizing Semantic Web, and Semantic Personal Information Management (SPIM). |                              |   |
| 7  | Haroon ashar:   | Agents based SCM   |                              |   |
| 8  | Naveed Khan:    | Strong mobility in SAGE  |                              |   |
| 9  | Atif Khan:      | Semantic registries for WSML based SWS   | BS in Software Development   |   |
| 10 | Hafiz Bilal:    | Congestion control in WCDMA systems using software agents  | B.Sc in Computer Engineering | 0321-6802141<br>mbilalrizvi@hotmail.com |
| 11 | Kamran          | Congestion control in WCDMA systems using software agents and neural networks.                       |                              |   |
| 12 | Adeel Shajar:   | Doing research and completing the course, SAGE lite  |                              |   |
| 13 | Ayesha Noureen  | Security in sensors networks   |                              |   |
| 14 | Atiya Akram:    | Security in sensors networks   |                              |   |
| 15 | Noor UI Qayyum  | SAGE security; KTH-NIIT Lab  |                              |   |

### MS Students supervision/ co supervision (MSIT7: 2006-2007)

| No. | Name            | Topic of Research | Qualification         | Contact   |
|-----|-----------------|-------------------|-----------------------|---|
| 1   | Abdul-Razaq     | Formal Methods    | MIT, M.Sc Mathematics | <a href="mailto:Ar19ar@yahoo.com">Ar19ar@yahoo.com</a><br>051-5704182 |
| 2   | Maqbool Hussain | Formalizing HL7   |                       |   |

|    |                  |  |  |  |
|----|------------------|--|--|--|
| 3  | M. Afzal         | Formalizing HL7  |  |  |
| 4  | Kamran Qadir     | Integration of ProActive GCM with SAGE; Inria, France joint funded project |  |  |
| 5  | Shahid Mahmood   | Integration of ProActive GCM with SAGE; Inria, France joint funded project |  |  |
| 5  | Zeeshan Pervaz   | Digital Watermarking   |  |  |
| 6  | Yasir Mahmood    | Digital Watermarking   |  |  |
| 7  | Nasir Haider     | Formal Methods   |  |  |
| 8  | Ali Hur          | Formal Methods   |  |  |
| 9  | Abdul-Moaiz      | WSMO   |  |  |
| 10 | Sohail Khan      | WSMO   |  |  |
| 11 | Muddasar Mahmood |  |  |  |
| 12 | Sohail Sarwar    |  |  |  |

### 1.15.5 Publications 2006-07

#### Year: 2006

1. Muzammil A. Khan, H. Farooq Ahmad, Arshad Ali, Faran Javed Chawla, M. Atif, Hiroki Suguri, and H. Ghulam Mujtaba "An Efficient Algorithm for Aligning DNA Sequences", ISCA 21st International Conference on Computers and Their Applications (CATA-2006), pp. March 23-25, 2006 Seattle, WA, USA.
2. Sarmad Sadik Malik, H. Farooq Ahmad, Arshad Ali, Hirko Suguri, "Using Honey Bee Teamwork Strategy in Software Agents", 10th International Conference on CSCW in Design pp. 620-626, May 3-5, 2006 China.
3. Aqsa Bajwa, Sana Farooq, Obaid Malik, Sana Khaliq, Hiroki Suguri, Hafiz Farooq Ahmad, Arshad Ali, "Persistent Architecture for Context Aware Lightweight Multi Agent System", 5th International Joint Conference on Autonomous Agents and Multi Agent Systems (AAMAS 06), pp. 19-31, 8-10 May 2006, Japan.
4. Sarmad Sadik Malik, H. Farooq Ahmad, Arshad Ali, Hirko Suguri, "Policy Based Approach to Enhance Task Execution Performance of Mobile Agents", The 2006 International Conference on Parallel and Distributed Processing Techniques and Applications (PDPTA'06), pp. 542-547, June 26-29, 2006, USA.
5. Maruf Pasha, Sabih ur Rehman, H. Farooq Ahmad, Arshad Ali, and Hiroki Suguri, "Middleware Between OWL and FIPA Ontologies in the Semantic Grid Environment", The 2006 International Conference on Semantic Web and Web Services (SWWS'06), pp. 30-35, Las Vegas, USA, June 2006.
6. Fawad Nazir, Mohsen Jameel, Arshad Ali, H. Farooq Ahmad, "Efficient Approach Towards IP Network Topology Discovery for Large Multi-subnet Networks" 11th

- IEEE Symposium on Computers and Communications (ISCC 2006), Sardinia, Italy.
7. Mehwish Nasir, H. Farooq Ahmad, "A Survey of Software Estimation Techniques and Project Planning Practices", IEEE Seventh ACIS International Conference on Software Engineering, Artificial Intelligence, Networking, and Parallel/Distributed Computing, USA (2006)
  8. Mehwish Nasir, H. Farooq Ahmad, "An Empirical Study to Investigate Software Estimation Trend in Organization Targeting CMMI", 5th IEEE/ACIS International Conference on Computer and Information Science (ICIS2006), pp.38-43, (2006), USA.
  9. M. Pasha, Sabih Ur Rehman, A. Ali, H. F. Ahmad, H. Suguri, " Semantic Grid: Interoperability between OWL and FIPA SL", Lecture Notes in Computer Science, Vol. 4088, pp. 714-720 (2006).
  10. Javed Iqbal, H. Farooq Ahmad, Arshad Ali, Hiroki Suguri, Sarmad Sadik, "Strong Mobility for FIPA Compliant Multi-Agent Systems", Lecture Notes in Computer Science, Vol. 4088, pp. 819-824 (2006).
  11. M Umer Khan, M Qaisar Ch, Hafiz Farooq Ahmad, Arshad Ali, Hiroki Suguri, "Efficient Case Matching and Retrieval Approach for Congestion Control in 3G Networks Using Intelligent Agents", Networks: Computation, Communication and Applications (NCCA'06), Oxford, UK.
  12. M. Pasha, A. Ali, H. F. Ahmad, H. Suguri, "An Ontology Gateway for Efficient Communication of Agents with Web Services", The 10th IASTED International Conference on ARTIFICIAL INTELLIGENCE AND SOFT COMPUTING, ASC 2006, August 28-30, 2006, Palma de Mallorca, Spain, pp.85-90 (2006)
  13. Mohsan Jameel, Hamid Mukhtar, Hafiz Farooq Ahmad, Arshad Ali, Hiroki Suguri, "IP Network Topology Discovery for Large and Multi Subnet Using Mobile Service Agents", 3rd International Symposium on High Capacity Optical Networks and Enabling Technologies (HONET 2006), September 6 - 8, 2006, Charlotte, North Carolina, USA.
  14. M. Qaisar Ch., M. Umer Khan, Hafiz Farooq Ahmad, Arshad Ali, Hiroki Suguri, Liaqat Ali, "Efficient Case Retrieval and Adaptation Approach for SLA Based Radio Resource Management in 3G Networks using Intelligent Agents", International Symposium on Broadband Access Technologies in Metropolitan Area Networks (2006), 5-6 October 2006, Niagara Falls, Canada.
  15. M. Naveed, M. Khalid Abdullah, Khalid Rashid, Hafiz Farooq Ahmad, "Representing Shared Join Points with State Charts: A High Level Design Approach", Transactions on Engineering, Computing, and Technology, Volume 15, October 2006, pp. 80-84, 2006.
  16. Sana Farooq, Aqsa Bajwa, Obaid Malik, Sana Khaliq, Hiroki Suguri, Hafiz Farooq Ahmad, Arshad Ali, "SAGE-Lite: An Intelligent Light-weight Multi-agent System", IEEE/WIC/ ACM International Conference on Intelligent Technology, 18-22, pp. December 2006, Hong Kong.
  17. Rabia Riaz, Arshad Ali, Ki Hyung Kim, H. Farooq Ahmad, Hiroki Suguri, "Secure Dynamic Key Management for Sensor Networks", Innovations in Information Technology, Dubai, 2006.

18. Muaz Niazi, Hafiz Farooq Ahmad, Arshad Ali, "Introducing fault-tolerance in web applications using SERFTIA", Proc. of the International Multiconference on Computer Science and Information Technology, pp 233-240, 2006.
19. Misbah Mubarak, H. Farooq Ahmad et al, "Strong mobility in open-source SAGE Multi-agent System", International Conference on Open-Source Technologies ICOST-2006 28-29 December 2006, Lahore, Pakistan.
20. Sarmad Sadik Malik, Maruf Pasha, Arshad Ali, H. Farooq Ahmad, Hirko Suguri, "Policy Based Migration of Mobile Agents in Disaster Management Systems", 2<sup>nd</sup> International Conference on Emerging Technologies, pp. 224-229, November 13-14, 2006 Pakistan.
21. Misbah Mubarak, Sara Sultana, Zarar Khan, Hajra Batool, H. Farooq Ahmad, Fakhra Jabeen, "An Approach to Ontological Interoperability", 2<sup>nd</sup> International Conference on Emerging Technologies, pp. 657-663, November 13-14, 2006 Pakistan.
22. Shadia Manan, H. Farooq Ahmad, Saad Liaqat, Hirko Suguri, "Autonomous Semantic Grid: Design and Architecture of WSDL Parser for Service Oriented Computing", 2<sup>nd</sup> International Conference on Emerging Technologies, pp. 612-616, November 13-14, 2006 Pakistan.
23. Maruf Pasha, Arshad Ali, H. Farooq Ahmad, and Hiroki Suguri, "Ontological Translation in Semantic Grid", 4<sup>th</sup> International Workshop on Multi-Agent and Semantic Grid (MASSG2006), pp. 35-40, Pakistan, 16 December 2006.
24. Ambreen Amin, Aatif Kamal, H. Farooq Ahmad, "Integration of Peer-to Peer Multi-Agent Systems", 4<sup>th</sup> International Workshop on Multi-Agent and Semantic Grid (MASSG2006), pp. 41-49, Pakistan, 16 December 2006.

**Year: 2007**

25. Sana Farooq, Aqsa Bajwa, Obaid Malik, Sana Khalique, Aqsa Bajwa, Obaid Malik, Hiroki Suguri, Hafiz Farooq Ahmad, Arshad Ali, "Efficient Agent Communication in Wireless Environment", 2<sup>nd</sup> Workshop on Artificial Intelligence on Techniques for Ambient Intelligence pp. 68-73, 5-6 January 2007, Hyderabad, India.
26. M Umer Khan, M Qaisar Ch, Hafiz Farooq Ahmad, Liaqat Ali, Arshad Ali, Hiroki Suguri, "Merging CBR and Neural Networks for SLA-Based Radio Resource Management for QoS Sensitive Cellular Networks", IEEE Proc. of the Sixth International Symposium on ADS (ISADS07), 2007, pp. 263-269, 21-23 March (2007).
27. Sana Farooq, Sana Khalique, Aqsa Bajwa, Obaid Malik, Hafiz Farooq Ahmad, Hiroki Suguri, Arshad Ali, "SAGE LITE: An Architecture and Implementation of Light Weight Multi-agent System", IEEE Proc. of the Sixth International Symposium on ADS (ISADS07) 2007, pp 239-244, 21-23 March (2007).
28. Aqsa Bajwa, Sana Farooq, Obaid Malik, Sana Khalique, Hiroki Suguri, Hafiz Farooq Ahmad, Arshad Ali, "Persistent Architecture for Context Aware Lightweight Multi Agent System", Lecture Notes in Artificial Intelligence, Vol. 4411, pp. 57-69 (2007).
29. Misbah Mubarak, Zarrar Khan, Sara Sultana, Hajra Batool Asghar, H Farooq Ahmad, Hiroki Suguri, Fakhra Jabeen, "A Dynamic Policy based Security Architecture for Mobile Agents", Lecture Notes in Computer Sciences,

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34. Sarmad Sadik, Arshad Ali, H. Farooq Ahmad Hiroki Suguri, "Policy based Ontology Framework for Mobile Agents", 6th IEEE International Conference on Computer and Information Science (ICIS2007), pp. 483 - 489 July 11-13, 2007, Australia.
35. Abdul Ghafoor, Bilal Mustafa, H. Farooq Ahmad, Arshad Ali, Hiroki Suguri, "SAGE, Open Source Fault Tolerant Architecture: Enhancement, Refactoring and Debugging", 21<sup>st</sup> Assurance System Symposium, Hiroshima, Japan, 13 July 2007, pp.27-31, 2007,.
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37. Fawad Nazir, Tallat Hussain Tarar, Faran Javed, Hiroki Suguri, Hafiz Farooq Ahmad, Arshad Ali, "Constella: A Complete IP Network Topology Discovery Solution", The Asia-Pacific Network Operations and Management Symposium (APNOMS); 10-12 October 2007, Sapporo, Japan, Lecture Notes in Computer Science: Managing Next Generation Networks and Services, Volume 4773/2007, pp. 425-436, (2007).
38. Naeem Khalid, Maruf Pasha, Sabi-ur-rehman, H. Farooq Ahmad, Hiroki Suguri "Ontology Services between Agents and OWL Based Web Services", The 3<sup>rd</sup> IEEE International Conference on Semantics, Knowledge and Grid (SKG), 29-31 October, China 2007 (accepted).
39. Falak Nawaz, Maruf Pasha, Farooq Ahmad, Hiroki Suguri "Pushing Semantic Web Service Profiles to Subscribers for Efficient Service Discovery", The 3<sup>rd</sup> IEEE International Conference on Semantics, Knowledge and Grid (SKG), 29-31 October, China 2007 (accepted).

40. Falak Nawaz, H. Farooq Ahmad, Hiroki Suguri, Arshad Ali, "Semantic Web Service Registry for efficient Service Discovery", 4th International Symposium on High Capacity Optical Networks and Enabling Technologies, November 18-20, 2007 Madinat Jumeirah Hotel Dubai, UAE (accepted).
41. Ambreen Amin, Aatif Kamal, Hafiz Farooq Ahmed "Interoperability between Mobile Agents and Peer-To-Peer Systems", 4th International Symposium on High Capacity Optical Networks and Enabling Technologies, November 18-20, 2007 Madinat Jumeirah Hotel Dubai, UAE (accepted).
42. Attiya Akram, Ayesha Noureen, Rabia Iqbal, Kim, H. Farooq Ahmad, "Evaluation of Hybrid Security System with Cluster Based key Management for Wireless Sensor Networks", International Conference on Intelligent & Advanced Systems 2007 (accepted).
43. Ayesha Noureen, Attiya Akram, Rabia Iqbal, Kim, H. Farooq Ahmad, "An End-to-End Security Architecture for Sensor Networks", The 2007 Annual International Workshop (WISP 2007) of the AIS Special Interest Group on Information Security and Privacy (SIG-SEC), December 8, 2007, Montreal, Canada, in conjunction with the 2007 International Conference on Information Systems (ICIS 2007).
44. Rabia Riaz, Ali Hammad Akbar, Ki-Hyung Kim, Farooq Ahmed, "SACK: Storage And Communication optimized Keying framework for wireless sensor networks", The IEICE Transactions on Information and Systems, Special Section on Information and Communication System Security 2008 (Submitted)

#### **1.15.6 Associated Labs**

- CERN Lab
- Linux Lab
- PhD Lab

#### **1.15.7 Research projects**

##### **International Collaboration**

##### **1.15.7.1 Current projects**

- a) **Autonomous Semantic Grid:** (in cooperation with Comtec, Japan)  
Integration of agents with web services and Semantic Web services. The main question is how Web services can be made intelligent? This is very large project and will remain active for the next foreseen future.

##### **1.15.7.2 Past projects (Completed)**

- a) **SAGE:** (in cooperation with Comtec, Japan)
  - IEEE FIPA compliant multi agent system framework for developing Intelligent agent based system
  - On going; start September 2002 Released as open source in November 2004 (10 year plan to continue)

b) **SAGE lite** (in cooperation with Comtec, Japan)

- IEEE FIPA compliant multi agent system framework for developing Intelligent agent based system for small devices.
- On going; start September 2005
- Released as open source in 2007
- Agentcities: 5<sup>th</sup> Framework European Project on Agent system development and deployment on global scale. The project has been completed in June 2003.
- Scalable fault Tolerant Agent Grooming Environment (SAGE)\*: Design and development of FIPA Compliant Multi-Agent System SAGE. SAGE is the first 2<sup>nd</sup> generation Multi-Agent System (MAS) in the world with the main objectives:
  - Fault tolerance,
  - Scalability
  - Mobility
  - Agent communication language semantics implementation

For more information: <http://sage.niit.edu.pk>, <http://www.comtec.co.jp/sage/>

## **1.16 G Communication Research Group**

### **1.16.1 Theme**

Development of future communication technologies

### **1.16.2 Overall Objectives**

This newly established research group will focus on the algorithm development and implementation of third generation (3G) and third generation plus (3G+) as well as fourth generation wireless technologies.

### **1.16.3 Application Domain**

- Mobile Communication Technologies
- Wireless Communication Technologies
- Signal Processing and its Applications

### **1.16.4 Group Members**

- Dr. Arshad Ali (PhD), IT/Communication, NIIT
- M. Aamir Jelani (MS), Communication / Signal Processing, NIIT
- M. Suhail Shah (BE), Communication, NIIT
- M. Waseem Arshad (Research Student)
- Syed Ali Asadullah Bukhari (Research Student)



- Haris Mehmood (Research Student)
- Hasan Mumtaz Mirza (Research Student)
- Rizwan Aijaz (Research Student)
- Ali Munir (Research Student)
- Aqeel Ahmad Qureshi (Research Student)

### **1.16.5 Associated Lab**

- Communication Lab
- 3G Research Lab

### **1.16.6 Research Projects**

#### **a) Multiuser Detection in DS-CDMA Systems**

The standardization of Direct-Sequence CDMA (DS-CDMA) systems has the major problem of Multiple Access Interference (MAI). To overcome these limitations, Multi-User Detection (MUD) emerges as a promising approach to increase the system capacity.

This project was undertaken successfully by implementing three MUD techniques (SIC, PIC and Hybrid). Extension to this project will aim to implement these techniques using real time data and study performance using Rayleigh Channel modeling.

#### **b) SS7 Stack implementation**

SS7 is the de-facto standard in PSTN / Mobile Telephony for out of band channel signaling. SS7 provides a universal structure for telephony network signaling, messaging, interfacing, and network maintenance. It deals with establishment of a call, exchanging user information, call routing, different billing structures, and supports intelligent network (IN) services. This project successfully implemented the stack for MTP layers and partial implementation of ISUP Layer. Extension of this projects aims to develop complete ISUP Layer functionality of SS7 Stack. A detailed set of requirements has to be generated from the SS7 specs followed by a detailed design architecture. Various simulations representing different configurations / environments would also be generated. Support from Telenor may be available in terms of standard implementation and Live Data Streams.

#### **c) OFDM Test bed**

OFDM is an emerging standard for high speed communication both wireless and fixed line systems. It has inherent resistance against various signal interference with low bit error rates.

Simulation test bed for OFDM was successfully developed using Simulink. Next Phase of this project aims to develop a hardware implementation of this test bed, showing the complete GSM Phone building blocks implemented in

hardware. DSP kits (TMSC713), FPGA based system or other relevant and available resources may be used to achieve this purpose.

**d) GSM Mobile Phone Test Bed**

Mobile Communication today is emerging as a major player in the communication industry. Mobile Phone is the main interface of users with the mobile network. Recently there has been exponential growth in the production and market acceptance of Mobile Phones.

Low cost and efficient customizable interfaces are the major challenge today considering the utilization of these devices in developing countries

This project will explore the GSM mobile phone and its building blocks. Having a good understanding will lead to the implementation of working test bed in Matlab and its prototype on the hardware DSP kits. Having a thorough command on the interfaces and standards would be a must requirement for successful completion of the project.

**e) SIP Protocol Tester**

SIP is an IETF defined standard for session management in IP traffic (VOIP etc). Other standards also exist like H.323 for IP traffic which competes with SIP for IP traffic call setup. This projects aims to develop a SIP Protocol Tester which provides a feature rich interface for SIP traffic. It also provides interface for creating various network loads to help understand SIP performance issues.

**f) Data compression using Wavelet transform for VOIP systems**

Wavelet Transform is increasingly being used in research community for signal analysis in many fields (medical, telecommunication, oil exploration, stock exchanges etc). This owes to the various characteristics of wavelet transform that are not available in other conventional (Fourier) transform.

This project aims to explore the voice data coding in an IP network (VOIP) and study the effect of various parameters that affect the quality of voice.

Meanwhile wavelet transform would be explored and its application for voice data be investigated. This will lead to implementation of wavelet transform for voice data compression specifically for VOIP system highlighting its effect on various quality measures for a VOIP system.

**g) Performance comparison of SIP and H.323 for Call setup delays**

SIP and H.323 are two competing standards for call setup management in a VOIP system. SIP is increasingly finding acceptability owing to a number of factors including Call Setup Delay.

This project will research into the call management in an IP network and compare the performance of SIP Vs. H.323 protocols. This will lead to significant improvement in algorithm used in SIP for call management.

**h) RTDX Based Simulation Test bed for development of SDR**

Texas Instruments (TI) provides RTDX (Real Time Data Exchange) interface based on JTAG interface. This can be used to integrate various simulation environments with TI DSP kits for development and verification of various DSP algorithms.

This projects aims to develop a components based model in Matlab for DSP algorithm development for various components of SDR (Software Defined Radio).

**1.16.7 Grants Obtained**

- 1Million PKR funding from HEC for establishment of 3G and 3G+ Research lab