BHARTI SCHOOL OF TELECOM

THE INTERNAL REVIEW REPORT OF AN ACADEMIC UNIT FOR THE ACADEMIC REVIEW

1. Curriculum

1.1 List of degree programmes offered – UG + PG and enrollment.	➢ M. Tech (JTM) ➢ MS(R)(BSY) ➢ PhD (BSZ) ➢ MBA (SMT)
1.2 Consistency of curricula with academic vision of the school.	The Bharti school M.Tech and MBA programmes were carefully crafted by a process of consultation with industry. It was created to cater to the growing need for telecom engineers with management skills, as well as for management personnel with expertise in telecom systems. The M.Tech students complete all requisite courses in telecom technology, and also credit courses in management. Similarly, the MBA students credit telecom technology courses in addition to management courses. This is consistent with the mandate of the school. Regular interaction with industry personnel through lectures helps the students stay up to date. MS (R) and PhD programmes were introduced recently to augment the research activities of the school. Post Doctoral Fellows are to be recruited very soon.

1.3 Quality of Programmes:	
(a) Periodicity of curriculum review UG and PG (*relevant documents*).	Since our courses are drawn from those of cognate departments, regular review of course contents takes place with other departments of the institute. However, a review of the curriculum of Bharti School program is to be taken up soon.
(b) Mechanism for review at UG and PG level (*relevant documents*).	The School Executive Committee SEC discusses changes that are required in the curriculum from time to time based on interaction with faculty and feedback from students.
(c) Coursework for each UG, PG and PhD programme – Core / Elective.	**See Attachment - 1**
(d) Pre PhD courses offered (in *last 5 yrs*).	Courses are drawn from cognate departments.
(e) New advanced Masters / Pre-PhD courses introduced in last 5 yrs.	Courses are drawn from cognate departments.
(f) Overlap between courses (c) and (d) & (e), including opening latter to UG.	Courses are drawn from cognate departments.
(g) Seminar series (weekly / regular) held each semester (provide list).	**See Attachment - 2** for list of seminars in the 2011-2014 periods. Information pertaining to earlier years is not available.
(h) Placement details (*as per format at Annexure-1*).	**See Annexure –1**
(i) Relevance of UG and programmes to recruiters, potential and on-campus recruiters (*as per format at Annexure-2*).	As noted earlier, the M.Tech and MBA programs of the school were carefully crafted to fulfill a need for personnel with expertise in communications and management. However, until now, a mechanism for feedback from recruiters is not in place. This information will be collected henceforth.
(j) Benchmarking of curriculum (*as per format at Annexure-3*).	Data is not available. This information will be collected henceforth.

2. Teaching environment

2.1 Student – Teacher ratio separately and total for UG, PG, Phd (based on gross numbers and on class basis).

	M.Tech	MS(R)	PhD	MBA	Total
Student	38	05	42	15	100
Faculty	40	40	40	40	40
Ratio					

Faculty of the School teaches UG & PG courses & guide PhDs / MS(R) in cognate departments. Students of the School credit courses in cognate departments. For this reason student-faculty ratio cannot be computed based on the above data.

2.2 No. of students graduated in each programme, incl. PhD, (data for 5 yrs)

M.Tech	2009 – 14	2010 – 21	2011 – 20	2012 – 18	2013 – 20
MS(R)	2009 – 05	2010 – 05	2011 – 00	2012 – 01	2013 – 01
PhD	2009 – 04	2010 – 09	2011 – 11	2012 – 10	2013 – 06
MBA	2009 –	2010 – 22	2011 – 13	2012 – 02	2013 – 13

2.3 Student – T.A.(or student-hours / T.A.) ratio

Student	102
T.A.(or student-hours / T.A.)	816
Ratio	08

2.4 No. of skilled technical staff

S.No.	Name	Service Period
1	Mr. M. K. Kaushik	(20/02/2004)
2	Ms. Ezhilarshi Arshi	(04/12/09 – 31/05/10)
3	Mr. Deepanshu Thakral	(04/12/09 – 10/03/10)
4	Mr. Dinesh Lohan	(08/03/10 – 31/08/10)
5	Mr. Vishwas Dubey	(24/12/09 – 25/03/11)
6	Ms. Kalpana Annapraga	(04/12/09 – 03/12/11)
7	Mr. Sandeep Sharma	(14/08/12 - 28/02/14)
8	Mr. Sugandh Sinha	(27/09/12- 28/02/14)

Currently, we have only permanent Staff member (M. K. Kaushik).

We are in dire need of more technical staff to maintain servers and inventory records, and maintain lab equipment. Temporary staffs are hired from time to time to assist in laboratories.

2.5 Gross laboratory spaces; break-up of lab space for core UG / PG teaching.

S.No.	Labs (PG)	Square feet
1	Research Project Lab (GF-107)	870
2	Telecom Software Lab (GF-108)	3000
3	Pervasive Telecom Lab (FF-205)	870
4	Wireless Communication Lab (FF-206)	3000
5	Telecom Networks Lab (SF-307)	3000
6	FF-203 Loaned to IT School temporarily	1537
7	SF-306 Currently being used by Center for Excellence in Cyber security and Information Assurance	870

2.6 Laboratory modernization performed in last 5 years for (i) UG core, (ii) PG core, (iii) elective courses (attach data before and after modernization),

Bharti School has no formal UG program. For this reason no UG labs (core or elective) exist in the Bharti School. However, Bharti School has whole-heartedly hosted students (UG students and PG students of IIT Delhi) working on research projects with its associated faculty whenever these projects has had a telecom research component.

As far as the PG labs are concerned, the up-gradation strategy successfully adopted in five of the teaching labs of Bharti School are as follows:

(1) Research Project Lab (GF-107):

Working space
- CFLs are used where possible
- One 5 KVA Online UPS was installed

Computing Infrastructure
- Dell and HP CPUs were purchased
- Dell and HP LCD Flat monitor were purchased

Software
- Ubuntu, window 7, CentOS used

Hardware
- 5 PCs CPU with 1 LCD Monitors purchase for project for staff or student from Faculty projects.
- 1 PCs SERVER purchased for data storage.

(2) Telecom Software Lab (GF-108):

Before upgrade	After upgrade
Working space • All lights were conventional tubelights + CFLs	**Working space** ▪ With green initiative underway, all tube lights were changed to retro-compatible LED lights, reducing the power footprint by 50%
Computing infrastructure ▪ Unicode CPUs were used with Linux ▪ Monitors were CRTs with higher power expenditure and bulky footprint	**Computing infrastructure** ▪ Computers were upgraded to have CPUs with hyper threading so that VMs could be easily provisioned. This allowed us to have multiple VMs per CPU and to roll out experiments with pre-configured VMs. As a consequence, client-server experiments could be done on the same machine. ▪ LCD flat-panel monitors were used, cutting the energy footprint to 15W per monitor
Software ▪ Red Hat was used as the OS with a maintenance license	**Software** ▪ Centos and then Ubuntu was used as the OS with a zero-maintenance license ▪ FOSS was adopted for all development
Printing ▪ Only one slow laser printer	**Printing** ▪ One color printer inkjet printer was installed ▪ One fast 35 pages per minute auto-duplex monochrome laser printer were installed
Servers were all at CSC	A 8-CPU 16-core Dell Server was provisioned with 16 GB RAM for high-performance computing requirements
Disk storage was only local 500 Mb attached to each(PC)	Two 8 TB Network Attached Storage Systems were installed allowing for enhanced local storage
Software was Linux	Software was upgraded to SMP Ubuntu kernels

(3) Pervasive Telecom Lab (FF-205):

No overt modernization was needed in this lab because only sponsored projects are running in it so all equipment purchased is modern already.

(4) Wireless Communication Lab (FF-206):

The lab was upgraded in a major way to cater to research in the area of Multiple Input Multiple Output (MIMO) systems and Space Time codes, broadband wireless access, software defined radio (SDR), Ultra Wideband (UWB) Communications, embedded Systems for Wireless Communications, channel measurement and modeling and broadband antenna design.
Generous grants from DST, AICTE, MHRD etc were used for upgradation to purchase all kits and measurement equipment for carrying out the above work

(5) Telecom Networks Lab (SF-307):

Before upgrade	After upgrade
Working space • All lights were tube lights & CFLs	**Working space** • With green initiative underway, all tube lights were changed to LED lights, reducing the power footprint by 50%
Computing infrastructure ▪ Unicore CPUs were used with Linux ▪ Monitors were CRTs with higher power expenditure and bulky footprint	**Computing infrastructure** ▪ Computers were upgraded to have CPUs with hyper-threading so that VMs could be easily provisioned. This allowed us to have multiple VMs per CPU and to roll out telecom experiments with pre-configured VMs. As a consequence, client-server experiments could be done on the same machine. ▪ LCD flat-panel monitors were used, cutting the energy footprint to 15W per monitor.
Software ▪ Red Hat was used as the OS with a maintenance license	**Software** ▪ CentOS and then Ubuntu was used as the OS with a zero-maintenance license ▪ FOSS was adopted for all development ▪ Open Mosix was first used as a cluster technology then replaced with hypervisor technology from xen, and then Vmware ▪
Hardware ▪ Only emulators were used before 2005	**Hardware** ▪ 25 FPGA boards with telecom interfaces (one per student) were purchased ▪ 25 SBCs were purchased (one per student) and made available for telecom experiments
Test & Measurement ▪	**Test and Measurement** ▪ A 200 MHz oscilloscope with CAN and FlexRay triggering was purchased - allowing experimentation on Automotive Telecom applications Due to the availability of this t&m equipment, one patent was granted to us in FlexRay+

2.7 Course files for each course for last 5 years.	All our courses are from Cognate departments.
2.8 Study materials (monographs, notes, books, videos, web-based materials, etc.) prepared, course-wise	**See Attachment – 3**
2.9 Research and innovations in teaching-learning processes	1. Many faculties have utilized web-based learning ideas. 2. Several faculty members have developed videos and course material for NPTEL. 3. The virtual lab MHRD national mission project was initiated by school members. 4. Several faculty members are participating in the new MHRD pedagogy national mission project. 5. The school places a lot of stress on industry interaction, and lectures and seminars by industry personnel are organized on a regular basis to ensure that students are abreast of new developments. 6. Students admitted to the M.Tech program are allotted a cubicle with computing facilities in a laboratory. This creates a learning atmosphere that is unique and gives them the opportunity to Innovate. Our school labs are open 24X7.
2.10 No. of students (UG and PG separately) who have spent at least a semester at another university / institute (over seas or Indian)	None
2.11 No. of students from overseas universities who have taken classes, done project work or internship, UG & PG separately, in the school	None
2.12 Course feedback.	Courses are drawn from cognate departments.

2.13 Industry experts who have delivered lecture(s) Seminars, discussions as part of a core / elective course – UG & PG separately.	Dr. Anand Srivastava: Access Networks (PG course EEL817) 2009 (3 Credits, Shared by Prof Vinod Chandra) 2010 (3 Credits) 2011 (3 Credits) 2012 (3 Credits) Dr. AlokNath De of ST Mircorelectronics EEL767 Telecom Systems
2.14 Industry exposure to students – course – related visits to factories, sites, industry exhibitions, field trip, etc. – UG & PG separately.	Students have Summer Internships at Corporate Account Group - SBI and Haworth in the field of finance.

3. Research

3.1 No. of masters and PhD students supported – (i) by institute Assistantship, (ii) on sponsored projects / consultancies, (iii) others sources and (iv) Sponsored by external organization.	(i) Nil (ii) PhD - 02 (iii) Bharti School – up to 50 M.Tech, PhD- 17 (FT) (iv) Nil
3.2 No. of PhD's enrolled, graduated per faculty / year for last 5 yrs.	A total of 40 PhDs enrolled. Year-wise enrollment has been as follows: 2009 – 04 2010 – 09 2011 – 11 2012 – 10 2013 – 06 Only one PhD has graduated (ManmohanChaturvedi guided by Prof. Ravi Shankar of DMS) so far. The PhD program was initiated only in 2007 by the school.
3.3 Areas of research (e.g. areas listed in prospectus, and others) by (i) Volume (quantifiable parameters), (ii) breadth, and (iii) Years these have been research areas (as per format at annexure – 4)	Telecom Networks, Telecom Software, Wireless Technologies, Optical Networks, Signal Processing, Telecom Systems Design, Planning and Management, Regulatory and Policy Aspects of Telecom Services and Systems, Embedded Telecom Systems, Telecom Network Management, Performance Analysis of Communication System and Resource Management. Information pertaining to Annexure-4 is not available at this time, and will be collected henceforth.
3.4 Publications per faculty (average per year for last 5 years).	**See Attachment - 4** Average – 2009 – 3.1 2010 – 4.14 2011 – 3.66 2012 – 4.38 2013 – 4.24

3.5 Publications (journal and conference) total and per (a) PhD student, (b) masters students, (c) UG students	**See Attachment - 5** (a) PhD - 36 (Student wise list attached) (b) M.Tech – 01(List attached) (c) NA
3.6 Best papers in last 5 years: (i) Individual best 3, (ii) school / centre best 10, and brief justification.	**See Attachment - 6**
3.7 Average citation per school / center.	Average is 20.56 citations / faculty, which reflects high impact of faculty publications. **See Attachment - 6**
3.8 Changes, modifications, etc. done to improve the quality of (i) M.Tech. And (ii) PhD graduates.	Airtel Lectures/Bharti lectures/other Industry oriented Lectures/Seminars/Workshops organised to improve the quality of both programs.
3.9 Sponsors projects – (i) individually, (ii) with another faculty of the group / section of the school, (iii) with another faculty of the school but from another group / section of the school (iv) with another faculty of another school / center.	Until recently all projects & consultancies were undertaken only through parent department of faculty. For this reason the list of projects is small & no consultancies can be listed. This problem has now been resolved and the situation is set to change soon. **See Attachment – 7**
3.10 Industry consultancies	NA

3.11 New areas of research which are different from the faculty's PhD thesis area.		
	Prof. Shankar Prakriya Cognitive Radio Energy harvesting Cooperative Communications	Prof. Subrat kar optical communication, sensor networks and embedded systems
	Prof. Mahim Sagar Health Awareness Property Valuation Consumer Awareness Telecommunication Policy Spectrum Pricing Marketing Innovations Cloud Computing	Prof. Swades De Underwater sensor networks Wireless energy harvesting aware sensor networks Video/multimedia broadcast over wireless Broadband wireless access Cognitive radio networks Power grid communication networks
	Prof. Devi Chadha Terrestrial Free Space Optical Communication Elastic Optical Networks New Optical Multi-hop Switching Architectures	Prof. Uday Khankhoje Electromagnetic scattering from randomly rough surfaces Finite element methods for electromagnetic scattering Applications of electromagnetic computation to remote sensing
	Prof. Karun Rawat RF Modulators RF MEMS.	Prof. S. Dharmaraja Performance Analysis of Wireless Networks Financial Mathematics
	Prof. Kushal Shah Fermi Acceleration Genomic Signal Processing Plasmonics	Prof. Vinod Chandra Optical Networks Optical Wireless Networks Green Optical Networks

3.12 Methodology for (i) identifying obsolescence in research areas, and (ii) identification of new areas for future research.	The Bharti school uses the following means to keep its faculty and students abreast of new research areas: 1. Airtel and Bharti school lectures by Industry personnel keep the faculty and students tuned to industry needs 2. The center of excellence in Telecom (Airtel IITD Center of Excellence in Telecom) provides an important platform for industry-academia interaction. Various companies bring their telecom related problems to AICET. This keeps faculty tuned to industry needs. 3. Seminars and presentations by students and faculty on their research at regular intervals Faculty disseminate their research through workshops
3.13 Number of large interdisciplinary projects (with school's areas, and across the institute.)	None as of now. Until very recently, projects could be undertaken only through cognate departments, and not through the school itself. For this reason, the list of projects undertaken in the school appears to be smaller than it actually is. However, this number is now expected to increase steadily since it is now possible to undertake projects through the school.

4. Innovation, Design and Development

4.1 No. of students who have been funded for innovation (TePP, prism, etc)	None
4.2 Technology developed (give list and brief information)	Until very recently, projects could be undertaken only through cognate departments, and not through the school itself.
4.3 Technology transferred (give list and brief information)	
4.4 Number of patents granted and patent granted as a fraction of patents filed	**See Attachment - 8**
4.5 Innovations of products, processes, design, etc. in the school.	
4.6 Availability and access to student's workshops, "tinkering laboratories" so that they may pursue their own ideas.	Students admitted to the M.Tech program are allotted a cubicle with computing facilities in a laboratory. This creates a learning atmosphere that is unique, and gives them the opportunity to innovate. Our school labs are open 24X7.
4.7 No. of students / team who have competed in national / international competitions, and outcome.	Nil

5. R & D Environment

5.1 No. of post-doctoral scholars hired in the school / centre and their duration, from (i) abroad, (ii) on project, and (iii) others, and outcomes.	The institute now has a policy in place for hiring post-doctoral fellows. We hope to hire post-doctoral fellows in the near future.
5.2 No. of foreign students enrolled in (i) masters, and PhD programmes.	Nil
5.3 No. of Indian and foreign faculty / researchers who have spent a sabbatical in the school.	Associate Professor "Liliana Blanco Castaneda" - Universidad Nacional de Colombia. Faculty of Science. Department of Statistics.
5.4 Sabbatical taken by faculty and where spent.	**See Attachment - 9**

5.5 Number of seminars (education and research separately) given by the faculty (i) in the school, (ii) in other school, (iii) at other institute.	**See Attachment – 10**
5.6 No. of faculty / researchers / scholars invited by the school for giving (i) seminars, (ii) spending at least a week in the school	(i) 20 (ii) Nil
5.7 No. of faculty / researchers who visited the school on their initiative for giving (i) seminars, (ii) spending at least a week in the school	(i) 20 (ii) Nil
5.8 Adequacy of research infrastructure.	
5.9 Adequacy of technical staff – existing numbers and competency areas; competency area in which there is a shortage.	At present we have only one lab technician manning ALL the labs of the school (teaching and research labs). Occasionally, project associates are hired to help out in labs. To a large extent, faculty and TAs spend time to make up for this shortage. At present, we need technical staff that can maintain servers and assist in software labs and maintain inventory of lab equipment.
5.10 Work space available for (a) Master students, (b) PhD students, (c) Project Staff, (d) post doctoral scholars.	**M.Tech:** 50% of Telecom Software lab, Telecom Networks lab and Wireless Communication lab, the rest being used for teaching 1500 x 3 = 4500sqft **PhD Students & Project Staff & Post-Doctoral Fellows:** Research Project Lab GF-107 = 870 sqft Pervasive Telecom Lab FF-205= 870 sqft (1740 sqft of research lab space in all) Currently, SF-306 (870 sqft) is being used by center of excellence on Cybersecurity and Information Assurance. FF-203 (1537 sqft) was loaned on a temporary basis to the IT School, and is not available for use by the school at this time. We do not have any post-doctoral fellows as of now, but expect to recruit very soon.

<table>
<tr><td>5.11 No. of national conference/workshop/seminars attended by PhD students (totally and per students for 5 years).</td><td>Total - 13
See Attachment 11 – Information is only available from 2011.</td></tr>
<tr><td>5.12 No. of international overseas conference/workshop/seminars attended by Ph.D students (Total and per students for 5 years)</td><td>Total – 11
See Attachment 11 – Information is only available from 2011.</td></tr>
<tr><td>5.13 No. of students who have continued to Ph.D. (i) in same dept. (ii) other schools of IITD (iii) in India and (iv) abroad (separately for M.Tech and B.Tech students)</td><td>(i) 02
(ii) 03
(iii) NA
(iv) NA</td></tr>
<tr><td>5.14 No. of projects with co-guide from industry</td><td>Industry sponsored projects are M.Tech & MBA students in the coming years.</td></tr>
<tr><td>5.15 No. of students who have spent time in industry as part of thesis/project work (give number and duration). '</td><td>Nil</td></tr>
<tr><td>5.16 Self assessment reports of the school/centers/schools of any.</td><td>Not applicable. However, the School Advisory (SAB) Board reviews functioning of the school every year. These are reflected in minutes of the SAB.</td></tr>
<tr><td>5.17 Placement of M.Tech and PhD graduates in technical careers (as per format at Annexure -5).</td><td>Data is not available. This information will be collected henceforth.</td></tr>
<tr><td>5.18 Inter – disciplinary work -: (I) joint thesis guidance by faculty across groups within a school or across schools/centers; (ii) Proposals submitted and funded – PI- CoPI and their group/school affiliations.</td><td>(i) Prof. Subrat Kar – Joint thesis guidance
<table><tr><td>Garima Mishra, PhD scholar</td><td>PhD thesis jointly guided with Prof.S.Dharmaraja, Maths Dept</td></tr><tr><td>S.Ramakrishna, PhD scholar</td><td>PhD thesis jointly guided with Prof.S.Dharmaraja, Maths Dept</td></tr><tr><td>R.Ranjan, MS(R)</td><td>MSR thesis (completed) jointly guided by Prof.S.Dharmaraja, Maths Dept</td></tr></table></td></tr>
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6. Outreach / External stakeholder engagement

6.1 Educational

(a) Workshops/Short term courses-topical research for disseminating research of IITD.	**Prof. Mahim Sagar** ➢ Capacity Building Initiative for Telecom Industry. "Certificate program on Telecom technology and Management" under Bharti School of Telecommunication technology & Management ➢ Branding and Corporate Communication workshop. ➢ Internal Branding and Corporate Communications Workshop ➢ Strategic Management Workshop **Prof. Karun Rawat** IEEE AP-MTT Chapter sponsored talk on: "Techniques in Multi-band/Multi-standard Doherty Power Amplifiers for Wireless Transmitters" at Ohio state University, Columbus, Ohio, USA.
(b) Workshops/Short term courses – education methods (teaching, learning resources, pedagogy).	Workshop on pedagogy held on October 25,2013 at IIT Delhi.
(c) Learning, research material in the website.	-
(d) Science and technology for public information – on website.	-
(e) Courses taught to students of other IITs/NITs/Others institutions.	Faculty have participated in teaching / assisting IIT Ropar
(f) Courses taught via NKN.	-
(g) Courses developed for NPTEL.	**Prof. Ranjan Bose:** Wireless Communications for NPTEL **Dr. S. Dharmaraja:** • Stochastic Processes, Video course, NPTEL Phase II. • Stochastic Processes, Web course, NPTEL Phase II (with Dr. N. Selvaraju).

(h) Books, monographs, study material made available outside IITD.	**Prof. Subrat Kar:** Developing NPTEL lecture on "Optical Networks" (2/12 lectures completed) ETSC also has my video lectures on "Optical Communication" available for sale.
(i) Experiments developed and made available to other institutions.	Virtual lab projects makes experiments available to all Institutes in india.
(j) Seminars live/via NKN, web to other institutions in India/abroad.	-
(k) Reach out to schools, NCERT, KVs, etc (e.g. K-12 Programmes).	Satya Bharti School Visits done by Bharti School Students (once in a year)
(l) Mentoring of other institutions e.g. new IITs, Nits, Universities etc. including faculty mentoring, curriculum development, laboratory development, etc.	Faculty of the school mentored IIT Ropar when it was located at IIT Delhi, and during its initial years. Faculty also assisted in setting up labs for IIT Ropar.

6.2 Industry collaboration

(a) No. of students (PhD/Masters) directly linked to industry funded projects.	Nil
(b) No. Of industry staff/engineers who have taken a regular course(s) for entire semester.	Dr. Anand Srivastava: Access Networks (PG course EEL817) 2009 (3 Credits, Shared by Prof Vinod Chandra) 2010 (3 Credits) 2011 (3 Credits) 2012 (3 Credits) Dr. AlokNath De ST Microelectronics EEL767 Telecom Systems
(c) Technology transfer to companies, entrepreneurs, local and other governments/government agencies, NGO (separately).	

(d) Continuing education/courses for industry.	**Prof. Mahim Sagar** ➢ Capacity Building Initiative for Telecom Industry. "Certificate program on Telecom technology and Management" under Bharti School of Telecommunication technology & Management ➢ Branding and Corporate Communication workshop. ➢ Internal Branding and Corporate Communications Workshop ➢ Strategic Management Workshop **Prof. Subrat kar** Apart from regular courses, teaches about 38 Refresher Courses + 2 Weekend Modules through FITT on a consultancy basis - on Telecom, Embedded Systems, Optical Networks.
(e) Faculty secondment to industry.	Nil
(f) Research project undertaken with industry as partner.	**Prof. Mahim Sagar** ➢ Immovable Property Valuation Index, Indian Context ➢ Developing A Framework of Consumer Awareness on Radio Signals for Telecommunication Industry **Prof. Subrat kar** ➢ One research project (Agilent) Consultant: M/s Muava Technologies, New Delhi Rs.0.50 lakhs. (2 years)Consultant / Technical Retainership: Training, Advice and Consultancy on Remote Telecom Shelter management to M/s PowerTech, Indore (through the Foundation for Innovation and Technology Transfer, Indian Institute of Technology, New Delhi). [Rs. 2 lakhs / 2 years] Technical Retainership: Training, Advice and Consultancy on Optical Networks to M/s Reno Optical Communications, Chennai (through the Foundation for Innovation and Technology Transfer, Indian Institute of Technology, New

Delhi). [Rs. 9 lakhs]. Technical Consultant, Characterisation of optical line equipment manufactured by M/s Nokia, Finland for their representatives M/s Supreme Telecommunications, New Delhi (through the Foundation for Innovation and Technology Transfer, Indian Institute of Technology, New Delhi).

Prof. Vinay Ribeiro

Here are projects sponsored by industry or with an industry partner. The project RP2682 had CEWIT Madras and Infosys Bangalore as partners. The other projects have the funding agency as industry project partner.

Project No.	Project Title	Sponsoring Agency	Sanctioned Funds	Completion Date
Rp2564	LTE perfromance evaluation and application development	CISCO, Sez Unit	Rs. 3,120,000.00	31-Dec-14
Rp2682	India -UK advanced technology centre (IU-ATC Phase - 2) of excellence in Next generation networks systems and service	Internationa l Division, Dept. of Science & Techn.	Rs. 2,549,000.00	25-May-15
Rp2732	Tracking Human Motion via Sensor Fusion	C S R Technology (India) Pvt. Ltd.	Rs. 1,224,000.00	7-Apr-14
Rp2750	LTE Performance Evaluation and Application Development Phase - II	CISCO, Sez Unit	Rs. 1,980,000.00	2-Jun-14
Rp2770	Structured Sharing of Networks and Computer Resources in a Community & Devices	Intel Labs University research Office (URO)	Rs. 4,027,000.00	3-Jul-16

(g) Laboratories, equipment, etc. provided by industry for use in UG /PG teaching laboratories and students projects.	Initially, all equipments in the school were purchased using funds made available by Bharti enterprises. The interest earned by the corpus fund was used to purchase equipment subsequently. We do not get institute funds for developing our laboratories. M/s Canonical (makers of the OS Ubuntu) have donated 100 copies of the all versions of the OS since v5.02. Today, this is not a very significant thing because anybody can download the OS for free. However, when Internet access was a scarce commodity, the shipped CD provided a vital resource. M/s Telelogic, a subsidiary of IBM, provided an initial free donation of 35 licenses of Telelogic Tau, which is a UML design tool. Valued then at a nominal value of over USD 30000 per license, this was a valuable boost and initiative which led to the setting up of the Protocol Engineering Lab in the Computer Technology Group. This has been used by students across IITD as part of software lab and telecom software lab (Bharti) - Telelogic (35 licenses: net commercial worth USD 40000 each x 35) M/s Opnet donated a initial donation of 115 licenses of Opnet which was a valuable asset in the development of the Computer Networking Laboratory - Opnet (115 licenses: net commercial worth USD 39000 each x 115). M/s Windriver Systems donated VxWorks to the Computer Technology Group (VxWorks – 35 licenses : net commercial worth Rs 1.5 crores)Xilinx (Software: Embedded Dev Kit, Xilinx Platform Studio, Foundation ISE, Sys Gen / DSP and Hardware: Spartan-3, XC2 boards: net commercial worth USD 21000) Altera donated Altera Quartus software + kits to the Computer Technology Group (40 UP2 kits : net commercial worth USD 60000)

(h) Seminars/workshops held with industry by the school.	**Prof. Subrat Kar** • Invited Seminar on "Carrier Ethernet" for M/s Fibcom, Noida Feb 2012 – Rs.1 lakh • Invited Speaker, TRAI, Regulatory Framework for emerging telecom environment, Aug 25-26, 2011 • Invited Speaker, TRAI, Regulatory Framework for SAARC countries Sep 4-6, 2011 • [Nominated Attendee by Director IITD] Workshop on "Next Generation Networks (NGNs)", Telecom Regulatory Authority of India 29-30 Nov, 2012 • Co-Organiser (along with Dr.C.P.Ravikumar) of Modular Training Course on "Unix Network Programming", Duration : one week, for M/s River Run Software, new Delhi.Mar 26-Apr 2, 1999 • Co-organiser (along with Prof S.Choudhury) of Modular Training Course on Embedded Systems for professionals and educators : one week , through FITT, New Delhi [17 participants] July 3-7, 2003 • Co-organiser (along with Prof S.Choudhury) of Modular Training Course No.1 on Embedded Systems for professionals and educators : ten weeks , through FITT, New Delhi [50 participants] Sep 8 – Nov 21, 2003 • Co-organiser (along with Prof S.Chaudhury) of Modular Training Course No.2 on Embedded Systems for professionals and educators : ten weeks , through FITT, New Delhi [50 participants] 14 Jan – 20 Apr, 2004 • Co-organiser (along with Prof S.Chaudhury) of Modular Training Course No.3 on Embedded Systems for professionals and educators : ten weeks , through FITT, New Delhi [52 participants] 18 Aug – 24 Nov, 2004 • Co-organiser (along with Prof B.Lall) of Certificate Course on Embedded Systems for Multimedia and Telecom intended for professionals and educators : ten weeks , through FITT, New Delhi [24 participants] 12 Jan 2009 - 22 Feb 2009 • Participated in India R&D 2009 – ICT Innovations, FICCI,

	Federation House, Tansen Marg, New Delhi Jan 22-23, 2009 • Nominated by IIT Delhi to attend "A Primer in Administration and Management for Scientists and Technologists" at Lal Bahadur Shastri National Academy of Administration, Mussoorie-248179, Uttarakhand, India May 25-29, 2009 • Attended two-day Training Program on Project Management Techniques conducted by Consultancy Development Centre, GoI Aug 28-29, 2009 • Attended 3rd National Conference on Mobile Content and Services, New Delhi Sep 02, 2009 • Organised and attended: Tutorial/Workshop on Fuzzy Logic and Applications, Bharti School of Telecom, New Delhi, India Nov 7-8, 2009 • Invited Participant, 2010 3rd Indo-American Frontiers of Engineering Symposium (IAFOE), at the Jaypee Palace Hotel and Convention Centre in Agra, India. This activity is sponsored by the Indo-U.S. Science and Technology Forum (IUSSTF- http://www.indousstf.org) and jointly organized with National Academy of Engineering (NAE), USA and IIT-Kharagpur as partners. Mar 10-13, 2010 • Organiser, Short Course on Next-generation Networking (with Dr.Krishan Sabnani as Invited Speaker), with the Airtel IIT Delhi CoE in Telecom / FITT IIT Delhi held at IHC, New Delhi Jan 9-10, 2010 • [2011 Sabnani Chair Initiative] Organiser, Workshop on Green Telecom, with inputs from Alcatel-Lucent and TERI Feb 8, 2011 • [2011 Sabnani Chair Initiative] Organiser, Workshop on Green and Sustainable IT, with inputs from Alcatel-Lucent - Operating large networks and systems is becoming increasingly more complex, energy consuming and expensive. The purpose of this workshop is to bring together (a) a diverse set of researchers across academia and industry working on like-minded goals: Designing networks and systems with low operational expenses and low energy

	footprints (b) to form two groups of investigators from academia and industry to propose multi-objective consortium based collaborative research projects in green telecom (both in wired and wireless areas)Jun 7, 2011 • Coordinator (along with Prof.Santanu Chaudhury), DST WSE 1st Workshop on Web Sensor Enablement at IIT Delhi 5-6 Nov 2011 • Invited Lecturer, Information Technologies in Public Spaces, NISTADS, New Delhi: Invited Speaker/Panelist on "Production of Information" with Prof.Clarence Ellis, U.Colorado at Boulder Nov 8, 2011 • Co-cordinator and Invited Speaker, Workshop on Cost-Effective Animal Management, NDRI Karnal 3-24 Mar2012 • Coordinator, Workshop on Precision Techniques in Animal Husbandry held at IIT Delhi 30 Mar 2012 • IIT Delhi Liaison and Representative, Workshop on Green Telecom and IT being organized jointly by the Indian Institute of Science (IISc) and Bell Labs India in Bangalore, India.April 4-5, 2012 • International Conference on Optical Engineering (ICOE 2012), Visweswaraiah Technological University (VTU), Belgaum (Session Chair + invited Speaker on "Taming the Photon" in Session 2/Track 7) 27-28 July 2012 • Coordinator (along with Prof.Santanu Chaudhury), DST WSE 2nd Workshop on Web Sensor Enablement at IIT Delhi 9-10 Dec, 2012 • Coordinator [Sabnani Chair Activity], SIG on Automotive Technologies : The Future Car Dec 11, 2012 • Coordinator (along with Prof.Santanu Chaudhury), DST WSE 3rd Workshop on Web Sensor Enablement at IIT Delhi Jan 19, 2013 • Invited attendee + Session Chairman/"Session 3: How Academia can contribute towards the Path to 5G", Launch Event of TSDSI – India's TSDO & "Path to 5G" Workshop, C-DOT, Mandi Road, Mehrauli, New Delhi 110030 Nov 8, 2013

6.3 Professional

(a) Service as Board, senate, selection committee member at other IITs, NITs and Universities.	**Prof. Subrat kar** Member, Technical Advisory Board, PowerGrid Corporation with permission from IIT Delhi. On Board of Studies for Indraprastha Institute of Technology (IIIT Delhi). On Board of Studies for MIT School of Telecom MITSOT Pune. **Prof. Vinod Chandra** Member, Inter Departmental Technology Cooperation Expert Group for Railway Signalling and Telecommunication DSIR, Ministry of Science and Technology
(b) Service as PhD thesis examiner at other institutions.	**Prof. Swades De** IIT Mumbai, JNU, BITS Pilani, IG Center for Atomic Research – Kalpakkam
(c) Service as technical expert on committees- MHRD, DST, DSIR, DRDO, Pan – IIT initiatives, other ministries, state and local governments.	**Prof. Subrat Kar** PEC Member DST / TDT for the period 2009-2013 RAC panelist for DRDO Department of Electronics & Information Technology (DeitY) - Member, Program Review and Steering Group for Photonics and Optical Sensing Invited Expert, Indo-US Task Force / Program Advisory Committee ECMA-Switzerland (Academic Member / representing IIT Delhi on TC32-TG17 / TC32-TG14), GreenTouch Consortium (Academic Member / representing IIT Delhi)

	Prof. Swades De DRDO M.Tech entry interviews(Communication Eng.)(2012,2008) DST funding proposal reviewer (2007 onward) DEITY funding proposal reviewer (2012 onward) DEITY project evaluation committee member (2013 -) project on "pollution monitoring sensor network"
(d) Technical expert on policy, regulatory, laws, standards committees.	**Prof. Subrat kar** Bureau of Indian Standards (BIS) Member (MHD-Health Informatics Sectional Committee, 2008 onwards and continuing) Member (LITD 11 - Fibre optics, Fibres, Cables and Devices Sectional Committee) Telecom Engineering Centre (TEC) / DoT - DCC-Switching (S1) , NWG-15 (Optical Transport Networks and Access Infrastructures) Telecom Standards Development Society India - TSDSI - membership under migration from DOSTI ECMA-Switzerland (Academic Member / representing IIT Delhi on TC32-TG17 / TC32-TG14)
(e) Member of Board/Advisory Board of public and private sector corporations.	**Prof. Subrat Kar** Member, Technical Advisory Board, Power Grid Corporation with permission from IIT Delhi. On Board of Studies for Indraprastha Institute of Technology (IIIT Delhi). On Board of Studies for MIT School of Telecom MITSOT Pune. PEC Member DST / TDT for the period 2009-2013 RAC panelist for DRDO Department of Electronics & Information Technology (DeitY) - Member, Program Review and Steering Group for Photonics and Optical Sensing Invited Expert, Indo-US Task Force / Program Advisory Committee ECMA-Switzerland (Academic Member / representing IIT Delhi on TC32-TG17 / TC32-TG14), Green Touch Consortium (Academic Member / representing IIT Delhi)
(f) Positions (e.g. Director, Vice Chancellor, etc.) help by faculty on lien.	-

6.4 Contribution to national development goals

(a) Projects undertaken and their outcome.

- The virtual lab project of MHRD is an important project of national importance. Numerous experiments have been developed in various areas of engineering.
- The pedagogy project of MHRD was recently taken up by school faculty to develop learning materials for various courses.
- AICET Projects Status / Medium Term Projects (1-2 years)

S	Projects Title	Brief Description	Start Date	Tentative End Date	Cost of project
1	Mobile Video Calling System-phase 1	Mobile to mobile video calls, using the internet with full duplex audio and video which can be used on All (or most) carriers and handsets with modest capacity. Very low required data rate & 3G not required.	7/01/11	7/1/12	25 Lakhs
2	Portable Wideband Detector for Electromagnetic Emissions	Development of a portable detector for direction finding, field strength measurement and multipath separation capability	1/10/11	1/10/14	82.1 Lakhs
3	White Space Communication for Cellular and Data Service in India	Development of a mechanism for optimum utilisation of the underutilised licensed bands such as the TV Band through Cognitive Radio (CR)	4/01/11	7/1/11	5 lakhs (1st phase)
4	Development of Spectrum Pricing Index	Radio spectrum, a scarce resource, refers to the part of the electromagnetic spectrum that corresponds to radio frequencies. These frequencies of up to 300 GHz are known as radio waves and used for radio communications. Telecom and broadcast services industries along with government agencies utilize this spectrum and create infrastructure that allows the emergence of information driven societies. This makes radio spectrum a crucial resource for any economy. Given its importance in the development of a nation, it is of critical importance to effectively manage this resource.Radio frequency spectrum is utilized primarily by the telecom and broadcast service industries. Considering the paucity of spectrum, efficient spectrum management is of critical importance. If spectrum policies are formulated carefully, it would not only lead to sustained growth of information broadcasting and communication technology industries thereby promoting social welfare but also maximize the revenues generated for the government.	1/10/12	1/10/13	5 Lakhs
5	Social Media Analyzer	Analyze geographical distribution of network traffic from popular sites	23/10/13	23/10/14	25 Lakhs
6	Development of Mobile Video full-duplexing decoder & Renderer system	This project is specifically aimed at development of a Mobile based system enabling a mobile device to capture & encode videos using the on-board hardware and decode & render videos on the screen (played back) at the same time.	15/08/11	15/8/12	25.15
				Total – 197.25	

(b) Policy inputs – implications, visible impact on society.	Nil
(c) Entrepreneurship development.	**Prof. Subrat kar:** About to set up own start-up company under FITT TBIU. Have proposed setting up of multi-company Telecom Research Cluster in new Sonipat Campus

6.5 Alumni engagement

(a) Regular interactions/ engagement with alumni and outcomes.	Nil
(b) Contributions from alumni.	Contents for Bharti Newsletter

6.6 Recognitions and Awards

(a) Awards to faculty.	Shanti Swaroop Bhatnagar (two faculty) INAE Fellow INSA Fellow INAE Youth Engineer IEEE Fellow (one faculty)
(b) Fellows of academics, INAE, etc.	**See Attachment - 12**

7. Governance

7.1 Governance

(a) Organization structure – their autonomy / terms of reference	The school advisory Board (SAB)guides the school, and reviews its performance every year. The School Executive Committee (SEC) looks after the administrative activities of the school, and allocates budget to various school activities. Currently, the SEC doubles as the School Academic Committee (SAC), and gives shape to the academic and research programmes of the school.
(b) Planning documents development by the school – space, faculty staff related.	**See Attachment - 13**
(c) Records of discussions within the school – internal document (meeting minutes, position papers, discussion papers, concepts papers, etc)	**See Attachment - 13** SAB & SEC Minutes attached
(d) Physical resources – percentage utilization for UG PG core and electives teaching separately, UG and PG student project, PhD students research. Projections for future.	Our core and elective courses are drawn from the courses of cognate departments. There is no resource crunch for teaching. We have three major teaching labs, and a few research labs. There is adequate space for research for students at all levels, even taking into account the planned increase in research students, and intake of post-doctoral fellows. However, when the school grows to its full potential in about 10 years, we do expect severe shortage of space.
(e) Financial resources - (I) funds provided to the school, (ii) processes of distribution, (iii) funding for focus area, (iv) finding for UG and PG core teaching laboratories. Outcomes of funds utilization. Changes in funding pattern and funds utilization and effects on school strategy.	(i) The school gets is funding from the interest component of a corpus fund. After a deduction of 10%, the rest of the amount is available to the school. Last year, the amount was about Rs. 1.5 crores. (ii) The school budget is approved by the school executive committee (SEC) (iii) Our focus in the past few years was to increase the number of research scholars. A formal PhD program started in 2007, and we now have 39 PhD students. (iv) Funding for PG labs comes from the equipment component of the school budget. Efforts are on to increase allocation for equipment by adding to the corpus amount. Funds will be sought for this purpose from AIRTEL.

(f) Delegation of decision making within school/centre. List the process and structures for financial and academic management, and the methodology for their review.	The school advisory Board (SAB) guides the school, and reviews its performance every year. The School Executive Committee (SEC) looks after the administrative activities of the school, and allocates budget to various school activities. Currently, the SEC doubles as the School Academic Committee (SAC), and gives shape to the academic and research programmes of the school. We have a coordinator who takes care of the M.Tech, MS and PhD students (the MMP coordinator), who is responsible for these programs. The MMP coordinator also interacts with students and discusses their feedback in the SEC. The coordinator serves to implement decisions taken by the SEC and chalks out a vision for the school with help of the SEC. The SAB reviews functioning of the school annually.

7.2 School management and Operations

(a) Organization structure – mandates, flexibility, etc.	The school advisory Board (SAB) guides the school, and reviews its performance every year. The School Executive Committee (SEC) looks after the administrative activities of the school, and allocates budget to various school activities. Currently, the SEC doubles as the School Academic Committee (SAC), and gives shape to the academic and research programmes of the school. We have a coordinator who takes care of the M.Tech, MS and PhD students (the MMP coordinator), who is responsible for these programs. The MMP coordinator also interacts with students and discusses their feedback in the SEC. The coordinator serves to implement decisions taken by the SEC and chalks out a vision for the school with help of the SEC. The SAB reviews functioning of the school annually.

(b) Processes for curriculum planning.	All curriculums related issues are deliberated upon by the School Executive Board.
(c) Guest faculty, affiliation for teaching core, elective UG & PG courses.	Dr. AlokNath De – ST Microelectronics Dr. AnandSrivastava – C-DoT
(d) Faculty short – listing criteria.	We use the short-listing criteria of the cognate department to recruit faculty, and do not have our own short-listing criteria.
(e) How collectiveness of the faculty has enhanced academic output and enhanced quality, etc.	The school brings together faculty in various departments / centers working in telecom related areas. By providing students, staff recourses & lab faculties, the school has considerably enhanced the profile of associated faculty. This is reflected in faculty publication profile.
(f) Nature, quantum and quality of support from of secretarial staff, stores and inventory management, purchases, ambience, etc.	The school is well supported by two office staff, three attendants, and one lab technician. Lab technician handles purchases. Some temporary staff are occasionally hired to support certain activities.

7.3 Faculty

(a) Faculty profile and a critique of the same.	We had faculty in communications and signal processing from the beginning. In recent years, we had new faculty in interdisciplinary areas. This has considerably enriched the school. We also have a number of faculty members with significant industry experience.
(b) Diversity in faculty profile by: (i) gender, (ii) category, (iii) region, (iv) PhD institution, (v) post –doctoral institutions worked in, (vi) organization / industry worked in, (vii) employment prior to joining the school	**See Attachment – 14**
(c) Procedure for faculty searches.	Not applicable – faculty are drawn from cognate departments.
(d) Result of faculty searches – area-wise (as in Annexure iv), number of applicants, short – listed and offered a position, their educational qualifications & experience.	Not applicable – faculty are drawn from cognate departments.
(e) Success in recruitment (data for last 5 years), and offers that the persons had from other IITs/IISc/TIFR	Our entire faculty is drawn from cognate departments. A large number of new faculty have affiliated with the school in the last five years.
(f) Faculty lost to other institutions post selection	Prof. Arzad Kherani and Prof. Naresh Sharma (both affiliated faculty),
(g) Faculty time utilization – in class, in meetings, project management, PhD guidance, masters project guidance, UG project guidance	Faculty teaches for about 7-11 hours per week. The school has a large number of students and student supervision takes up a lot of faculty time. We have 39 PhD & upto 50 M.Techs registered.
(h) Level of harmony amongst school faculty	High.

7.4 Students

(a) Criteria for short-listing and selecting students for admission to Master's and PhD. Programmes of past 5 years.	Same as cognate department. **See Attachment – 15**
(b) Facilities provided to students and their maintenance / management system.	Top-up scholarships are provided to students when funds are available. Conference travel support is provided to students. This is managed by the SEC.
(c) Mentoring seminars / sessions held for PhD students for prospective faculty careers.	At present there is no formal mentoring scheme. TA duty prepares the students for a carrier in teaching.

8. Benchmarking

8.1 Indentify school/centers within IITD as peers.	Other schools in the institute are new. The Khosla school of IT can be considered as a peer within IITD.
8.2 Indentify school/centres/Schools/divisions from other IITs, IISc, NITs, private universities as peers and reasons/criteria there for.	The GS Sanyal school of telecommunications at IIT Kharagpur, which was established in 1996 has objectives quite similar to that of Bharti school. There are however some notable differences – the number of Master's students at GS Sanyal School is very small as compared to the Bharti school. Unlike Bharti school, they stress on MS (R) rather than M.Tech. The number of PhD students is also far smaller than Bharti school. Despite these differences, the broad objectives of the GS Sanyal school are similar to those of the Bharti school.
8.3 Indentify schools/centres from institutions in other countries as peers.	There seem to no other institutes that offer Master's program in Telecom Technology and Management. There are institutes like TELECOM ECOLE that offer programs in management of telecom systems.

8.4 Define parameters for benchmarking (I) research, (ii) curriculum – separately for UG, Masters, and Ph.D programmes, (iii) teaching – learning processes.	**(i)Research:** Number of journal and conference publications in a year, number of sponsored projects/consultancies taken up, number of graduating research students **(ii)Curriculum:** Number of students at Master's and PhD levels, and their perceived quality as evident from placement records. In the case of research students, the number of conference and journal publications is an important indicator. **(iii)Teaching-Learning Process:** Effectiveness/quality of the teaching -earning process is quite subjective, and needs to be judged by feedback from students and recruiters, besides teachers.
8.5 Perform benchmarking and report the analysis/findings for the last 5 (or 10) years.	We are not aware of any major institute (IITs/IISc) in India that offers programs in telecom technology and management. **(i)Research:** The number of faculty in the Bharti school (39) is far larger than the G S Sanyal school of IIT KGP (6 as of today). Perhaps because of this, the number of journal publications of the G S Sanyal school as published in their web-site in 2011, 2010 and 2009 was 1, 4 and 3, and the number of conference publications was 5, 16 and 13 respectively in 2011, 2010 and 2009 for the GS Sanyal School. The Bharti School faculty published a total of 106, 120, and 90 journal and conference papers in the same period. It should be noted that the number of students at Bharti school is far larger. The number of Masters students (MS (R)) at G S Sanyal school is very small (5, 3, and 2 in 2010, 2009 and 2008 respectively). All of these were MS (R) students. In the Bharti school there were 26, 19 and 06 students at the Masters level in the same period (excluding MBA students). The number of PhD students with the Bharti school is also far larger, though the first PhD student was admitted in 2007 only.

	(ii)Curriculum: The Bharti school's M.Tech program is on Telecom Technology and Management, with components of both Telecom technology and basic management principles. It also runs an MS (R) program. The school also operates a program on Mangement with specialization in Telecom systems Management. The school also offers post doctoral fellowships. The GS Sanyal school in comparison focuses on telecom alone. **(iii)Teaching/Learning Process:** AT IIT Delhi, the students admitted to the Master's program get a workbench with computing facilities that doubles as a laboratory. This creates a congenial atmosphere for the students to learn.

9. Feedback Systems and results

9.1 System for feedback from UG students and it's results.	We have no UG students.
9.2 System for feedback from PG Master's and Ph.D students and their outcome.	1. Issues faced by PhD and other PG students are brought to the SEC through their supervisors or the MMP coordinator 2. Student representatives meet the MMP coordinator and the school coordinator at regular intervals in each semester. 3. Faculty of the school meet students every semester. All identified issues are discussed in the SEC.
9.3 System for feedback from recruiters (I) on campus, and (b) off – campus – separately for UG and PG graduates; and the results.	Feedback from recruiters is obtained from training and placement unit. The SEC discusses these, and makes suitable changes. However, this feedback needs to be obtained systematically from recruitersver a period of time.

9.4 Mechanism of obtaining industry feedback and the findings.	Currently, there is no mechanism for industry feedback in general. However, feedback is obtained on regular basis from AIRTEL/Bharti, our sponsor, and various issues are discussed in the School Activities Board.
9.5 Alumni feedback mechanism and its outcome.	The school maintains a network of alumni. Feedbacks from alumni are obtained. A meeting of alumni is to be organized shortly.
9.6 Placement records – Ph.D, M.Tech and B.Tech.	**See Attachment – 16**

10. Future vision for next 5 – 10 years

10.1 Goals and benchmarking for future in relation to (I) curricula, (ii) research, (iii_ outreach, and (iv) processes for regular internal assessment.	(i) **Curricula:** We need to relook at our curriculum and revise it as per need. Courses themselves are revised by cognate departments. We have completed ten years, and this is the right time to relook at the curriculum. (ii) **Research:** Faculty of the school do take up a large amount of sponsored research (many through parent departments). Their research output in terms of publications is quite high as compared to the best institutes in the country. BY increasing facilities in the school, we can substantially improve this. Faculties are being encouraged to take on more industry-oriented research through funding agencies, industry, and AICET. Technology demonstration projects are required along with theoretical work to give high visibility to the school and create an impact. To enable this, we will relook

	at labs that we have, and provide space to new faculty to nurture their growth. We also need to tie up with industries to facilitate this. (iii) **Outreach:** At least two or three short-term courses in areas relevant to the school should be conducted every year, perhaps involving industry personnel too. This will benefit both faculty and students, and broaden their horizons. (iv) **Internal Assessment:** The present system of feedback from students, alumni and faculty is working well, and should be strengthened by more frequent formal meetings. A meeting with alumni is being planned. A formal method for evaluating the contribution of faculty to the school needs to be evolved. This will be done soon. A systematic way to measure/quantify work done by staff is being planned, and will help us in planning staff utilization.
10.2 Vision of curricula and teaching- learning processes – UG, PG and Ph.D.; innovations proposed.	
10.3 Area identified for improvement in (I) curriculum (ii) teaching – learning processes.	(i) Curriculum: Stress on industry oriented/sponsored M.Tech projects along with theoretical ones. (ii) Teaching-learning process: An increase in industry lectures/seminars to help increase expertise of students in standards and modern communication systems.
10.4 New areas for research and Masters programme, and industry participation in these.	Base station power consumption and its minimization remains a major problem for telecom companies. They incur enormous expenditure on genets to operate base-stations. Research in this area will be funded by AICET. LTE-WiFi interconnectivity and white space utilization are other areas identified by telecom companies as important for future growth. Research on these activities will be taken up through various funding agencies, including AICET.

	Energy Harvesting/scavenging for wireless devices is an areas of interest to a large number o faculty in the school and the department of electrical engineering. Faculty of the school does take up research and consultancy projects sponsored by industry. Some have sponsorship for research scholars. Industry participation in Master's projects is highly desirable, but has not taken off in a big way until now. We need to focus our attention on this aspect.
10.5 Projections for (I) funded projects, (ii) Journal publications.	(i) Until very recently, the institute did not have a mechanism to allow school faculty to take projects through the Bharti school. Projects were always taken from the parent department/center/school. This issue has been resolved by the administration recently. For this reason, the number of sponsored research projects/consultancies appears to be smaller than it actually is. Unfortunately, there is no way to represent the information accurately in parent departments and schools. However, in the future, this should not be an issue, and number of research projects will rise substantially. (ii) Number of faculty publications is expected to increase by 10% at least because of the additional new facilities that the school will provide.
10.6 Projected graduation numbers – Ph.D, M.Tech and B.Tech.	Increase in PhD students is expected. We hope to recruit post-doctoral fellows very soon.
10.7 Projected faculty profile, and areas for recruitment of faculty.	Increased participation from faculty with interdisciplinary profiles will enhance research in the school, and help increase activities in AICET. Faculty in other departments/centers with interest in telecom will continue to associate with the school, and their participation in school activities will be encouraged. Faculty members in management with telecom expertise are needed.
10.8 Projections for future benchmarking (for comparison after 5 years) – institutions in India and abroad, and parameters for future comparison	1. Number of PhDs produced – at least 5-6 in a year 2. Number of post-doctoral – 5 or more 3. Amount of funding for research projects should increase by

	3-4 times the current level 4. At least two major technology demonstration projects should be completed that bring visibility to the school and create an impact 5. At least two workshops/seminars conducted every year with industry participation, and with eminent invited speakers
10.9 Infrastructure and governance – limiting factors that affect achievement of benchmarks and methods to overcome these.	1. Funds continue to a serious impediment to progress. We need funds to refurbish labs and scale up operations of the school. We hope to increase the corpus by infusion of fresh funds. 2. Lab technicians are required to man the laboratories – currently, we have only permanent technical staff. 3. Constant efforts are being made to associate more faculty with the school. We need a larger pool of faculty in the area of networks. To tackle practical problems related to telecom, expertise in a number of engineering discipline is required. By tapping expertise of faculty with interdisciplinary skills, it is hoped that the school can be enriched. 4. A lot of faculty time is wasted in non-technical tasks. Trained secretarial help can go a long way in making faculty members more productive. All steps possible will be taken to provide such help to faculty.
10.10 Working with other school / centre will undertake.	The school needs to work closely with faculty of cognate departments.
10.11 New initiative that the school / centre will undertake.	1. Initiative to systematically train PG students in industry standards by a quality improvement programme. 2. All avenues to increase the number of industry-oriented projects will be made. To the extent possible, all PG students should work on industry related problems with one guide from industry. 3. Modern telecommunication systems are complex, and require expertise in a wide variety of engineering disciplines. Currently most faculty members of the school have expertise in signal processing and communications. We realize the need for diversity in disciplines, and need to harness faculty members with expertise in other areas to take the school ahead. We strongly believe that expertise in inter-disciplinary areas will greatly enhance the profile of the school. It will also strengthen activities of the AICET (Airtel

	IITD Center of Excellence in Telecom). 4. AICET has to be further strengthened, and its activities expanded. We need to stress on technology development projects through AICET. It is felt that tapping expertise of faculty in interdisciplinary areas and in other departments (and possibly other institutes if required) will help us achieve this end. 5. A new body-Telecom Standards Development Society India (TSDSI) – was registered recently. By working in close interaction with this body, it is expected that the school will start playing a major role in standard bodies. This will enable the school to achieve to its true potential.
10.12 Outreach goals and anticipated limitations in the attainment of these	Summer courses/workshops need to be conducted to train manpower in critical areas. Outreach through such activities was always central to the school. We need to increase our activity in this sphere, and call in experts from various parts of the country. This will help faculty and students stay up-to-date. Faculties are already contributing to outreach by partipating in MHRD national mission projects like Virtual labs and Pedagogy projects.
10.13 Mechanisms for effective changes based on feedback received and development and implementation of corrective measures	The SAB recommends changes, and these are implemented by the SEC. The SEC also implements changes based on feedback received from students, alumni, and faculty themselves.
10.14 Questions to which the school seeks answers from the Review committee.	The Bharti School has no faculty appointed solely to the school. Only two faculties possess joint appointments, the rest belong to other departments/centers/schools and are affiliated to the Bharti School. The school is a nodal point for all activity in communications, and provides researchers working in different units a common platform. By providing lab space, research scholars, Master's students and other resources, productivity of the associated faculty in enhanced. Student teacher ratios and other similar parameters will have to take into consideration the data of

	parent departments. Since faculty from many departments/centers/schools are involved, there seems to be no reliable method to quantify certain parameters like student-teacher ratio etc. Until very recently, the institute did not have a mechanism to allow school faculty to take projects through the Bharti school. Projects were always taken from the parent department/center/school. This issue has been resolved by the administration recently. For this reason, the number of sponsored research projects/consultancies appears to be smaller than it actually is. Unfortunately, there is no way to represent the information accurately in parent departments and schools. However, in the future, this should not be an issue. The school is young, and needs time to grow to its true potential. Telecom is one of the most important growth area for the nation. Your comments & suggestions will help us draw up a roadmap for future growth.

11. Information in public domain

11.1 Minutes of all meetings.	**See Attachment – 17**
11.2 All reports archived in the central / school / centre libraries	-
11.3 Past vision documents, review documents, standing review committee documents	-
11.4 Any other documents developed by the school, a group / section of the school / centre	-
11.5 Feedback documentation and action taken on the same, and its outcome.	The SAB and SEC minutes demonstrate that the feedback obtained from faculty, students, and SAB members is implemented by the SEC.

Annexure – 1

REVIEW OF THE DEPARTMENT/CENTRE/SCHOOL

PLACEMENT DETAILS – On campus

(data for last 5 years)

Prog. Type	Prog. Name	No. Of graduating students	No. Of Core companies that asked for prog. by name (+)	No. Of students selected (+)	No. of non – core companies that recruited students (++)	No. of students placed in non – core companies (++)	No. of students not placed at graduation time
M.Tech. (2007)	JTM	11	09	09	02	02	NIL
M.Tech. (2008)	JTM	6	03	03	03	03	NIL
M.Tech. (2009)	JTM	14	10	10	04	04	NIL
M.Tech. (2010)	JTM	19	13	13	04	04	02
M.Tech. (2011)	JTM	18	12	12	04	04	02
MS(R) (2007)	BSY	NIL	-	-	-	-	-
MS(R) (2008)	BSY	NIL	-	-	-	-	-
MS(R) (2009)	BSY	4	03	03	00	00	01
MS(R) (2010)	BSY	3	03	03	00	00	NIL
MS(R) (2011)	BSY	NIL	-	NIL	-	-	NIL
MBA (2010)	SMT	22					NIL
MBA (2011)	SMT	13					

(add more rows for other programmes)

* = Give name of programmes

+ = Attach separate list of individual company names and nos. recruited; give separate data for PSUs

++ = Attach separate list of individual company names and nos. recruited