Experiences in Distance Education

Sridhar Iyer

KR School of Information Technology

IIT Bombay

sri@it.iitb.ac.in

http://www.it.iitb.ac.in/~sri

Outline

- IITB Distance Education (DEP) network

- Technology R &D:
  - RTAN: Data transfer protocol over DEP
  - MADE: Mobile agents for remote examinations
  - xNet: Demos for learning for networking topics

- Pedagogical Issues:
  - Offering of IIT courses over DEP

DEP: The KReSIT Model
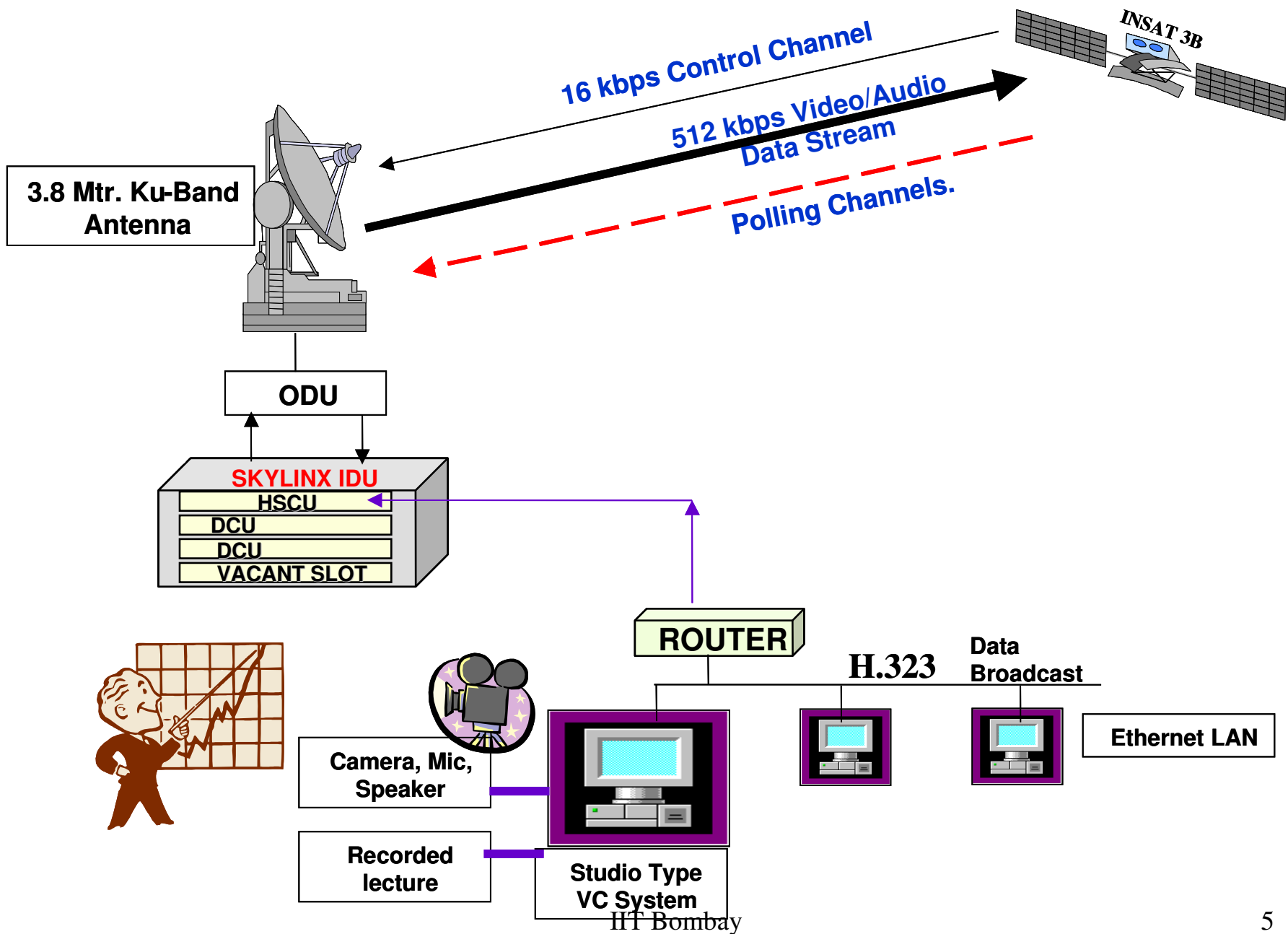
- **"Class Room" environment**
  - "Interactive" Lectures and Discussions
- **"Hub And Spokes" star network**
  - IIT Bombay - Remote Centres (RCs)
  - 512 Kbps DAMA channel; 16 kbps TDMA control channel
- **Some numbers**
  - Infrastructure at IIT Bombay: ~Rs. 1.0 Crore
  - Infrastructure at RCs: ~ Rs. 19 Lakhs
  - Recurring Bandwidth Costs: ~Rs. 37 Lakhs per Year (512 Kbps)
  - Other costs: Staff, dispatch, classroom etc.
- **Scaling: 6 RCs today, 25 by Dec 2003, ….**

The DEP Network Setup

Satellite

Satellite dish   Viasat HUB Comnet Noida

Remote Site

Remote Site
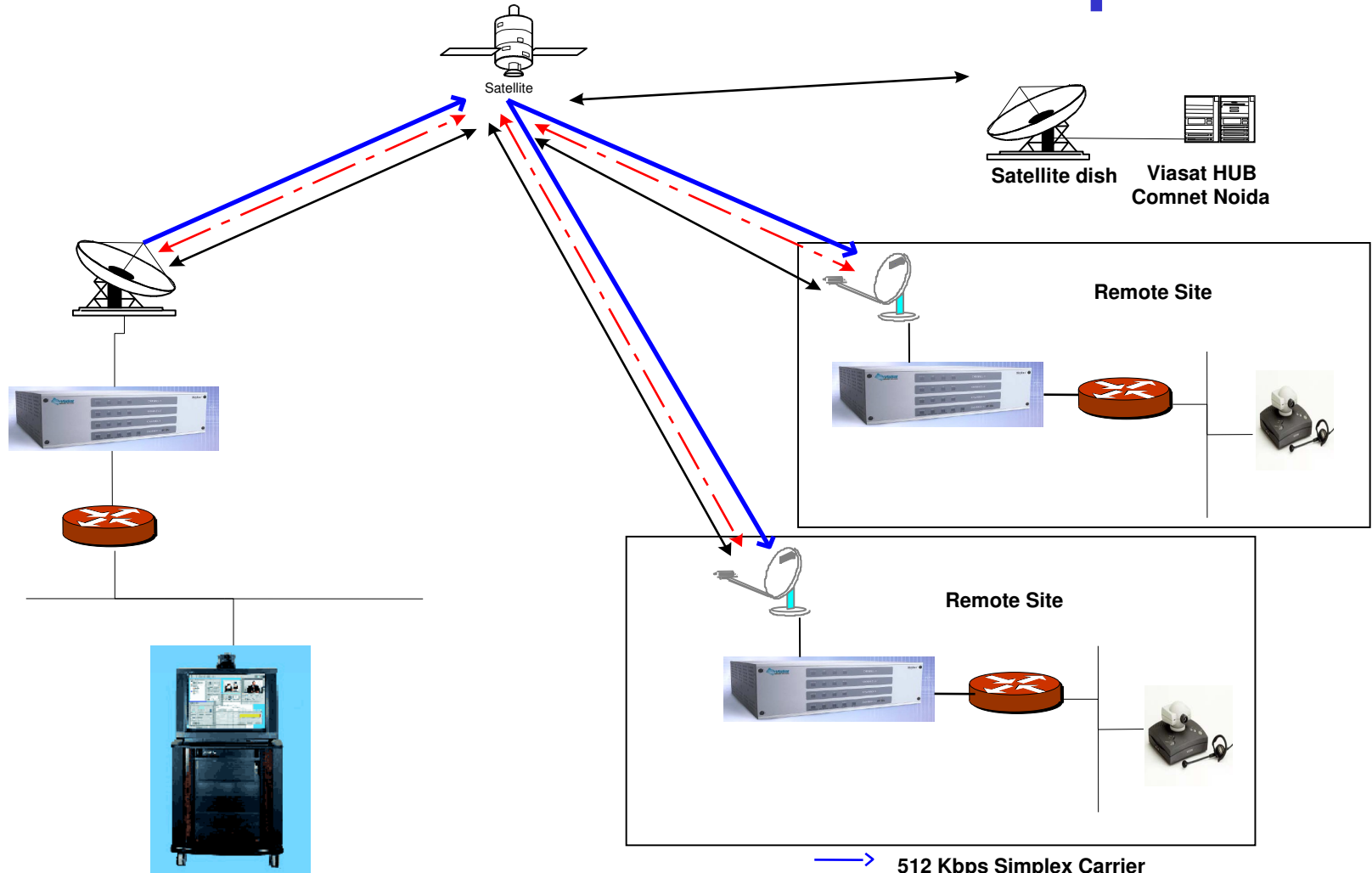
Central Site - IIT Powai

512 Kbps Simplex Carrier

16Kbps TDMA Control

Control Channel to Comnet Hub

INSAT 3B

16 kbps Control Channel

512 kbps Video/Audio Data Stream

Polling Channels.

3.8 Mtr. Ku-Band Antenna

ODU

SKYLINX IDU

| HSCU |
| DCU |
| DCU |
| VACANT SLOT |

ROUTER

H.323

Data Broadcast

Ethernet LAN

Camera, Mic, Speaker

**Recorded lecture**

Studio Type VC System

IIT Bombay

5

Data Transfer Requirement

- Reliable file transfer over the DEP network:
  - Large files of the order of 1 GB : videotaped lecture
  - Small files of the order of KBs : tutorials etc.

- The Problem
  - Need to have TCP like reliability
  - The 16 kbps full duplex reliable channel is too small for doing FTP/TCP in reasonable time
  - The 512 kbps DAMA channel is a half duplex multicast channel supporting UDP

RTAN

- Application level UDP based reliable transfer protocol
- Use the 512 kbps half duplex channel for data transfer
- Use the 16 kbps full duplex channel for control

- Reliable Transfer over Asymmetric Networks (RTAN)
  - The overall transfer consists of many **Transfer Cycles**
  - Each Transfer cycle consists of **one Data Cycle** and **many Recovery Cycles**
  - A **fixed number of packets** are sent per Data Cycle to all the clients.
  - All the **packets dropped** by at least one client are **remulticast** in Recovery Cycles until all the clients have received all the packets sent in the Data Cycle.

Satellite

Satellite dish — **Viasat HUB Comnet Noida**

Remote Site
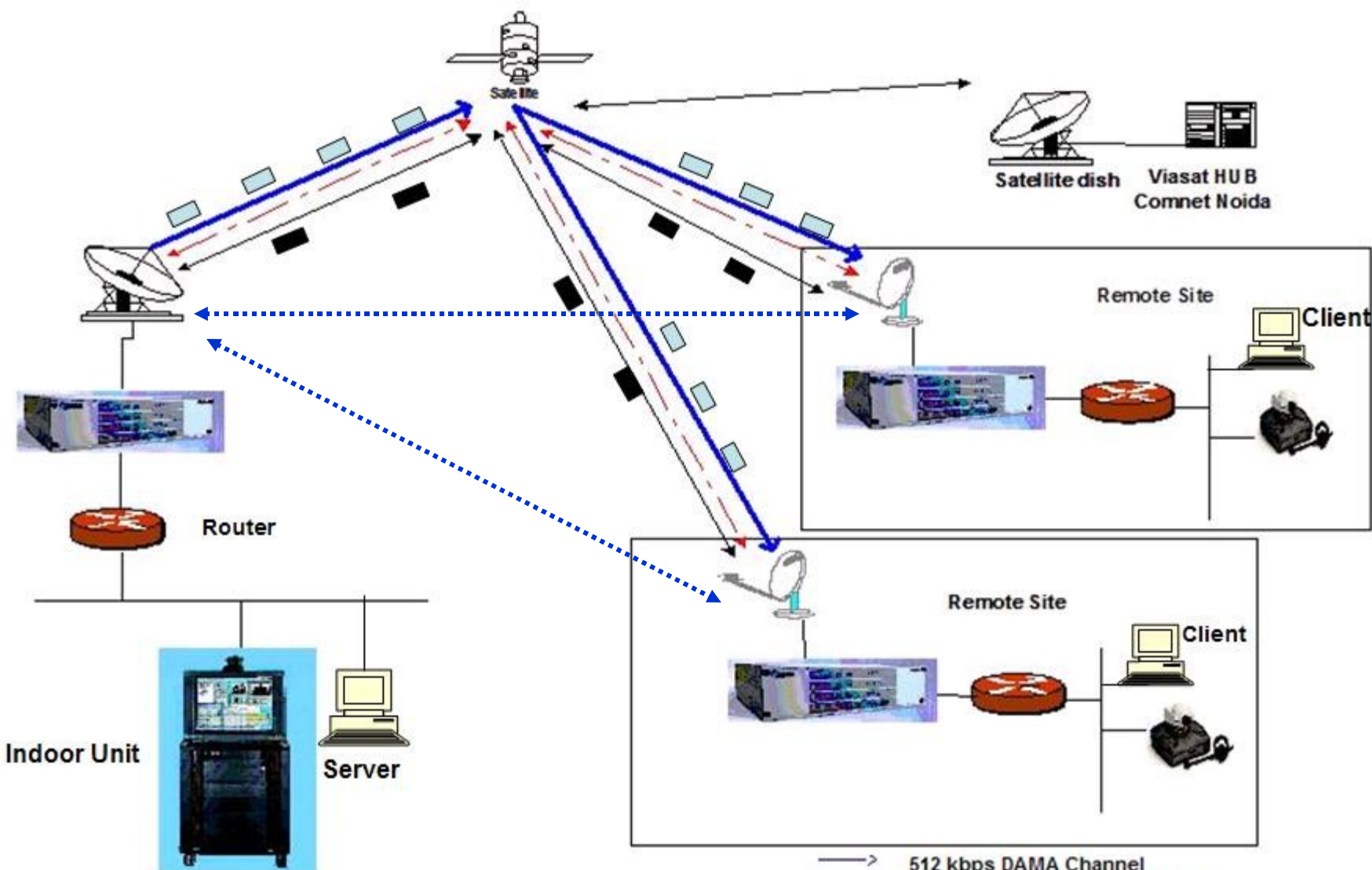
Client

Router

Indoor Unit

Server

Central Site - IIT Powai

Remote Site

Client

———> 512 kbps DAMA Channel
<———> 16 kbps TDMA Control Channel
<———> Control Channel to Comnet Hub
☐ Data Packet on DAMA Channel
■ Control Packet on TDMA Channel
◄∙∙∙► Logical TDMA point to point channel

RTAN: Deployment and Experiments

- Deployment issues:
  - Router configuration for multicast
  - Time To Live value
  - Link synchronization and Up-Down

- Field Experiments:
  - Network MTU found to be ~1400 bytes
  - Error rates observed to be from 0.5% to 5%
  - ~75 Kbps was data rate achieved for reliable transfer

MADE

- Use of Mobile Agents for the various phases of distance examinations

- Examination Process:
- Exam setting
  - examiners set the question papers
- Distribution and testing
  - question papers are presented to the students
- Evaluation and result compilation
  - answers are collected and results compiled

Mobile agents

Programs that can autonomously migrate amongst nodes of a network and perform computations on behalf of a user

Client/server communication

Mobile agent communication
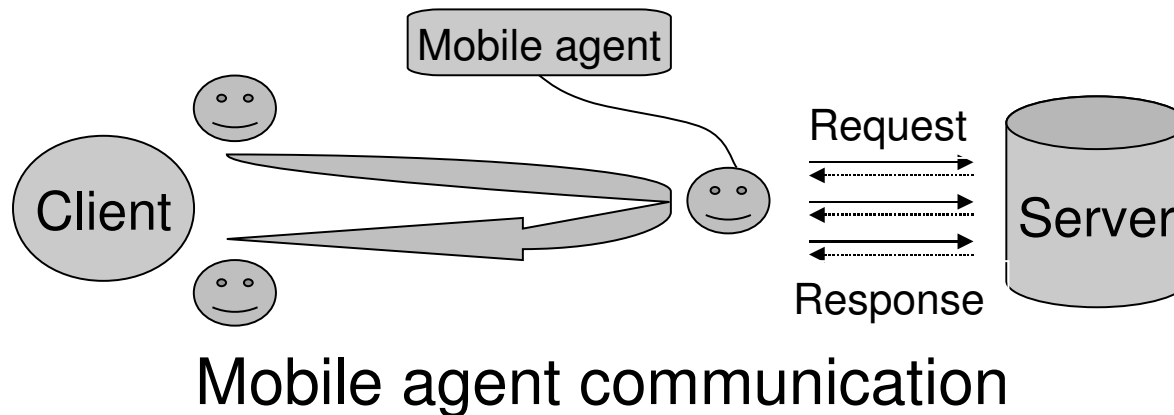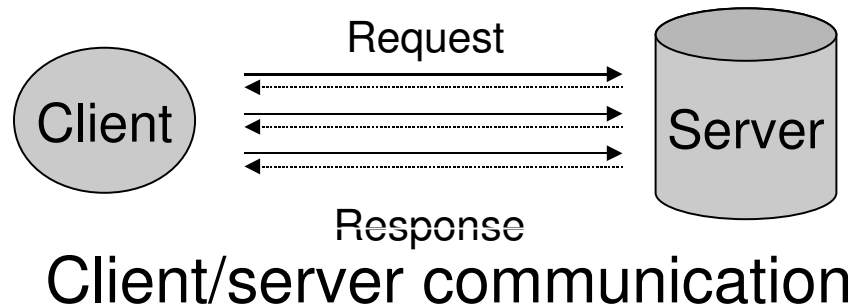
Examination setting: overview

Comprehensive Paper

PS-1

PS-2

PS-3

Paper Assembler

PS-5

PS-4

To Distribution Server

PS = Paper Setter
= Mobile Agents

Window 1 (left, partial):

Create Questions

◄ ► OK DEL Fet

Enter Your Que

HTTP port is usually one of t

Enter Option 1
20

Enter Option 2
40

Enter Option 3
60

Enter Option 4
80

Correct Option
Four

AGENT
Status Messages here
Paper Collected from...../localhost:5000
Paper Collected from...../localhost:6000
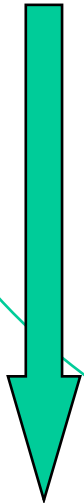
Window 2 (center):

Create Questions

OK DEL Finished Q No 1

Enter Your Question
What the name of the weightlifter from India who won the only medal in Sydney olympics?

Enter Option 1
P.T.Usha

Enter Option 2
Shiny Abraham

Enter Option 3
Malleshwari

Enter Option 4
Shakti Singh

Correct Option
Three

Dynamic Upgrade

Window 3 (right):

Create Questions

OK DEL Finished Q No 3

Enter Your Question
Number of Indians who have won Nobel Prize is:

Enter Option 1
4

Enter Option 2

Enter Option 3

Enter Option 4

Correct Option
On

Agent Messages

Should I wait?
Press <WAIT>
Should I come little later?
Press <LATER>
If you are done with questions,
Press <FINISHED>

WAIT   LATER

Distribution and Testing

Distribution Server

Single copy of paper

① →

⑤ ←

Each copy returned

Exam Center Distribution Server

② ↔

List of Students enrolled
…
…

c9611060

Separate Copy per user

④

Answered and Returned

③

Each Candidate get a Copy

Evaluation and Result Compilation

c9611060

Objective Questions Evaluator

Evaluation Server

Examiner B

Examiner A

Examiner C

Examiner D

Results

. . .

. . .

Agents collaborate to produce the final result

Student examination system: summary

Paper Assembler

Install Agent

Fetch Agent

PS-1

PS-2

PS-3

Result Publishing Server

Answer Paper Agent

Examiner –1

Examiner –2

Evaluation Server

Objective Question Evaluator

Distribution Server –1

Distribution Server –2

Question Paper Courier Agent

Student- 1a

Student- 1b

Student- 2a

Student- 2b
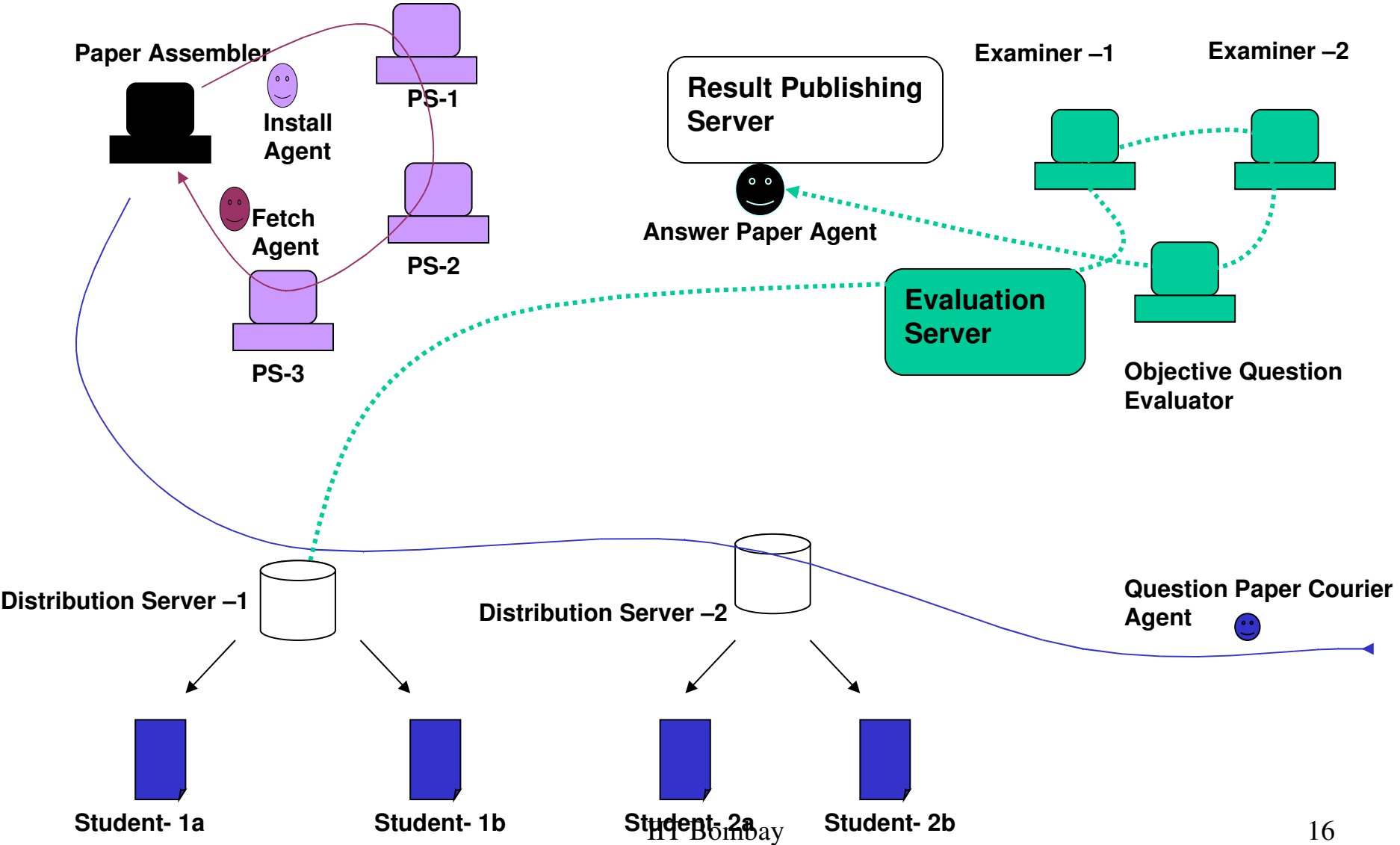
xNet: eXplaining Networking

- Goal: develop web-based self-learning materials for eXplaining Networking concepts, protocols and technologies

- Several modules, e*ach* on **one** concept/protocol
  - HTML/Java Applet based simulation resources
    - A brief HTML description of the protocol, including links to relevant RFCs and other references
    - Some "default/in-built" Java applet demos of the protocol functioning, in pre-defined network topologies
    - A "custom/user-driven" simulation, wherein the user defines the parameters for the protocol simulation

File   Edit   View   Favorites   Tools   Help

Address http://quark.it.iitb.ac.in/~xnet/tcp/default/tcp1.html   Go

| Demo | Configure | Pause | Resume | Reset | Help | Analysis | Step | About us |

Simulation of Sliding Window Protocols

er | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
w

of Protocols

op n Wait (SnW)
- ⊙ Without Error
- ○ With Lost Packet
- ○ With Lost Ack

Back n (GBN)
- ○ Without Error
- ○ With Lost Packet
- ○ With Lost Ack

elective Repeat (SR)
- ○ Without Error
- ○ With Lost Packet
- ○ With Lost Ack

| Go! |

SENDER

3

RECEIVER

Packe
No.

1-5-9
2-6-1
3-7-1
4-8-1

■ Fr
■ Ac
■ Fr
■ Ac
□ S

Pedagogical issues in teaching at IIT v/s DEP

- Communication medium:
  - IIT class has "high" bandwidth => Possible to interact freely, get instantaneous visual feedback
  - DEP class has "low" bandwidth => Constrained interaction and that too with non-trivial delays
- Student's background:
  - IIT class has JEE/GATE filtering => Possible to assume minimum level of competence
  - DEP class has minimal filtering => Large variation in background/abilities even after pre-requisites
  - IIT students are mostly full-time
  - DEP students are mostly part-time working professionals
- Instructor's skill:
  - IIT class emphasis is on domain knowledge
  - DEP class requires good teaching skills also

Observations on DEP teaching

- Many standard assumptions about giving a course within IIT do not hold for DEP
  - Extensive domain knowledge alone is not sufficient
  - Visual feedback about student's understanding is inadequate
  - Being a "good" teacher within IIT does not imply that the same material and delivery style will be good for DEP students

- DEP teaching is fun and satisfying if:
  - One likes teaching
  - One is willing to adapt one's style for the medium
  - One is willing to put in the "extra" effort to prepare detailed course material

Watch out: Pitfalls

- Assuming that customizing one's course for DEP will not take much time
  - Making slides for DEP usually takes much longer than anticipated
- Assuming that specifying pre-requisites is enough to ensure uniformity
  - DEP students usually meet the pre-requisite only on paper
- Getting carried away in class
  - Not being aware of what is being broadcast
- Handling all floor requests
  - Few clueless/shameless students can upset entire lecture timing
- Attempting a lot of interaction
  - May result in bizzare queries/answers
- Assuming that everything will go fine
  - Murphy's Laws strike with amazing regularity ☺

Thank You