KyaTera project

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PROGRAMA TIDIA

TIDIA: Tecnologia da Informação no Desenvolvimento da Internet Avançada

ITC for the Development of Advanced Internet

Approved on 14/02/2001 – Innovation Programs

The INTERNET as subject of research

FAPESP

TIDIA

Tecnologia da Informação no
Desenvolvimento da Internet Avançada

What is the KyaTera Project?

- A testbed for Internet research, a distributed lab facility to test ideas in
  - Transmission and Networking technologies
  - Advanced Internet applications – OPTICAL INTERNET

- Groups of experts on Internet enabling technologies and applications, working together

- Multiple networks interconnecting laboratories (FTTLab):
  - Optical cables with multiple fibers (single mode)
  - Fibers with multiple wavelengths (WDM)
  - Flexible testbed: any technology, topology, application
  - Stable network – 1 Gb/s end-to-end
  - Stable and experimental networks coexisting
  - No (tangible) bandwidth limit, high quality, secure, trustworthy, robust,…

Proposed and Coordinated by CePOF

KyaTera Goals

- **To do research in Internet enabling technologies**
  - **Communications**
  - **Networking**
  - **Remote control of lab instruments**

- To implement a fiber optic network interconnecting laboratories ()
  - FTTLAb: Fiber-To-The-Lab

- To develop advanced applications and special uses of the INTERNET
  - WebLabs starting in first phase
  - Open to suggestions

- Generate HUMAN RESOURCES in quantity and quality

- Generate KNOWLEDGE, IDEAS

- Promote Academy – Industry COLLABORATIONS
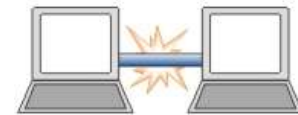
Three KyaTera Layers

Applications Layer

CePOF

- Web enabled Laboratories (WebLabs)
  - ➜ Control and automation, robotics
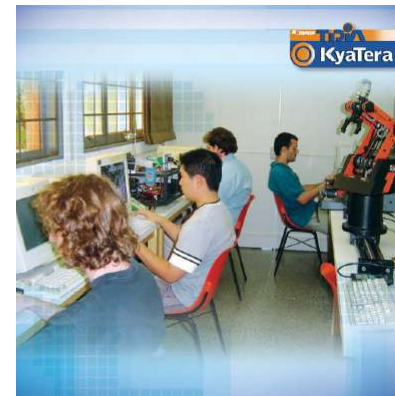 - ➜ Multimedia communications

Networking Layer

- Telecom Networks
- Computer Networks
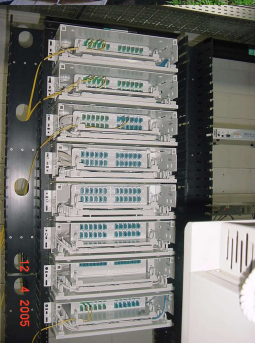 - ➜ IP, SDH, Protocols, QoS, Network Security

Physical Layer

CePOF

- **Fiber-Optic Transmission Systems**
- **All-Optical Networks**
  - ➜ **DWDM, CWDM, photonic devices**

Outside Plant Status – November 2005

Coordinated by CePOF

KyaTera Proprietary Optical Fiber Plant Deployment

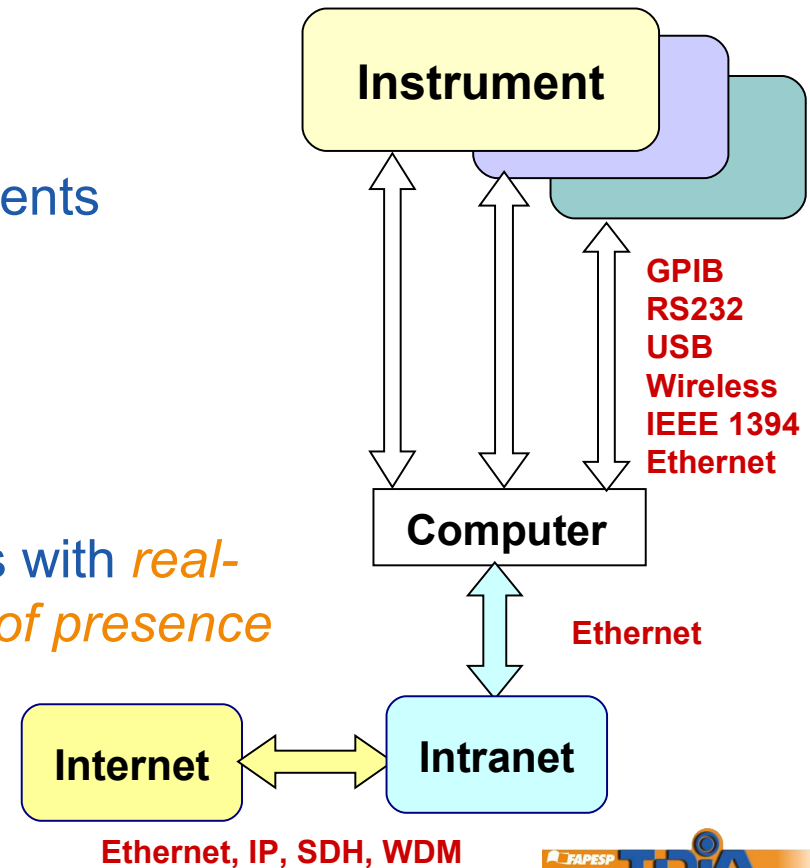| City MAN	Campus LAN	Labs in campus	Cable (m)	Fiber (m)	Fusion splices	PC / APC connectors	Splicing boxes
São Paulo							
	USP-SP	19	11,586	282,2136	694	502 / 192	2+4
São Carlos							
	USP Scar	9	2,769	42,992	168	144 / 0	1
	UFSCar	4	763	5,724	42	42 / 0	0
	USP-UF Link		6,110	14,664	72	24 / 24	1
Campinas							
	Unicamp	16	7,211	169,418	592	424 / 144	2+2
	PUC-Camp	1	4,502	108,048	48	24 / 24	0
	CPqD	1	5,203	124,872	96	24 / 24	3
	TOTALS	**54**	**38,144**	**747,854**	**1,712**	**1184 / 408**	**15**

Eng. Marco Aurélio Fortes 26-Oct-05

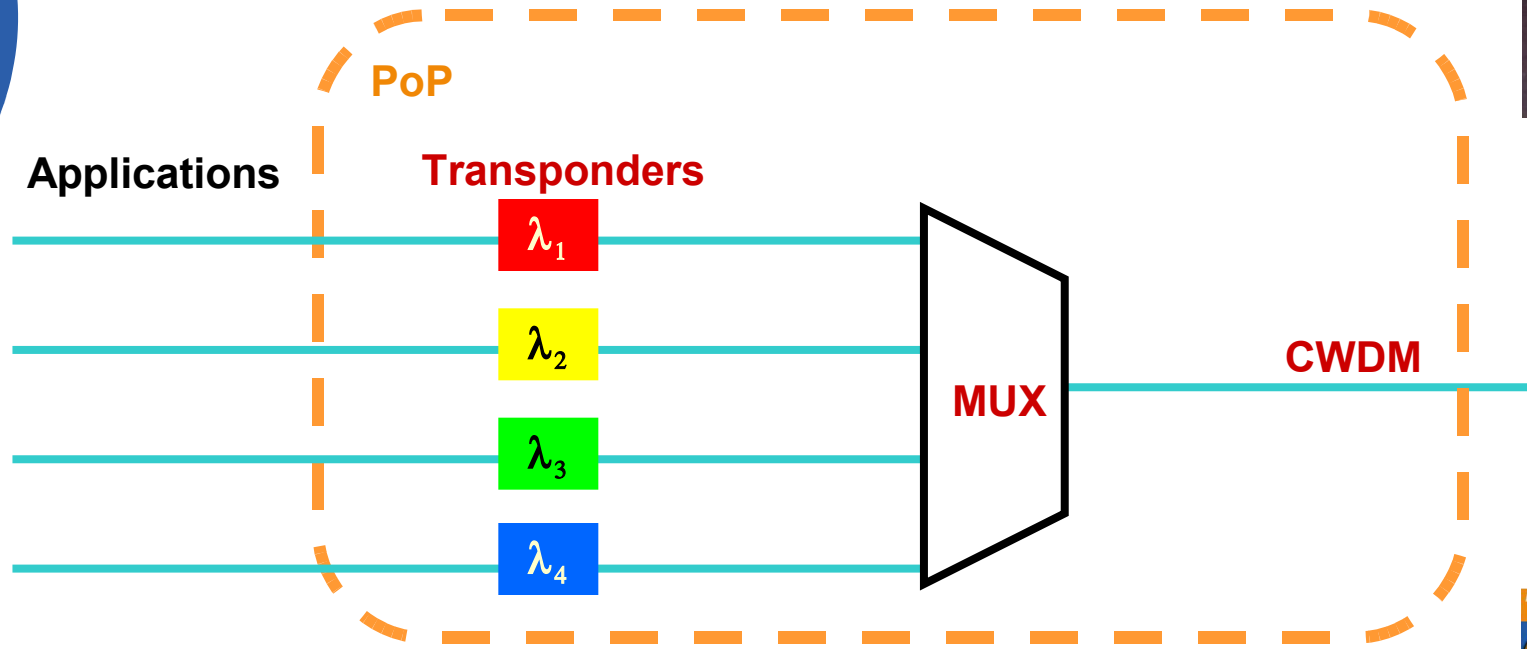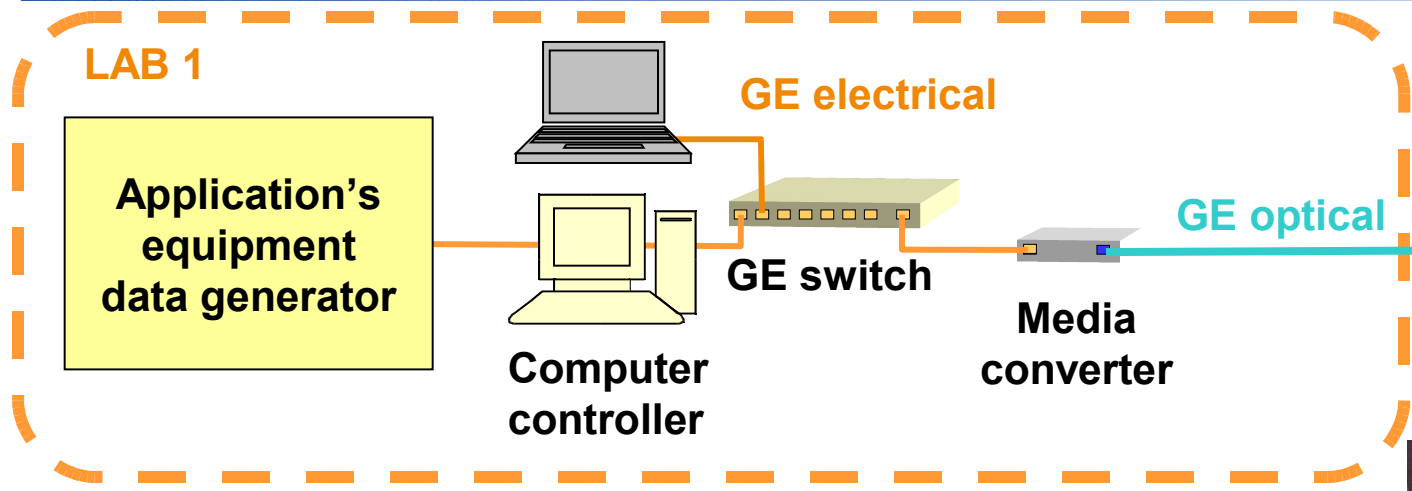**+ 500 km from Telefonica**
+ 3600 km being negotiated

- **Real Laboratories accessed via INTERNET**
- **E-Learning in <u>ALL EXPERIMENTAL SCIENCES</u>**
- **Tele-Research, Tele-Collaboration**
- **Distant training**

◉ *Non-presencial*, but *real* experiments

◉ We need to understand
  - automation, control, HD video,…
  - … and, specially, the Network

… in to order to develop weblabs with *real-time control* providing *sensation of presence*

Instrument

GPIB
RS232
USB
Wireless
IEEE 1394
Ethernet

Computer

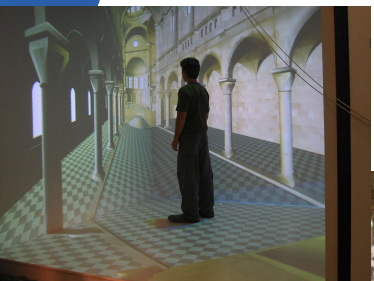Ethernet

Internet ⟷ **Intranet**

Ethernet, IP, SDH, WDM

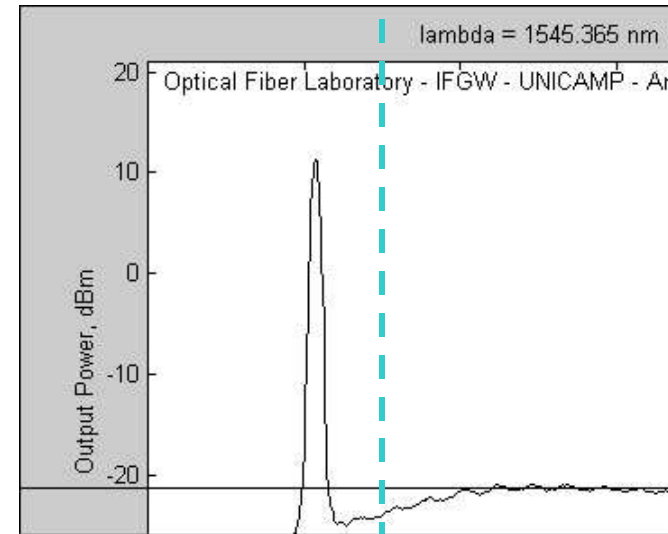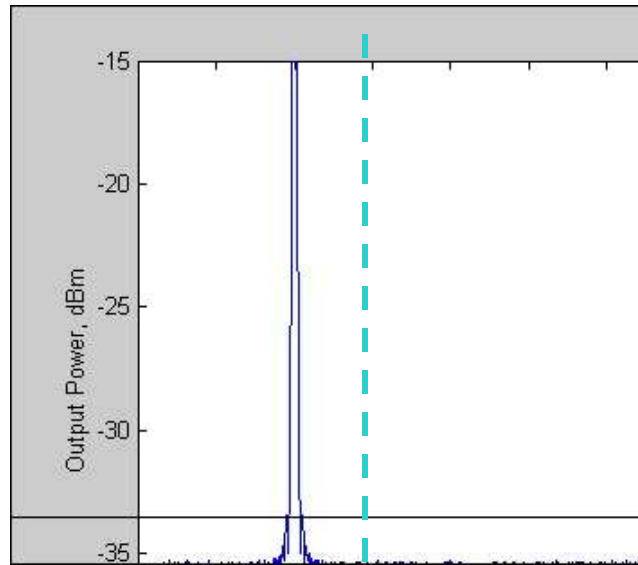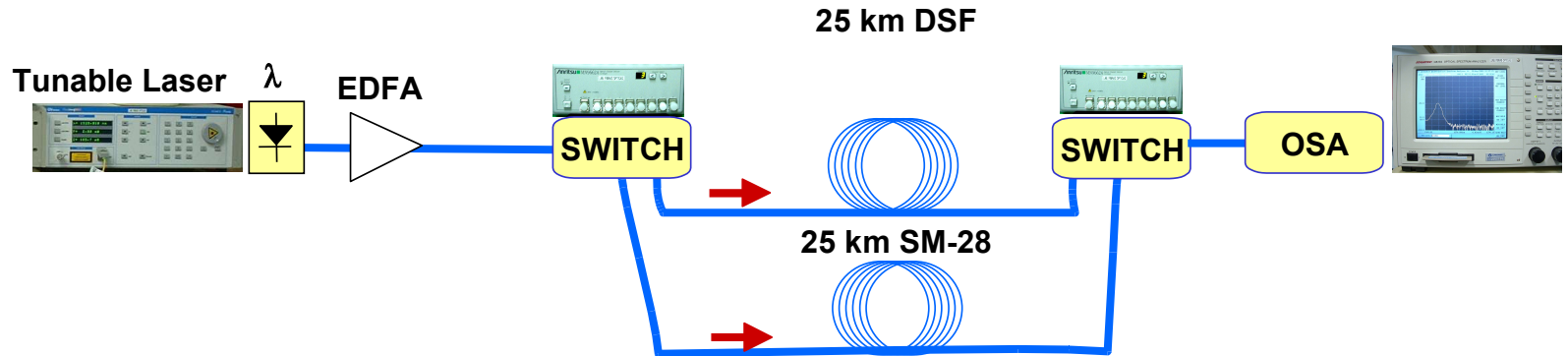KyaTera

Applications Layer - WebLabs

KyaTera WebLabs

- Chemical engineering
- Optical communications
- Biology
- Advanced manufacturing
- Medicine
- Microwaves communications
- Psychology
- Photonic devices
- Robotics
- Atmosphere monitoring (Lidar)
- Virtual reality

Melipona bicolor bicolor Lepeletier, 1836 – guarupu
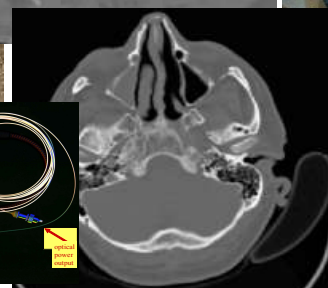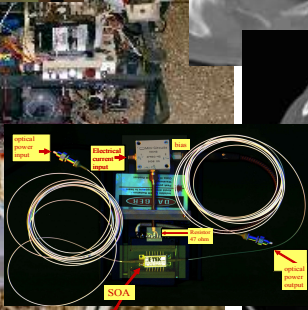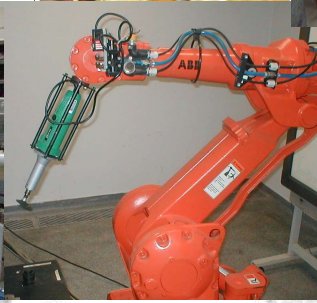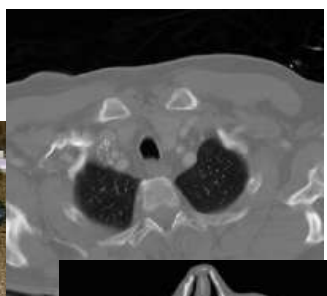
Campinas – São Paulo, Nov. 2004

Simulation versus experiment

WebLab3: Four Wave Mixing

IFGW - Optical Comm Lab

λ_1
λ_2
MUX
SWITCH
Tunable Lasers
25 km DSF
25 km LEAF
OSA
SWITCH
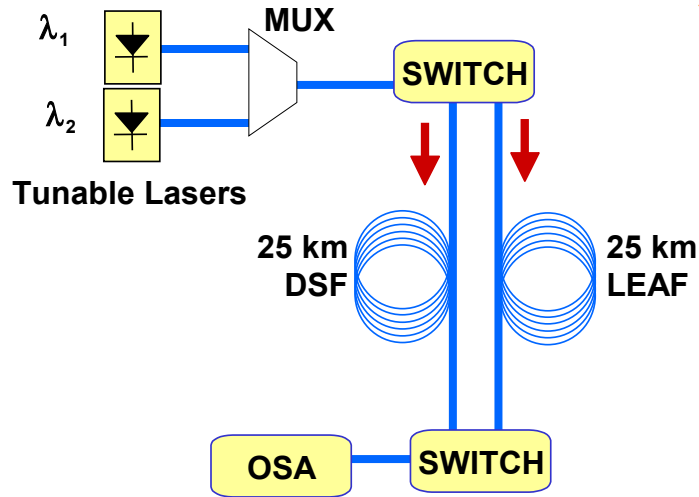
Unicamp – Mackenzie: Ago 2005
Via ANSP

Unicamp – PUCC: Sept 2005
Via KyaTera

Unicamp - TIDIA Workshop: Nov 14
Via KyaTera fibers (to SP) + radio

Nonlinear effects in WDM systems

WebLab2: 320 Gb/s DWDM System

Unicamp Campus, April 14, 2005
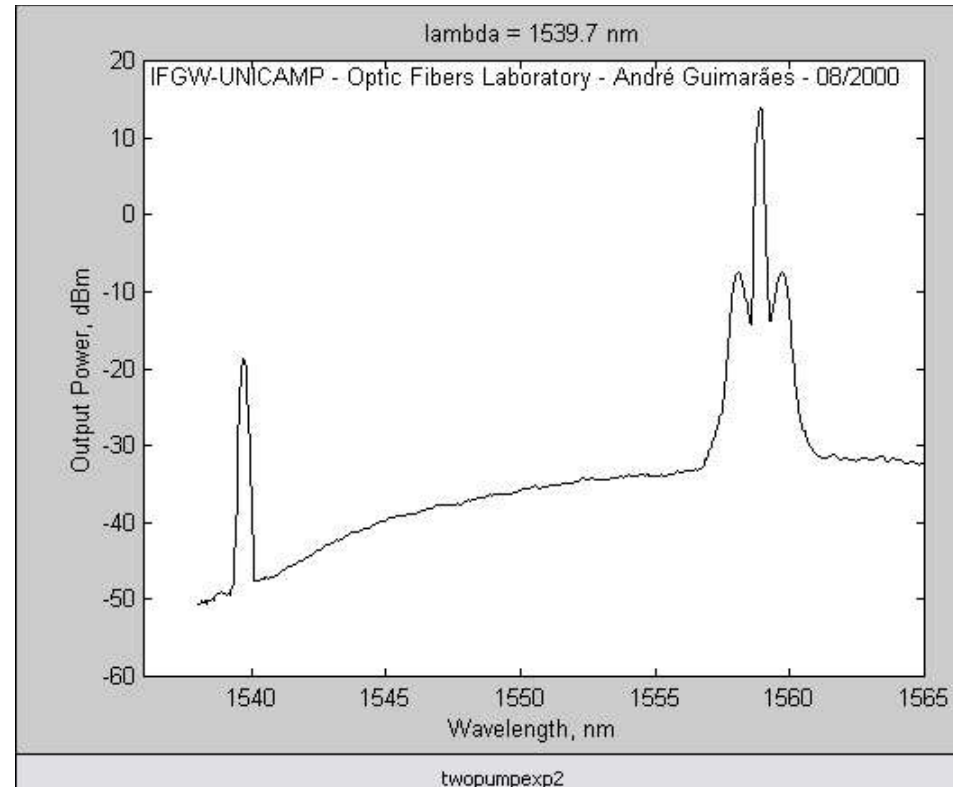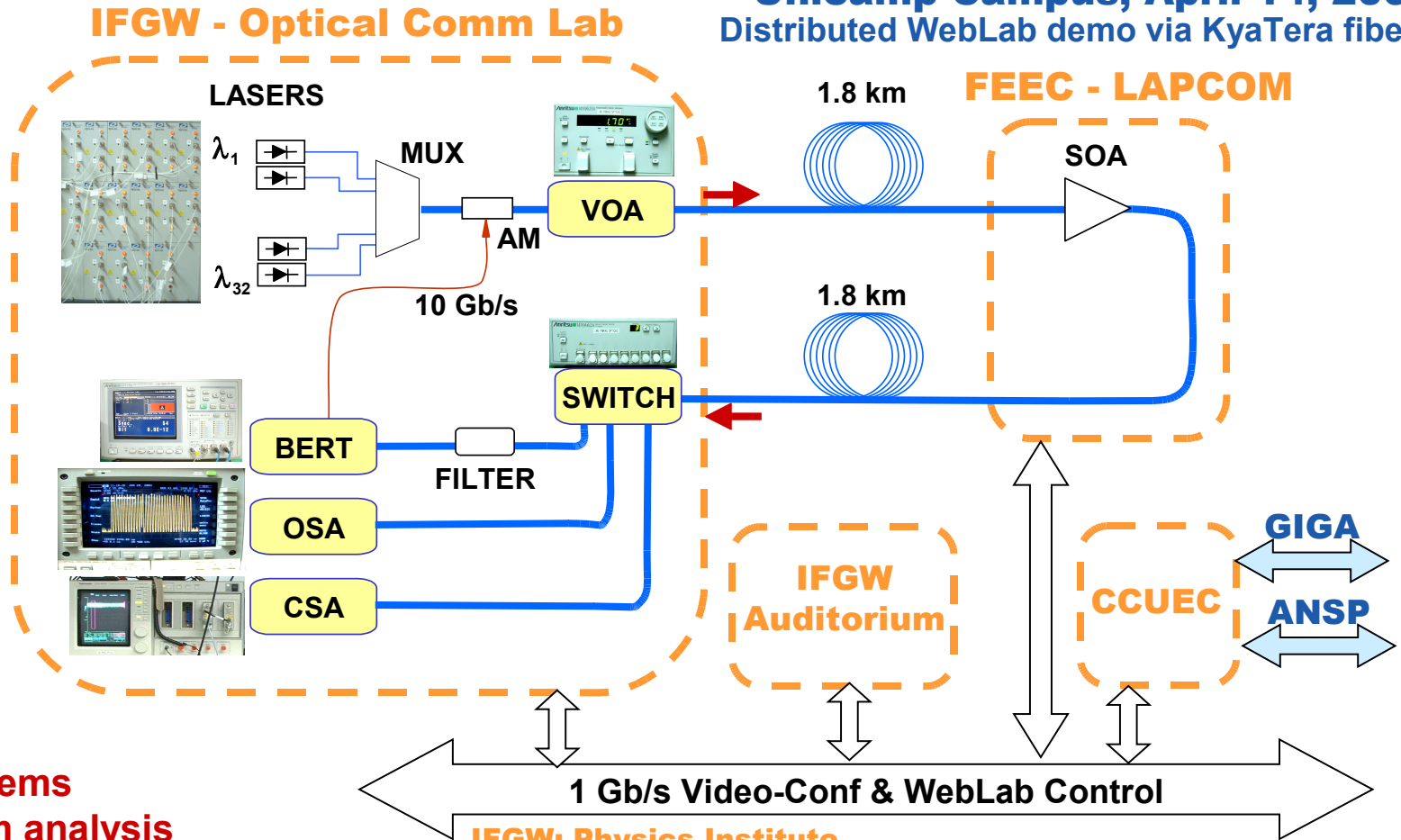Distributed WebLab demo via KyaTera fibers

IFGW - Optical Comm Lab

FEEC - LAPCOM

LASERS
λ_1
λ_{32}
MUX
AM
VOA
10 Gb/s
1.8 km
SOA
1.8 km
SWITCH
BERT
FILTER
OSA
CSA

IFGW Auditorium
CCUEC

GIGA
ANSP

DWDM systems
Eye diagram analysis
Optical amplifiers
Optical spectrum analysis
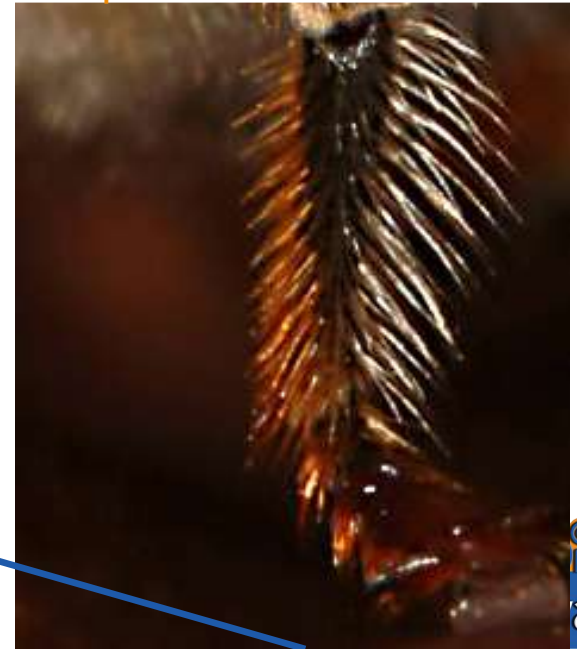10 Gb/s systems

1 Gb/s Video-Conf & WebLab Control

IFGW: Physics Institute
FEEC: Faculty of Electrical and Computing Engineering
CCUEC: Computing Center
GIGA: Giga Project (CPqD+RNP)

FAPESP TIDIA KyaTera

◉ It may replace the real specimen

➔ which is usually sent by mail for comparison

Instead of this image

Prof. Antonio M. Saraiva, USP

- **Audio acquisition inside a colony and analysis**
  - **Studies on audio inside a colony (communication)**
  - x **other conditions (weather, food availability, threats).**
  - **Patterns, spectra, level**

- **WebLabs to improve International Collaborations:**
  - **Prof. Antonio M. Saraiva – USP and Dr. James C. Nieh – University of California, S. Diego**
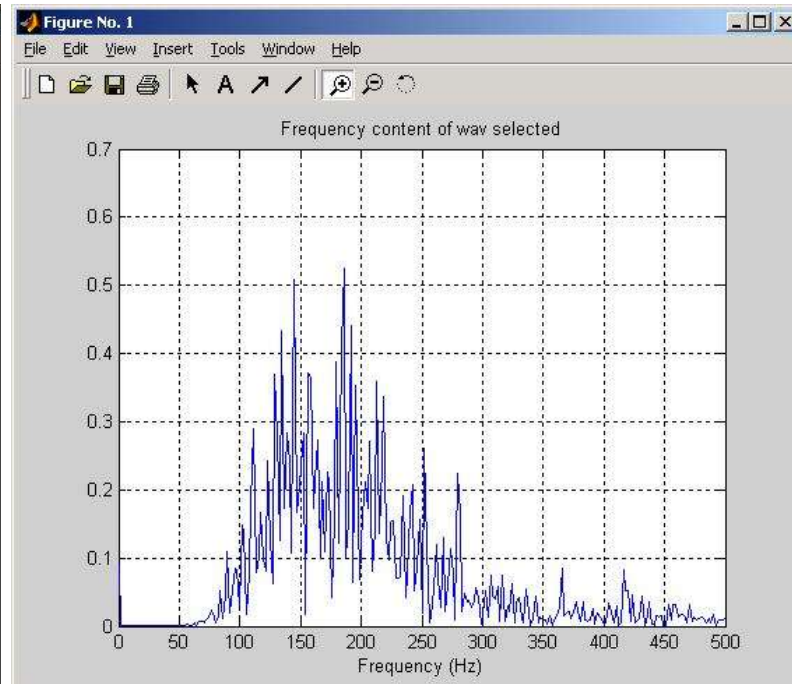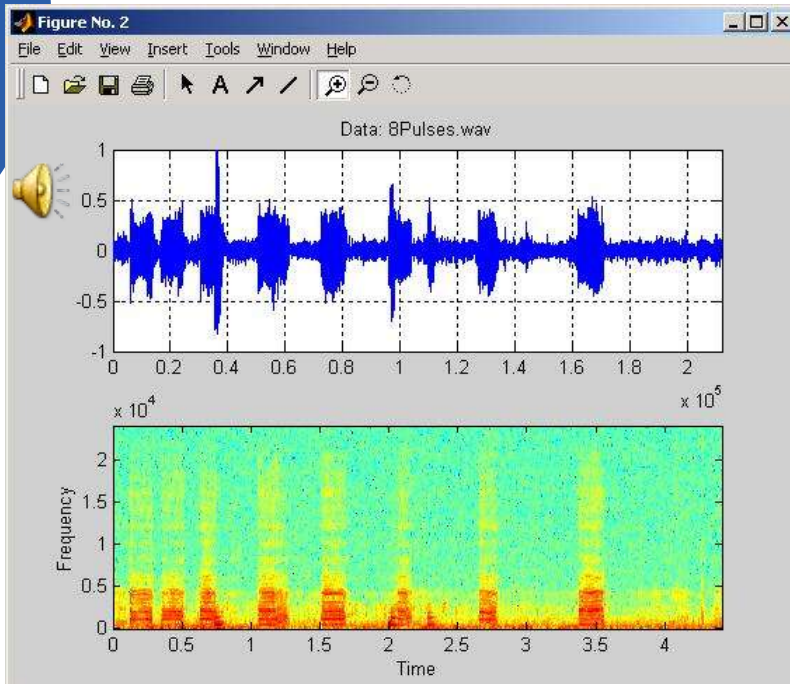
Teaching the learning process

High Definition Video (to see the water drop) would improve the experiment

How do we train the rat to change its habits?

Low network latency required to train the rat remotely

We need full understanding and control of the network:
Bandwidth allocation; low latency; application priorities;…

LSC
Laboratório de Sistemas de Computação

Modeling rat responses, Drausio Capobianco, Cesar Teixeira, Maheus Barbosa, Felipes S. Santos, Cássio Prazeres - LSC-UFSCar/COC

Publications, Theses, and Patents

Type	Number
Journal papers, International	162
Journal papers, National	12
Conference papers, International	142
Conference papers, National	89
Books or Chapters in books	1
Patents, International	1
Patents, National	1
Theses, MSc.	12
Theses, PhD	24

Participants

Research Groups	Number
Principal Laboratories	5
Associate Laboratories	22

People	Number
Principal Investigators	24
Faculty Professors	97
PhD or Pos-Docs	14
PhD Students	62
Masters Students	58
Undergraduate Students	54
Technicians/Engineers	14
Fapesp TT fellowships:	12
Support (Nara)	6
Totals	339

Industrial Partners

- Telefonica, CPFL, ElectroPaulo,
- Terremark, Akamai,
- Corning, OFS, Metrocable,
- Padtec, Cisco, Lucent,
- National Instruments, …

## National and International Networks

- ANSP, RNP, GIGA, LILA, WHREN, NLR, i2CAT, …

Visions of the Internet

- **Secure, trustworthy,**
- **ubiquitous,**
- **low-cost, open infrastructure suited for sensors and controllers;**
- **robust against attack, crisis proof;**
- **1000-fold reduction in energy/bit;**
- **reconfigurable;**
- **qubits compatible**
- **… in 10 years.**

"**Making the world [of communications] a different place," D.D. Clark, et. al., End-To-End Research Group, March 24, 2005**
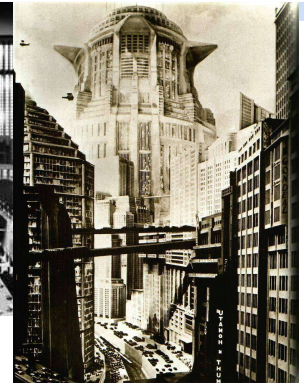
Metropolis, Fritz Lang (1927)
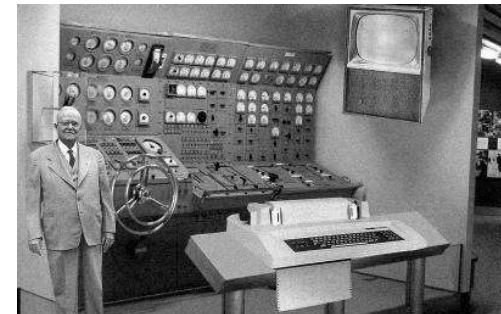
Home computer in 2004 (1954)

Challenges for the research community

- To validate and demonstrate any of these visions, **it will be necessary to build some sort of prototype, testbed, or experimental infrastructure**. So part of the challenge in achieving these visions is to agree, as a community, what sort of infrastructure would best serve us in our experiments. Some of the objectives in this list might be met as part of **a fundamental redesign of the Internet itself**, and this research objective would call for a testbed that can demonstrate a new network architecture.

- …So we offer two challenges to the research community:
  - first, to set itself some long-range visions and work to achieve them, and
  - second to agree *as a community* on the test infrastructure necessary to support those visions.

End-To-End Research Group, March 24, 2005

Expectations

Consolidating research

- Dissemination to attract vocations for TIC
- Develop project management skills and tools for large, cooperative research projects
- Spin-off sub-projects (WebLabs, Thematic Networks)
- Spin-off small businesses

New research subjects

- New technologies and new advanced Internet applications

Advancements in all sciences

- Advanced Internet networks will allow researchers in Brazil to collaborate easily and efficiently with researchers abroad.
- Present challenges in science need be attacked by several groups scattered around the world, sharing their competences (and lab resources) through the web.

A new Internet (?)

- Is the Internet broken?
- How it would be The new Internet?
- What kind of Tesbed do we need to test it?

www.kyatera.fapesp.br