GARR – La Forma del Cambiamento/Le Radici Del Futuro

Dal Primo Ping al Quantum

Università di Pisa – 19 Maggio, 2026

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Sommario

Inserimento dell’Italia nell’Internet Globale

Evoluzione Verso il Quantum Computing e il Quantum Internet

Conclusioni

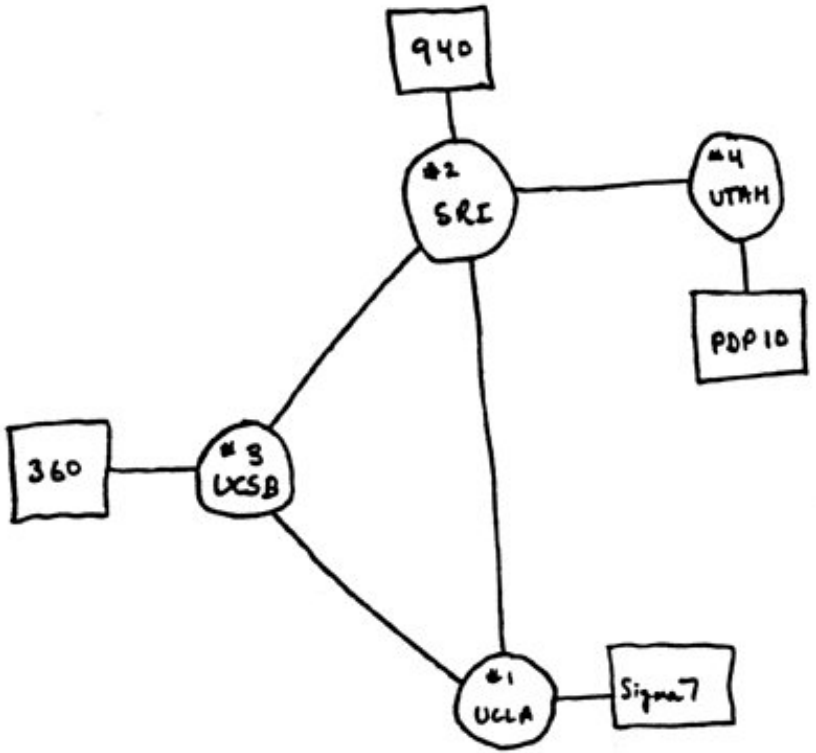
1969: La Nascita di ARPANET

UCLA → Primo Nodo ARPANET

SRI → Secondo Nodo

UCSB → Terzo Nodo

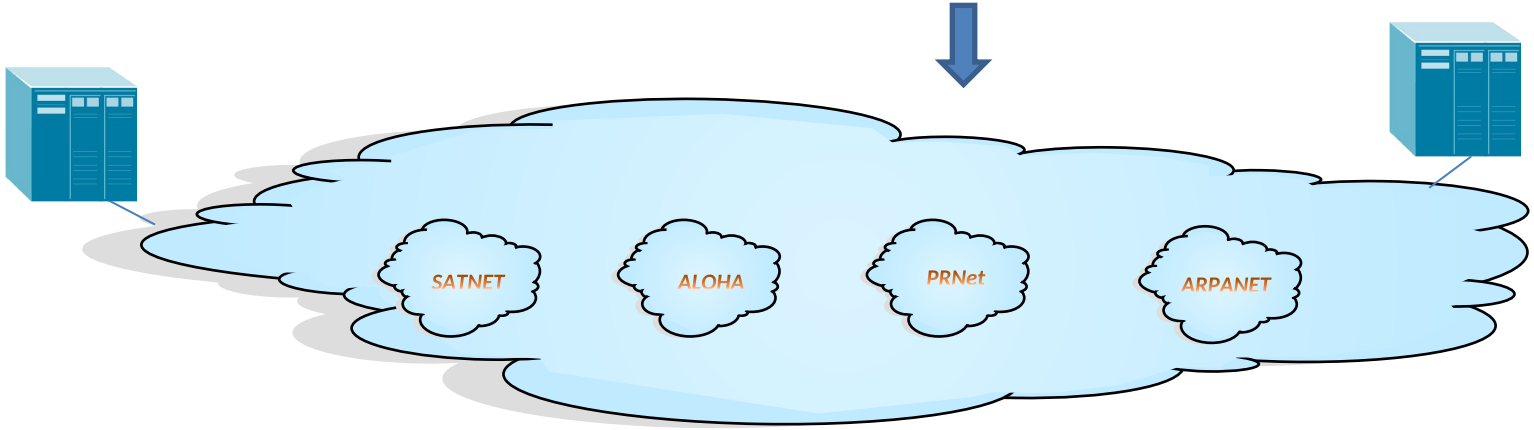
University of Utah → Quarto Nodo



Da ARPANET a Internet

Nel Settembre del 1974, *Vint Cerf* e *Bob Kahn* pubblicano la loro idea su come interconnettere le varie reti

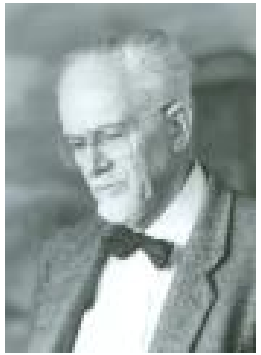
Nasce *Internet*



Progetti di Networking al CNUCE

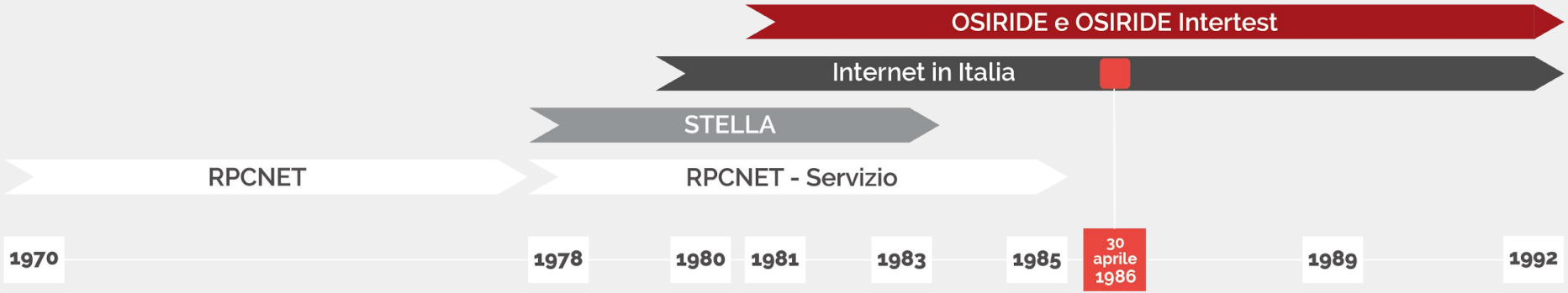
- ✓ I primi segnali su ARPANET arrivano a Pisa nella seconda metà degli anni ’60
- ✓ Tali segnali vengono raccolti dal **CNUCE** (Centro Nazionale Universitario di Calcolo Elettronico) fondato dal Rettore dell’Università di Pisa, Prof. Alessandro Faedo e diretto, fino al 1978, dal Prof. Guido Torrigiani

Alessandro Faedo



Guido Torrigiani

Progetti di Networking al CNUCE



Internet Sbarca in Europa

Seconda metà anni ’70

- Gli USA estendono la sperimentazione di Internet in Europa
- A tal fine, cercano nelle varie nazioni gruppi con solide competenze di networking con cui condurre la sperimentazione
- Viene utilizzata la rete satellitare **SATNET** per collegare gli USA con l’Europa

IAT SEGRETERIA DIREZ

CNUCE

Pisa, 12 February 1980
Prot.n.36935 LL/sb

ISTITUTO DEL CONSIGLIO NAZIONALE DELLE RICERCHE

Dr. Robert Kahn
Advanced Research
Projects Agency
1400 Wilson Blvd.
Arlington, VA 22209

c.c. Prof. Gianfranco Capriz
Dept. of Mechanics
Whiting School of Engineering,
The Johns Hopkins University
Baltimore
Maryland 21218
USA

Dear Dr.Kahn,

I have been informed by Prof. M. Gerla (UCLA) that the SATNET experiment is to be further extended in Europe. This information has also been recently confirmed by J.L. Grangé (IRIA) and H. Lang (DFVLR).

As Prof. L. Fratta wrote to you, the Italian National Research Council (CNR), and, in particular the CNUCE Institute of CNR (located in Pisa), would be extremely interested in hosting a SATNET node to be used for research purposes.

CNUCE has been working in the computer networking field since 1973 and has been responsible, working together with other research institutions, for the design and implementation of a packet switching distributed control network known as RPCNET (REEL Project Computer Network).

This network has been well documented in international conference proceedings (ICCC76, ICCC78, etc.) and is now being used by computing centers of CNR and Italian Universities to facilitate the research work of the Italian Scientific ant Technical Community by providing cheap and effective computing services.

For the last eighteen months, CNUCE has had the responsibility for directing the Italian side of the

CNUCE IAT SEGRETERIA DIREZ

prot.n.36935

international project STELLA (Satellite Transmission Experiment Linking LAboratories) collaborating with TELESPAZIO (Italian PTT branch for satellite data trasmission) and INFN (Nuclear Energy Physics Organization). The objective of this project is to design and implement a fast communications system to transfer large amounts of high energy physics data from CERN (Geneva) to other centers in Europe.

The OTS (Orbital Test Satellite) satellite, owned by ESA (European Space Agency), succesfully launched in May 1978, will be used by STELLA. The speed of the OTS communication channel is 2 Mbps. A ground terminal of 3 meters diameter is now being installed at CNUCE and this experiment should be completed within a few mounths.

The European Economic Communities has recently commissioned CNUCE to design an extension to this experiment which include CCITT protocols, mainly X25.

A few months ago, the Italian government approved a program to design and implement a Telecommunications Satellite, ITALSAT, and CNUCE is represented in a national group which will propose data transmission experiments using this satellite.

This is a brief outline of same of the activities at CNUCE (we have a staff of about 100). I think that a meeting could be useful to give you further information on these activities and on the role played by CNUCE in the Italian informatics research world.

As the Director of CNUCE, is visiting the John Hopkins University, Baltimore, until the end of March, it should be possible to arrange a first, preliminary meeting between you and Prof. Capriz in the US. If necessary, we could then arrange a further technical discussion between us.

Looking forward to hearing from you,

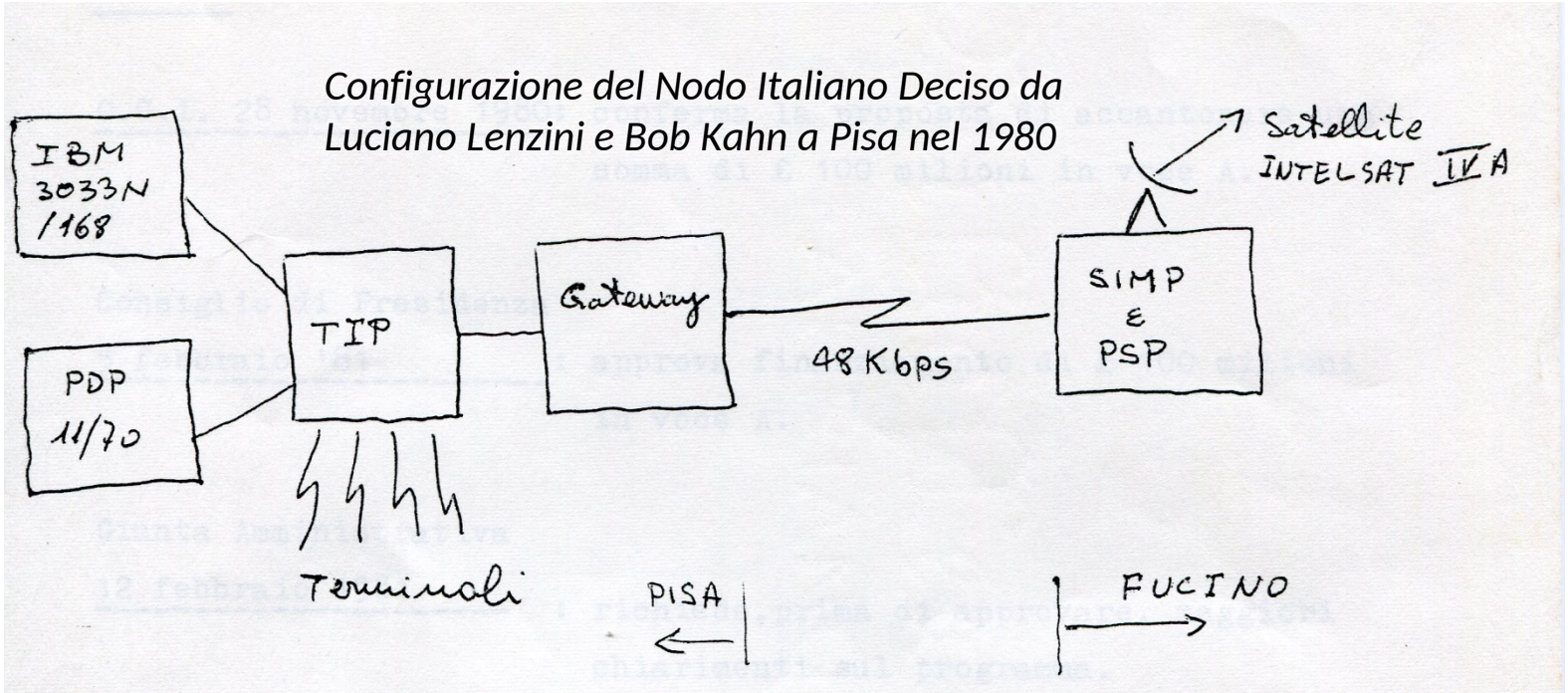
yours sincerely,

Dr. L. Lenzini
Head of Distributed
Systems Division

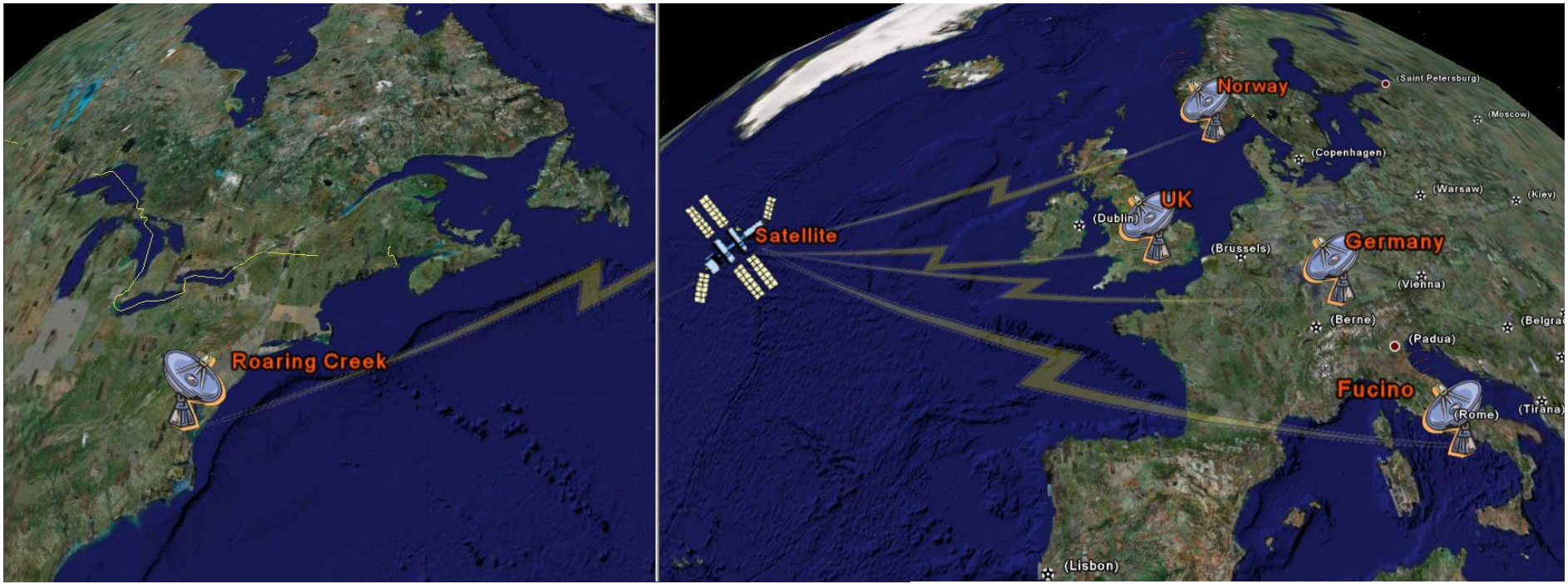
P.S. I will try to contact you by telephone on February 20th or 21st at about 10 a.m. your time.

Configurazione Nodo Italiano

Configurazione del Nodo Italiano Deciso da Luciano Lenzini e Bob Kahn a Pisa nel 1980

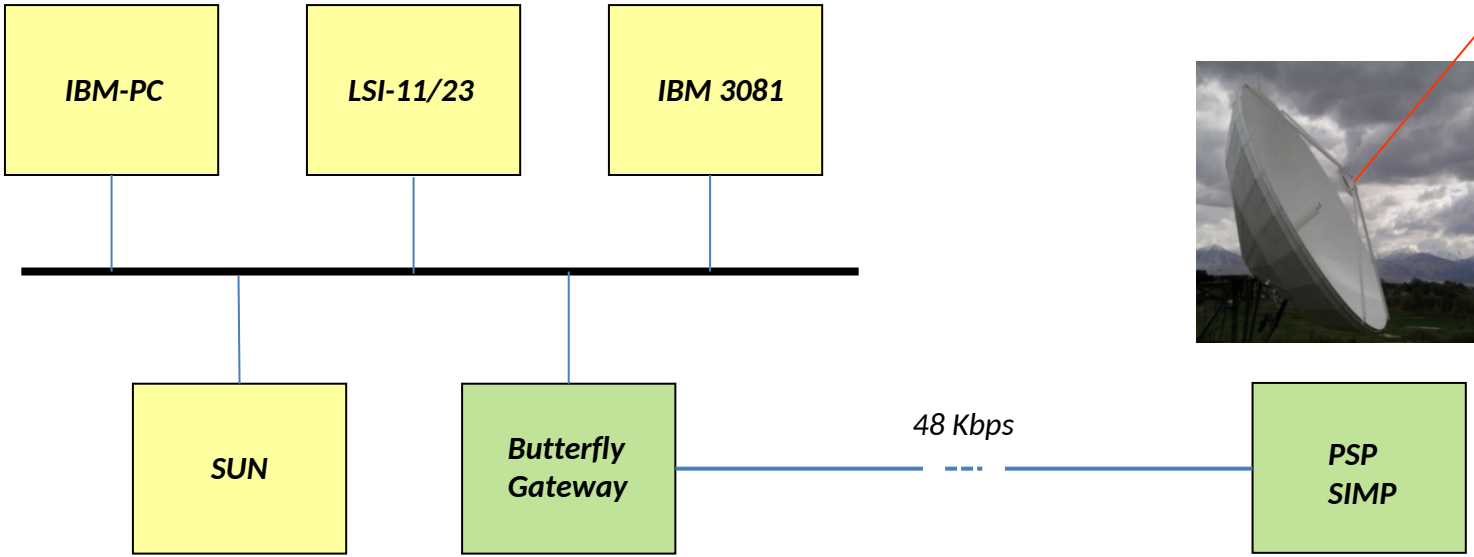


Collegamento USA-Europa via Satellite

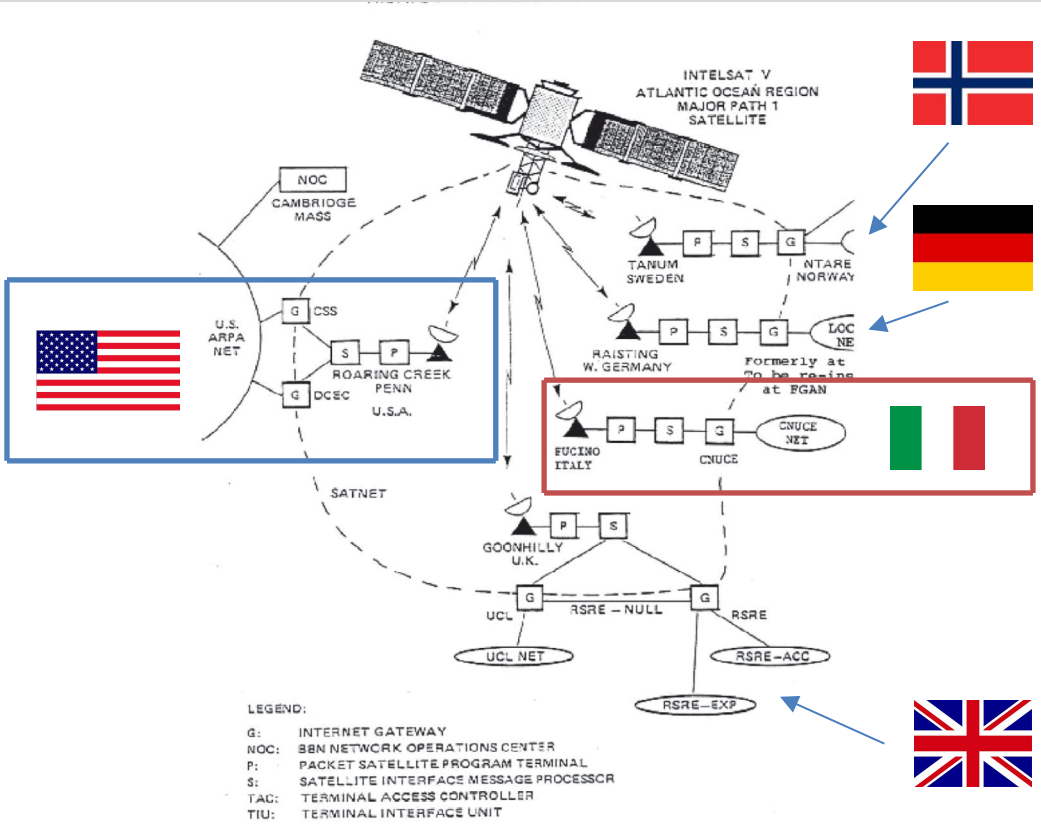


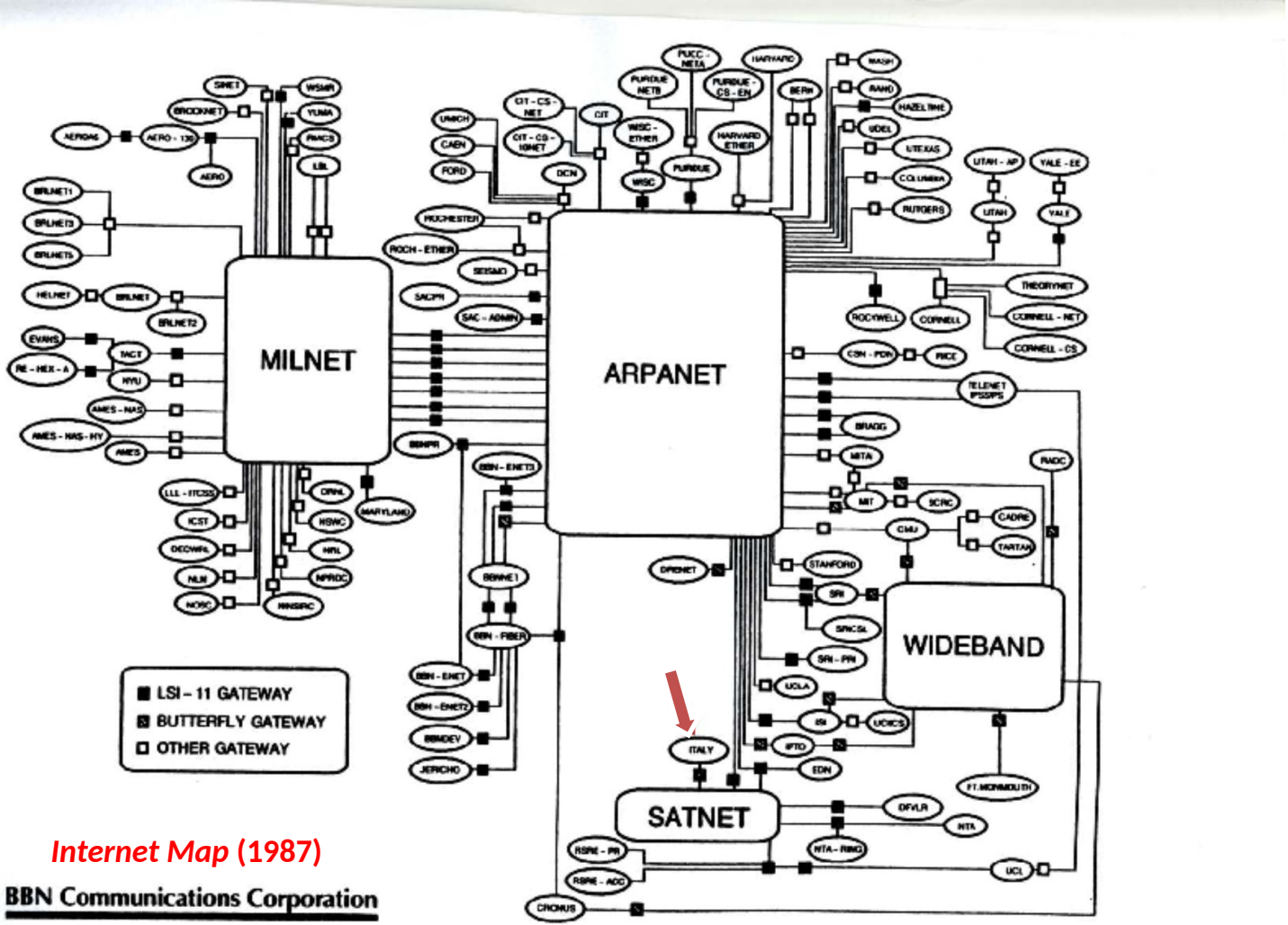
Internet al CNUCE nel 1986

Il primo pacchetto italiano di Internet attraversa l'oceano Atlantico il 30 Aprile 1986!



I Nodi SATNET di Internet (1986)



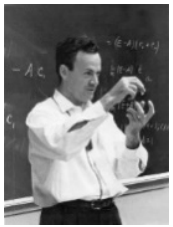

MILNET
ARPANET
WIDEBAND
SATNET
LSI – 11 GATEWAY
BUTTERFLY GATEWAY
OTHER GATEWAY
Internet Map (1987)
BBN Communications Corporation

Computazione e Meccanica Quantistica

- L’idea di basare il calcolo sui principi della meccanica quantistica è stata concepita da:

1979
Paul Benioff

1980
Yuri Manin



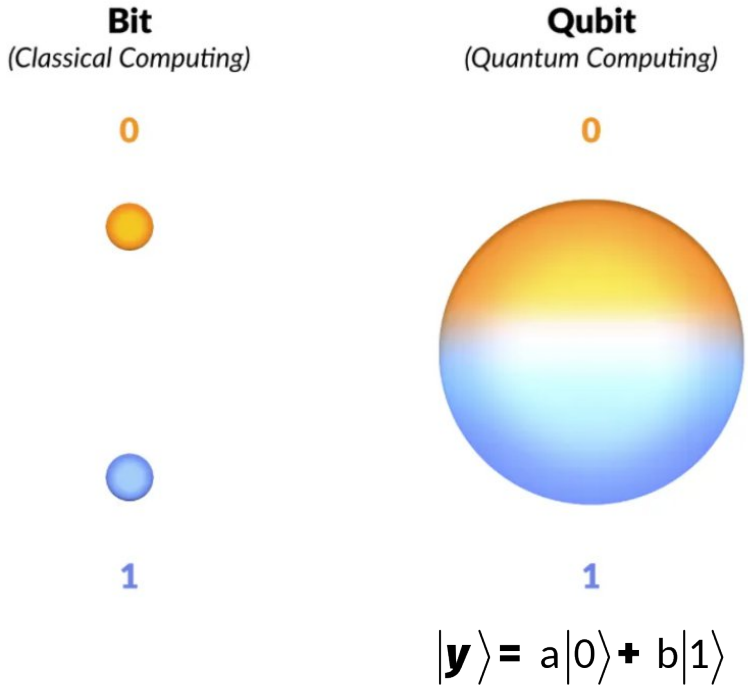
1982
Richard Feynman

Un Nuovo Paradigma Computazionale

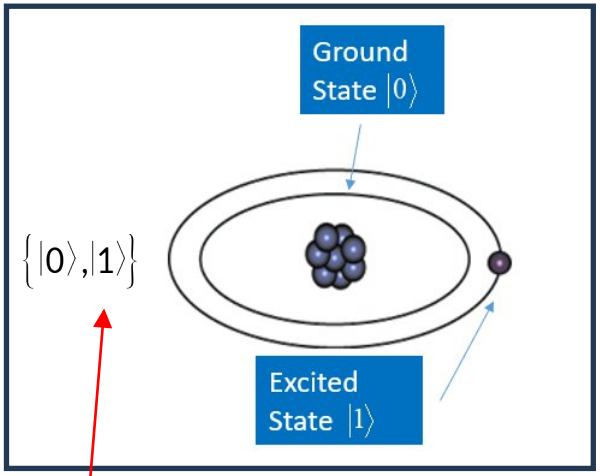
Questi studiosi hanno gettato le basi della **informatica quantistica** (*quantum computing*)

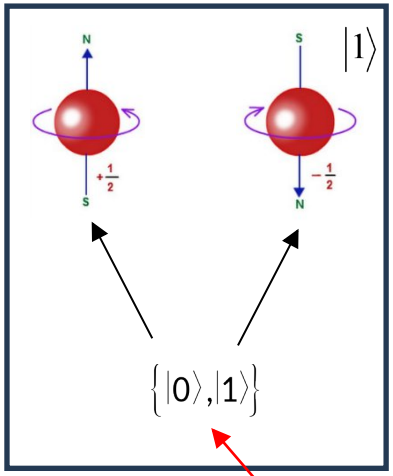
- Il calcolo quantistico sfrutta i principi della meccanica quantistica
- Il paradigma computazionale è radicalmente diverso da quello classico
- Alcuni problemi possono essere risolti molto più efficientemente

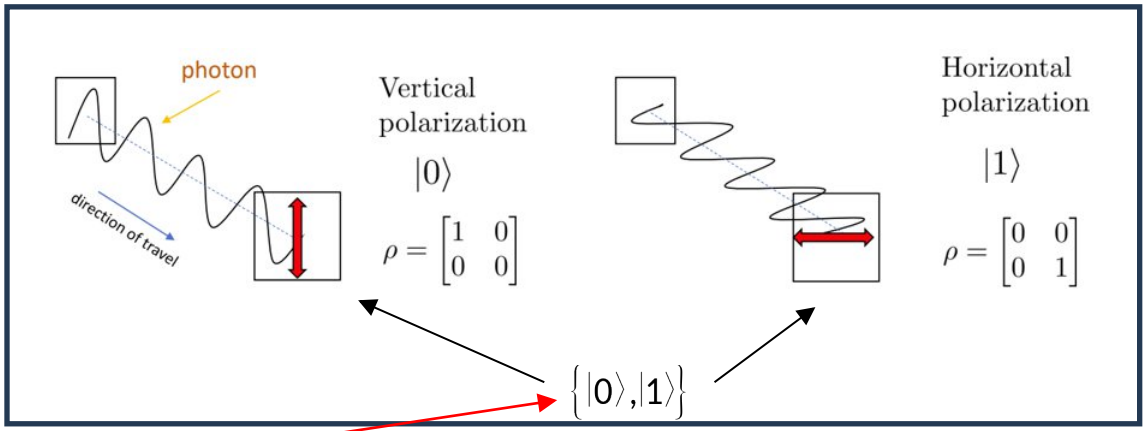
Il Qubit


Bit
(Classical Computing)
0
1
Qubit
(Quantum Computing)
0
1
$|y\rangle = a|0\rangle + b|1\rangle$

Qubit Technologies







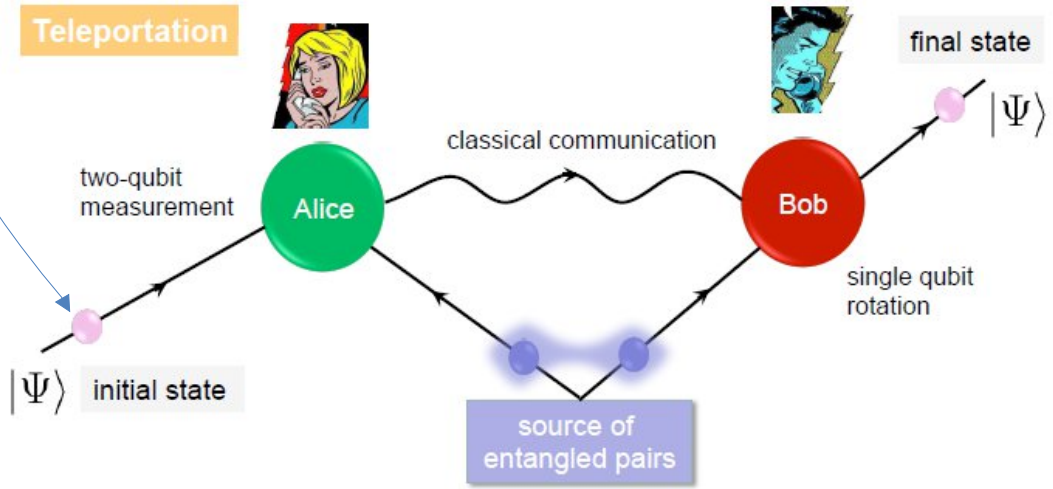
Computational Basis or *Standard Basis*

Why the Internet Must Be Rethought

- The classical Internet relies on the **packet-based store-and-forward paradigm**
- In this model, data packets can be:
  - copied
  - inspected
  - stored for extended periods
- Quantum mechanics **breaks these assumptions**, and thus **t**he store-and-forward paradigm **no longer applies**
- Thus, **quantum problems** require **quantum solutions**, and indeed there are **clever ways** that **address these issues**

Quantum Teleportation

Teleportation refers to an operation in which the quantum **state** of a qubit (confined single electron or photon) dissolves **here** and reappears **there**, on a different qubit (electron or photon)



Teleportation è il pilastro su cui poggia il Quantum Internet

From Impossible to Obvious

“New ideas pass through three periods:

- *It can’t be done.*
- *It probably can be done, but it’s not worth doing.*
- *I knew it was a good idea all along!”*

Arthur C. Clark

Grazie!

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