The Radio Network of the University of Bologna

Bologna

Forlì

Ravenna

Bertinoro

Calderaro

Cesena

Rimini skyscraper

M.Maggio

Rimini

bit rate of the links

34 Mbit/s ATM

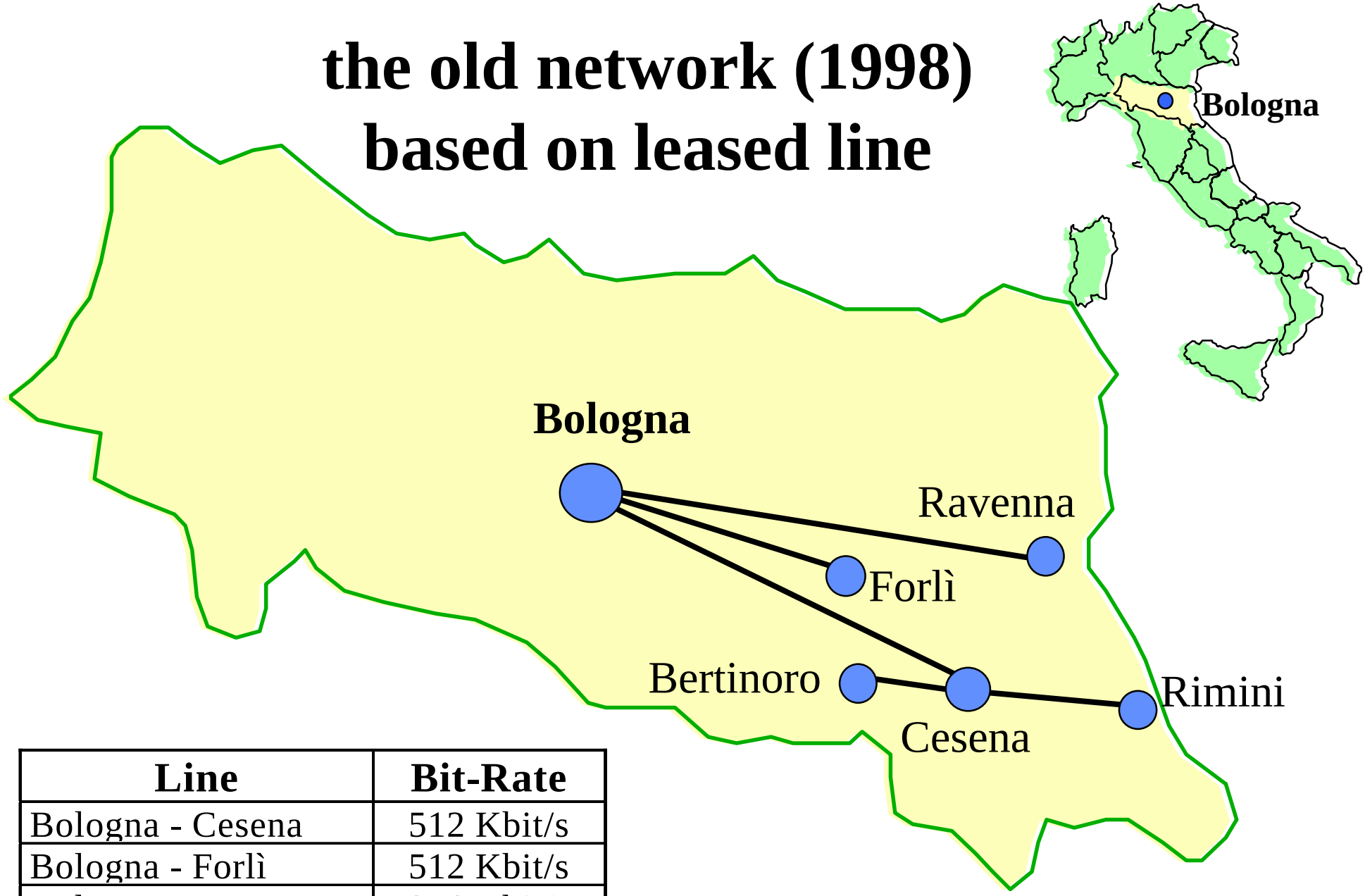
4 Mbit/s

2 Mbit/s

University Site

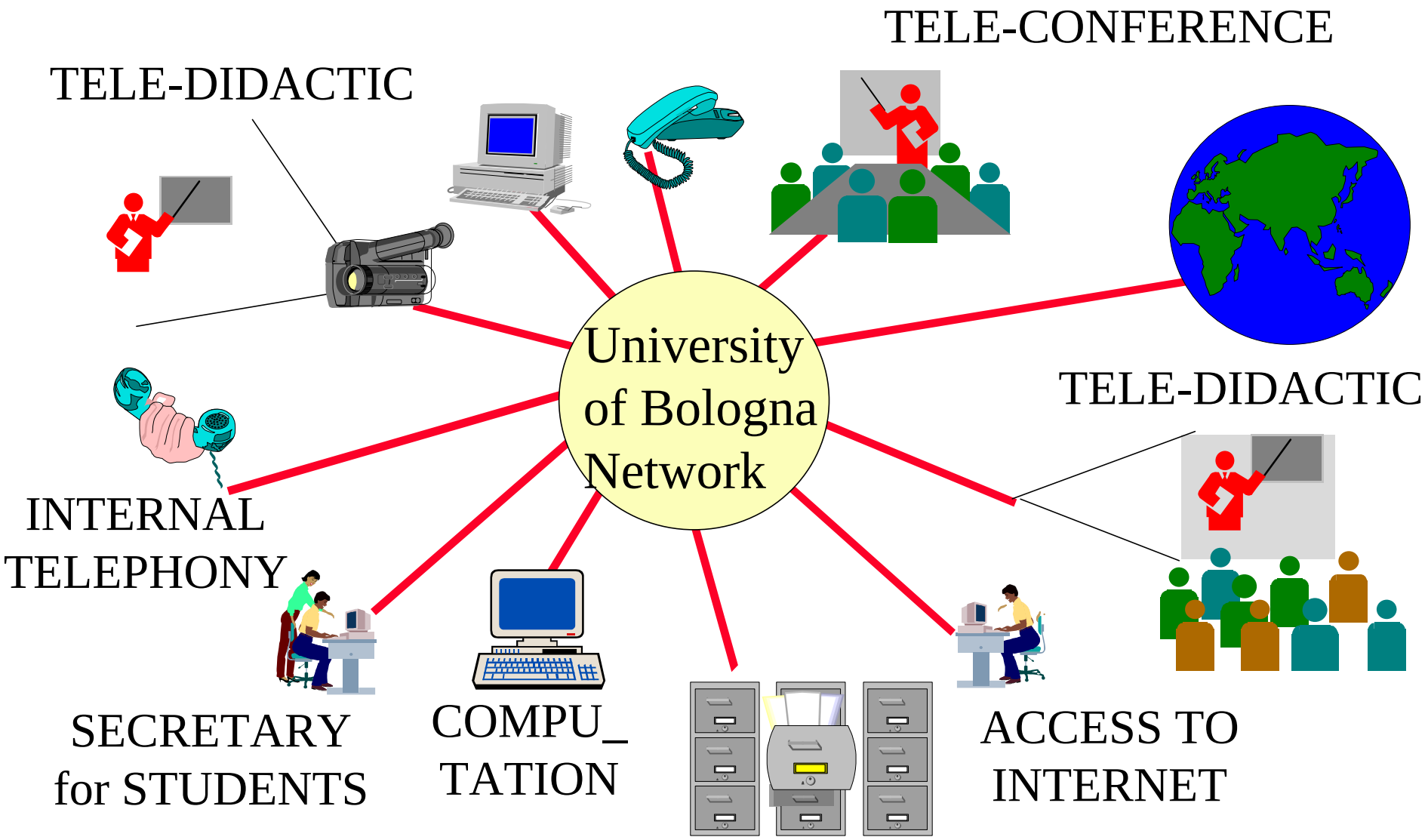
Radio Repeater

the old network (1998) based on leased line

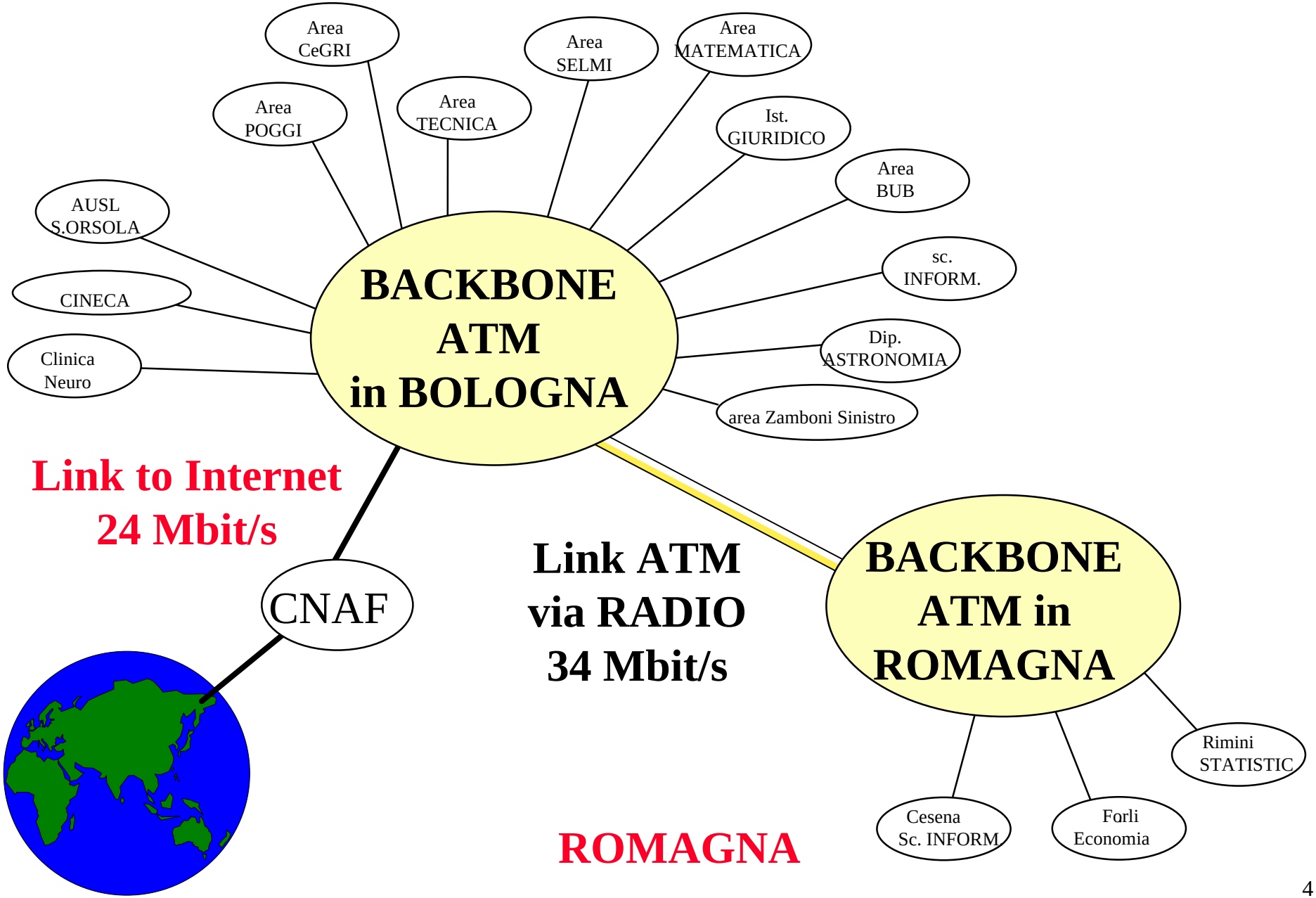


Line	Bit-Rate
Bologna - Cesena	512 Kbit/s
Bologna - Forlì	512 Kbit/s
Bologna - Ravenna	256 Kbit/s
Cesena – Rimini	256 Kbit/s
Cesena - Bertinoro	64 Kbit/s

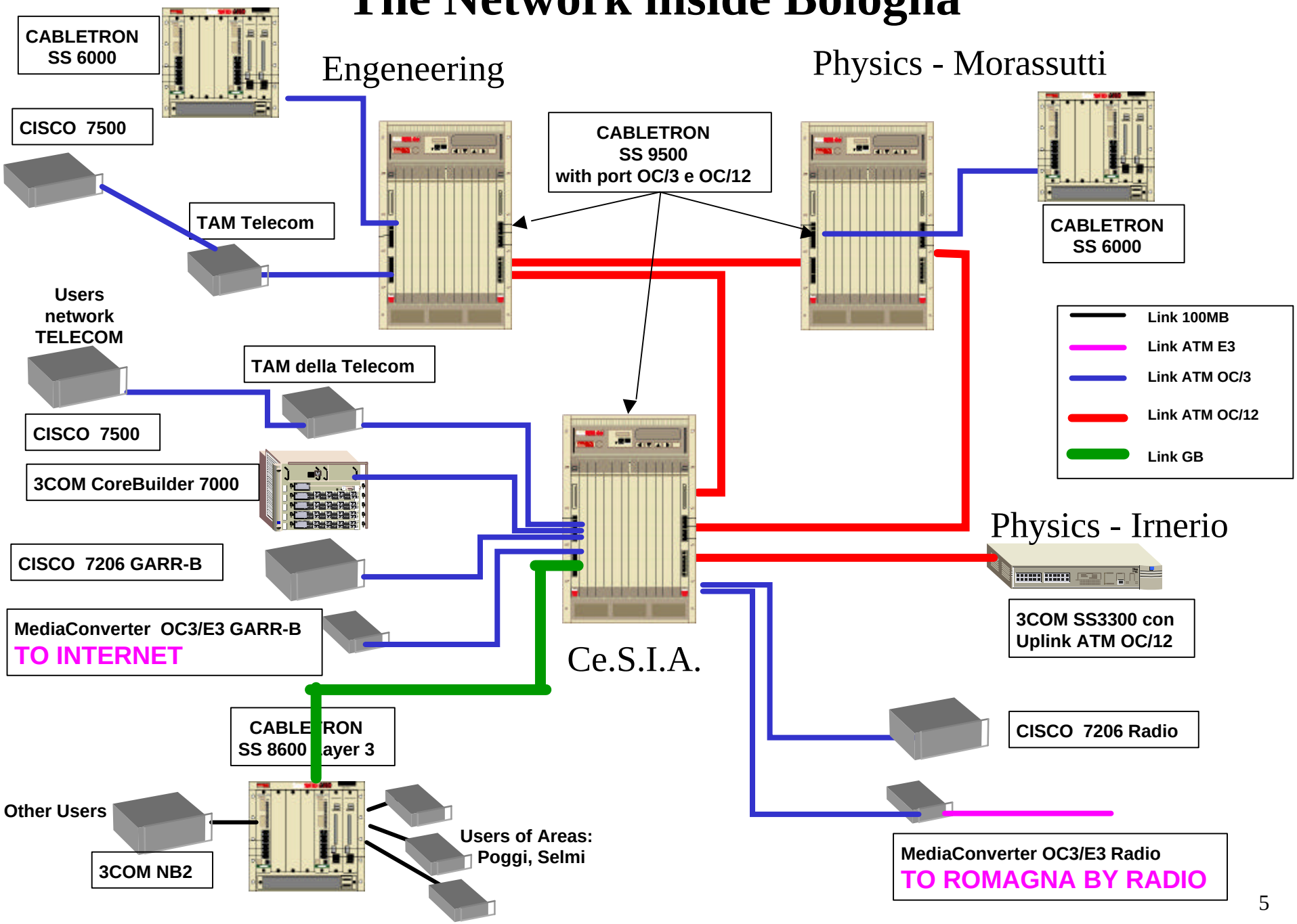
The Services for the University Network Users



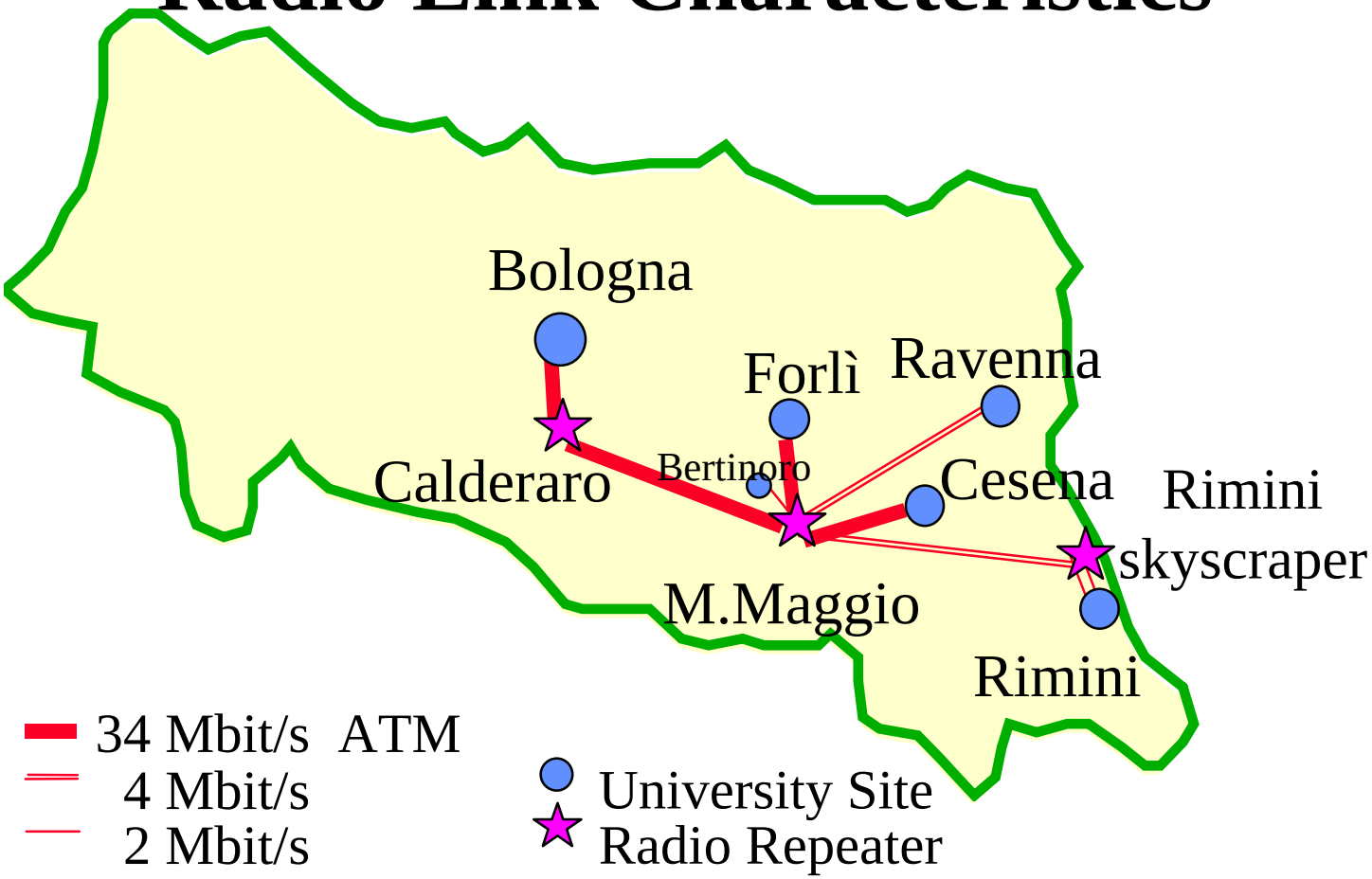
The Architecture of the Network



The Network inside Bologna



Radio Link Characteristics



Link	bit rate (Mbit/s)	Distance (km)	Frequency (GHz)
Bologna - Calderaro	34	19	8
Calderaro - M. Maggio	34	57	8
M. Maggio - Cesena	34	8	14
M. Maggio - Forlì	34	11	14
M. Maggio - Ravenna	4	31	2.3
M.Maggio-Rimini Skyscraper	4	36	2.3
Rimini Skyscraper - Rimini	4	1	38
M.Maggio - Bertinoro	2	1	17

Italian Regulations for Digital Radio Communication

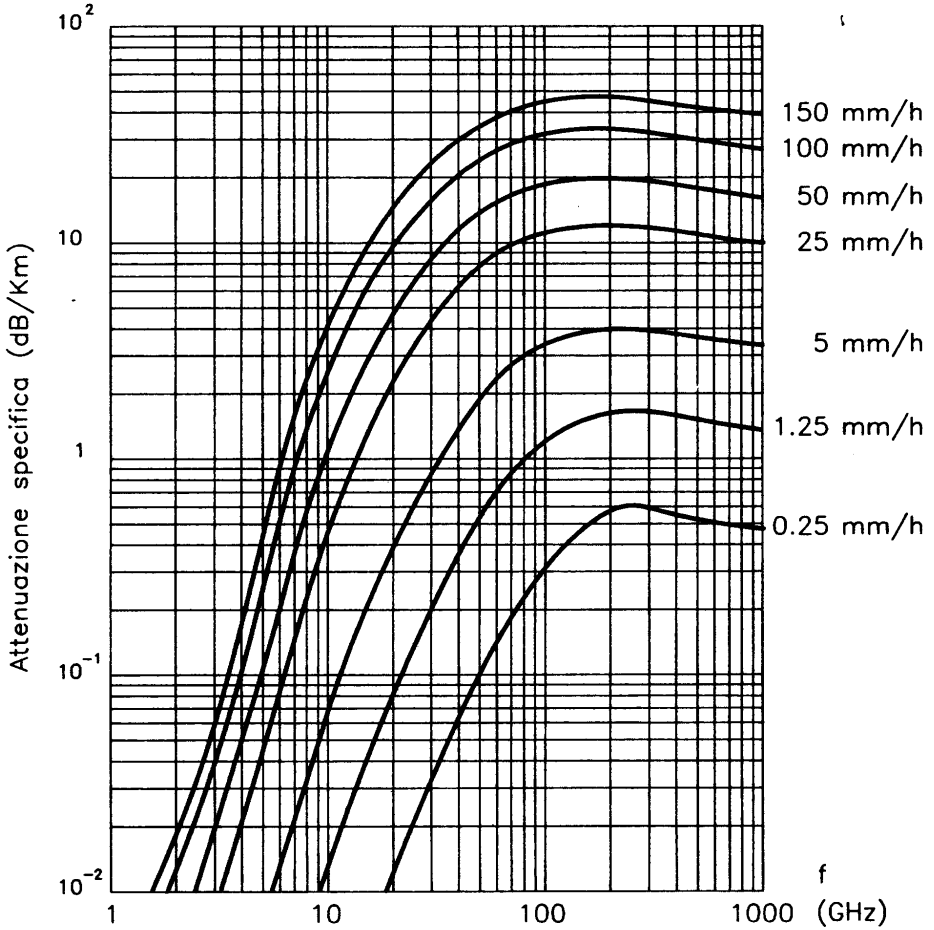
Frequence	Owner	bit/rate
2.3 - 2.44 GHz	Ministry of Communication	2 or 2 x 2 Mbit/s
7.75 - 8.5 GHz	Ministry of Defense	34 Mbit/s
14.25 - 14.5 GHz	Min. of Comm.	34 Mbit/s
17.3 - 17.7 GHz	Min. of Comm.	8 or 4x2 Mbit/s
37.0 - 38.5 GHz	Min. of Comm.	34 Mbit/s

The Choice of the Transmission Frequencies: Criteria

- **Length of the radio link**,
  due to signal attenuation in the link and rain
- **Bandwidth requested**,
- **Regulations of the Communication Autority**,
  In Italy, the Ministry of communication regulates the use of radio transmission and, in particular, bandwidth and radio signal modulation.
- **Antennas diameter and support structures**,
  due to weight and wing.

Signal Attenuation due to Rain

(depending on trasmission frequency and rain intensity)



very high attenuation for frequencies greather than 10 GHz, sometimes, unavailability of the link

Length of the Radio Link

- **Frequency greater than 10 GHz**,
  - the rain attenuates to much the signal
  - radio link must be shorter than 15 km

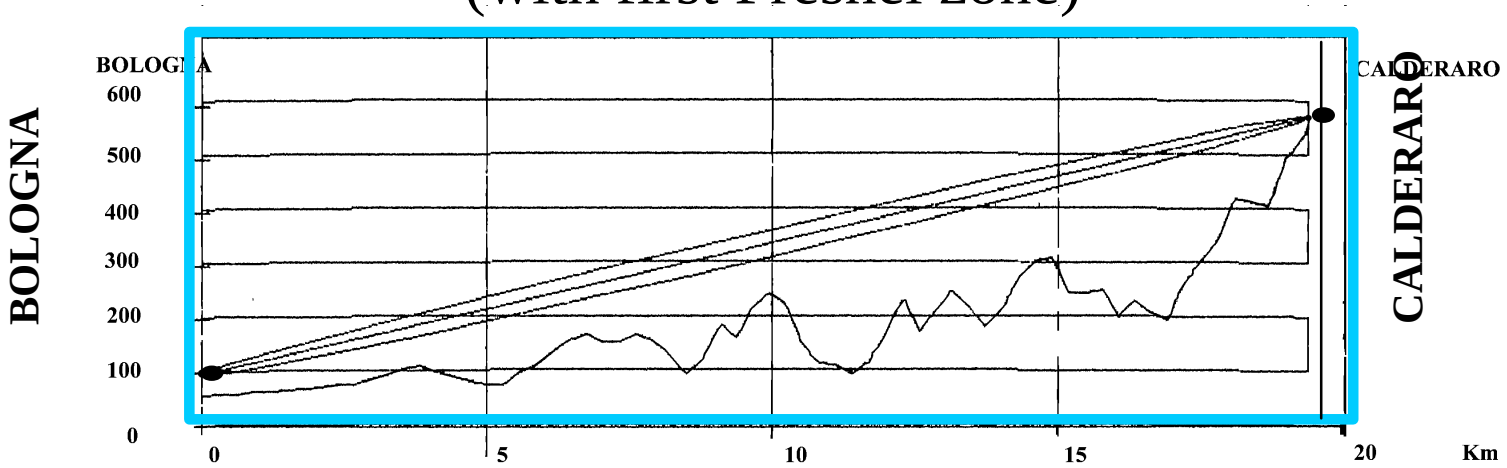
- **Frequency smaller than 10 GHz**,
  - radio link up to 60 km
  - sometimes problems due to “multipath”
  - space diversity may be used

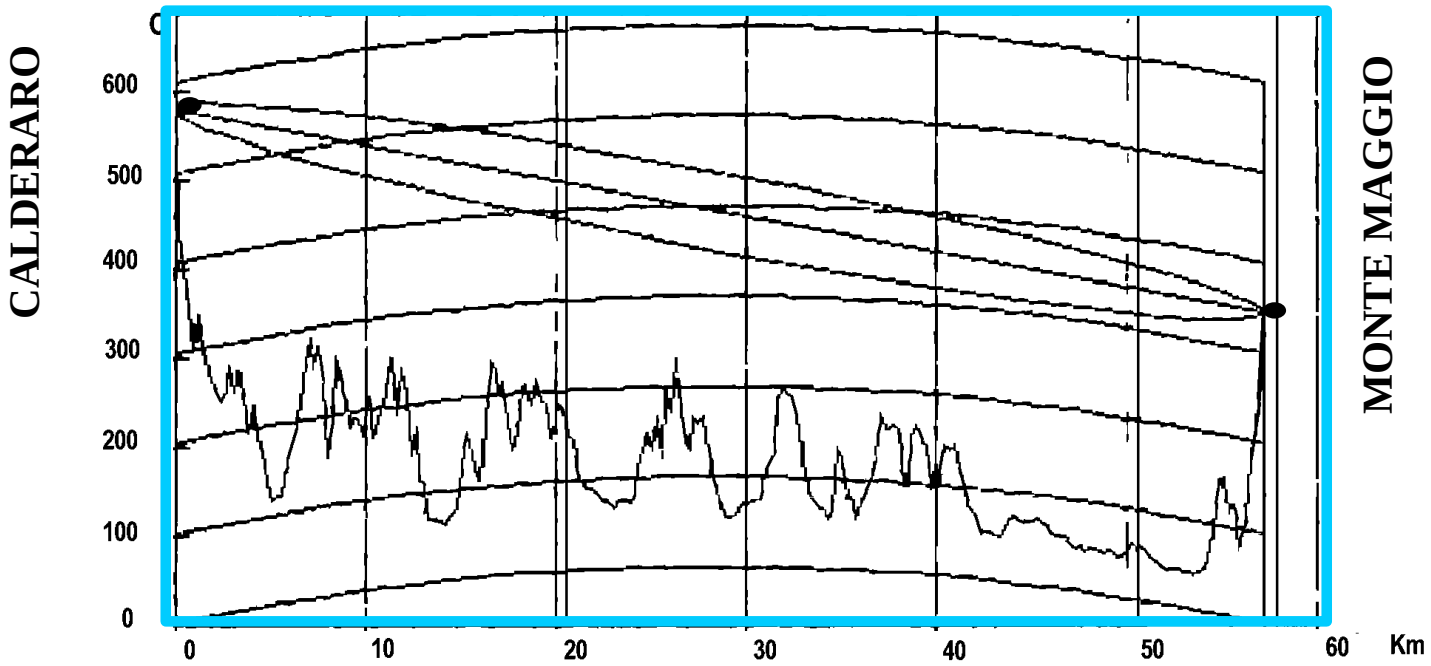
The Specola Tower.

The start point of the Radio network in Bologna.

The Outline of the Radio Links of the Backbone

(with first Fresnel zone)





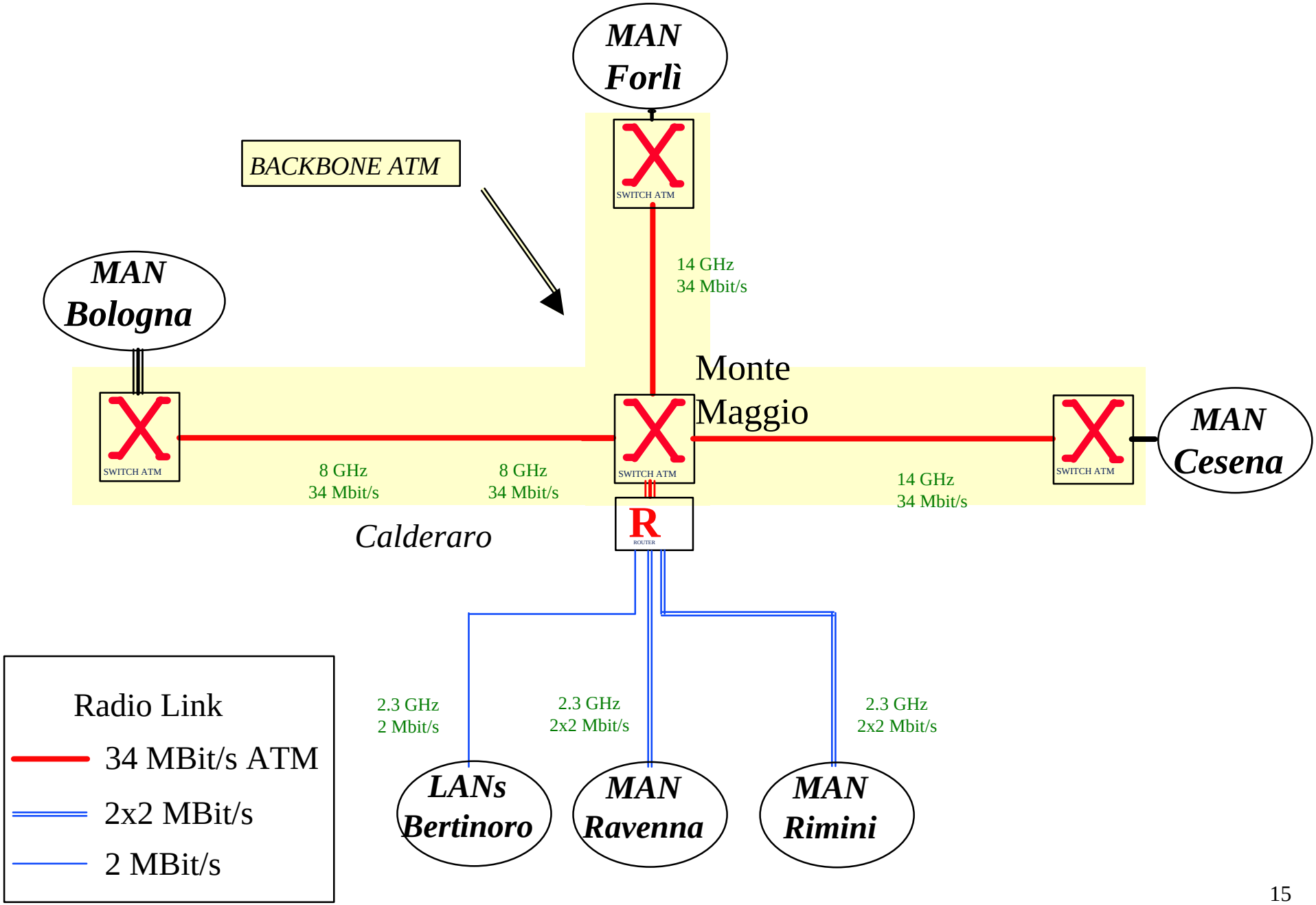
The Trellis at Monte Maggio

The 3 metre Antenna at Monte Maggio

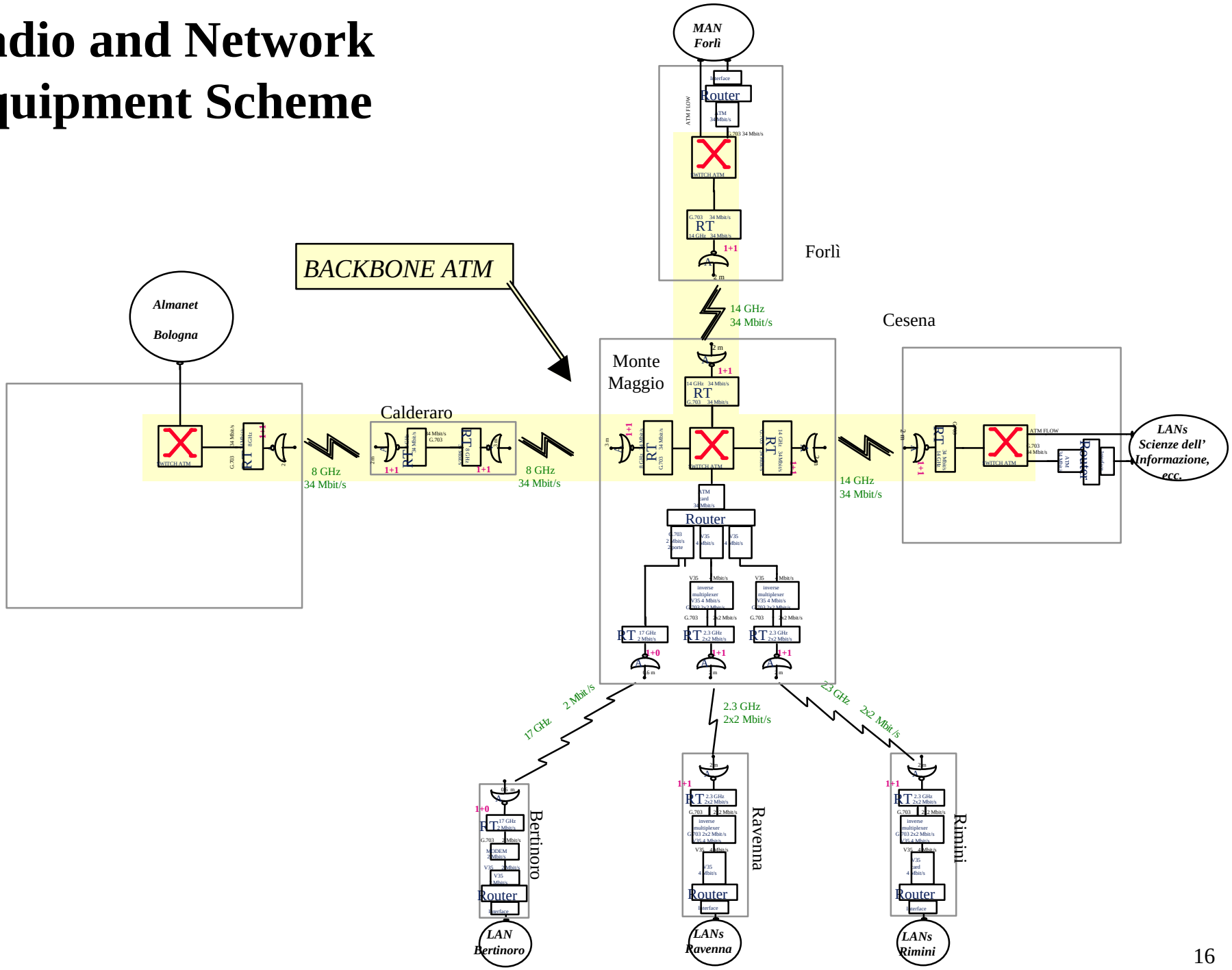
view from the ground

lateral view

The Backbone ATM over Radio Link



Radio and Network Equipment Scheme

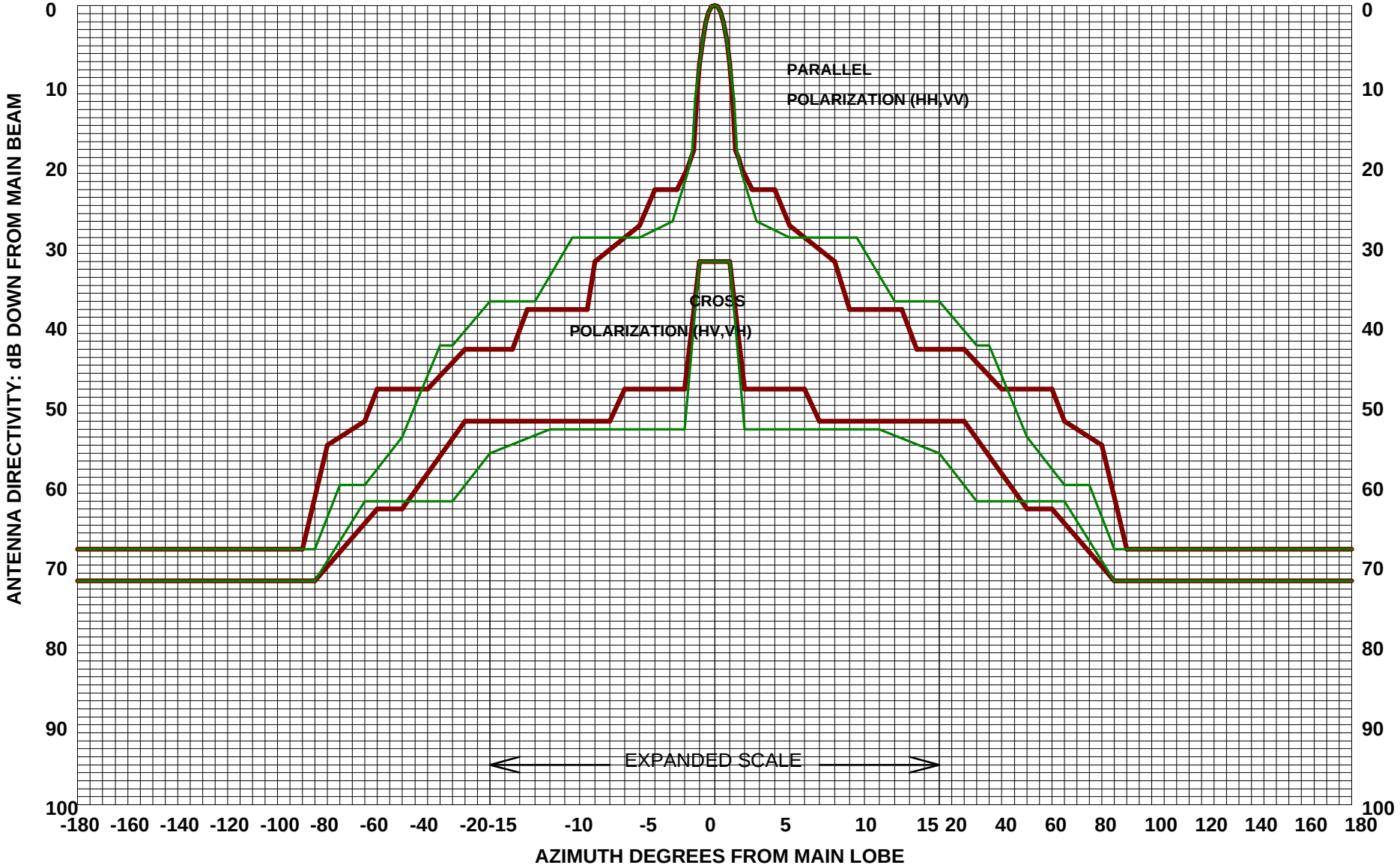


Radiation Pattern Envelope

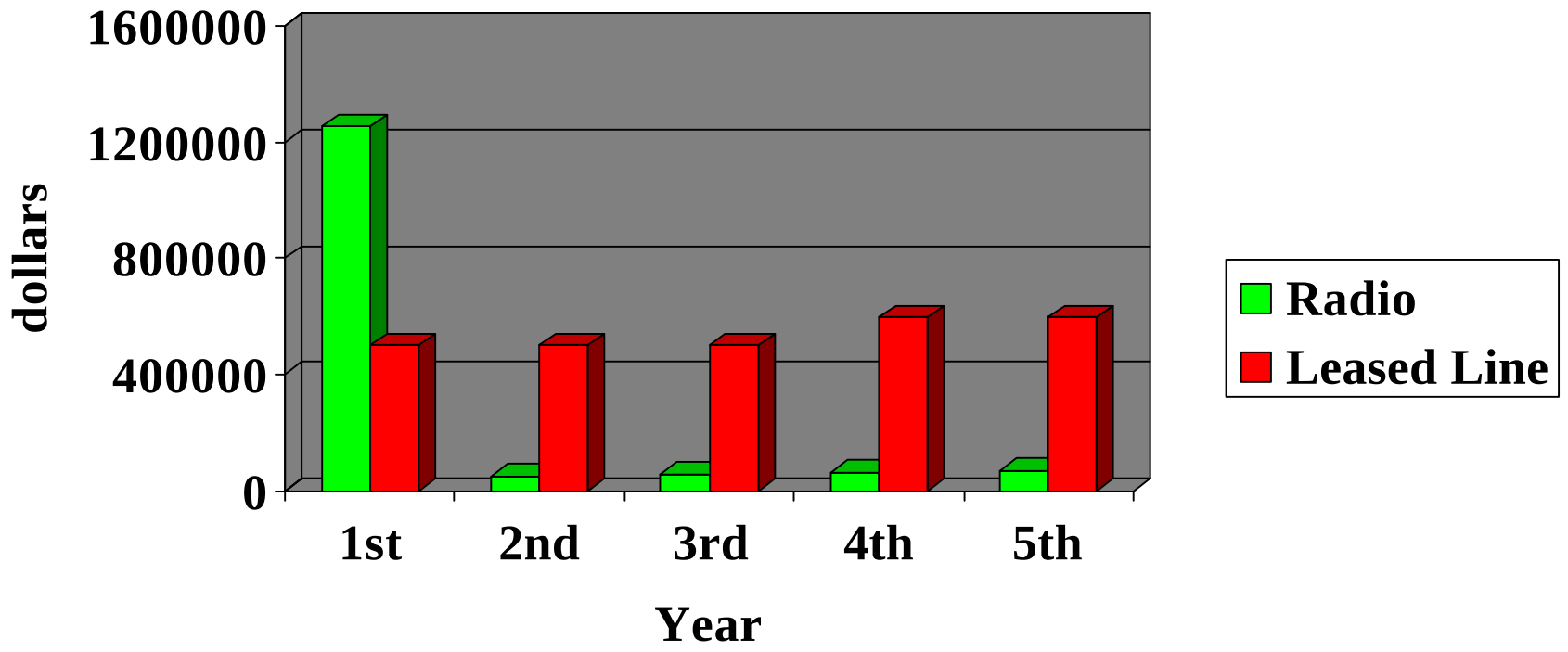
Antenna Type Number **VHP4-142**
4 (1.2) ft(m) Antenna 14250-15350 MHZ
Gain: 42.50 dBi at Midband **Single Polarized**
Envelope for a Horizontally Polarized Antenna (HH,HV)
Envelope for a Vertically Polarized Antenna (VV,VH)
For further information ask for Andrew Bulletin 1032, 'Radiation Pattern Envelopes'.

ANDREW

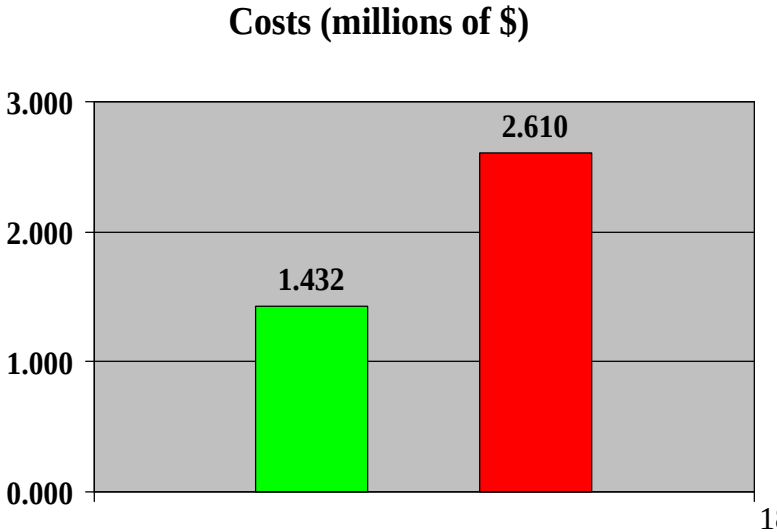
RPE Number 4180
Date 2- 6-95



Cost for 5 Years



Costs ($)	
Radio Network	Leased Line
1 432 598	**2 610 285**



Main Positive Characteristics (a)

- **Fault Tollerant system,** by introducing redundancy in radio transmitter (1+1 isofrequency) and power supplier.

- **Unavailability of the Radio transport**, due to meteorological events, **only 8 minutes for each year**.

- **Increasing of the available Bandwidth** (34 Mbit/s) between Bologna and Romagna, about 20 times.

- **Decreasing of the Transmission Time**. For example, using the “ping” program between Cesena and Bologna, from 60-100 msec to 5-10 msec.

Main Positive Characteristics (b)

- **Dinamic management of the available Bandwidth (ATM)**

- **Support for Quality of Service (QoS)**, in particular the network may provide services with guaranties for:
  - transmission with constant bit rate
  - delay into a fixed range

  or
  - best effort service

- **Configuration of Virtual LANs, for advanced management.**

- **Use of the Radio Network for implementing Telephony.**

- **Support for Teleconference and Teledidactics.**