¿Hay un futuro para las Telecomunicaciones?”

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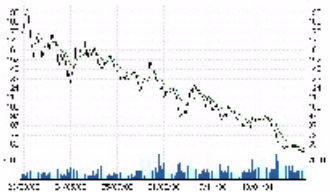
Is there a future for Telecommunications?

- **Today's Situation**
- **A possible Future**
- **Challenges ahead**

Birds of a Feather



TELCOS

MOBILE OPER.

INTERNET COMPANIES

MANUFACTURERS

FUTURE CENTRE TODAY'S SITUATION TELECOM LAB ITALIA

If ΔE/ΔR[1] is much higher than 1 over a 2-3 years time it means the company has no long-term strategy. The increase in earnings is obtained by slashing cost, by being more efficient. There is nothing wrong with that; it is just that you cannot keep decreasing cost over a certain limit (0 is the absolute limit!). If, in spite of slashing cost, you are not managing to increase your revenues it means that your market has reached a maximum penetration. It is even worse. History shows that high earnings deriving from cost compression and higher efficiencies are bound to be squeezed by lower prices, i.e. your efficiency is soon turned into an advantage for the clients, not for you.

This is important because it is one of the issues pending on e-business (and e-business companies).

If, on the other hand, ΔE/ΔR is much lower than 1 it means that the company has the wrong strategy. The increase in revenues does not generate any parallel increase in margin, i.e. you are investing money but are not making any money. This is a crucial aspect for Internet companies. Amazon has consistently increased their revenues but has not been able to generate earnings.

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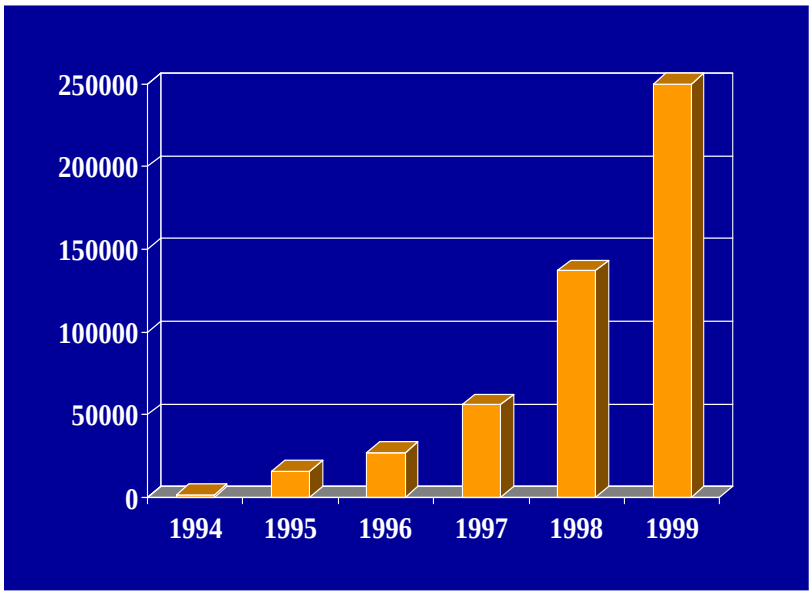
[1] ΔE/ΔR indicates the ratio between the growth in earnings (ΔE) and the growth of revenues (ΔR) over a certain period of time. In the Internet business one may assume a period of 2 years. Longer periods of time are not sustainable because of the fast pace of market and technology evolution.

Promises, Promises



TODAY'S SITUATION

During those years we had a lot of data available: the problem was that we looked only to those that were "cool". Indeed, newspapers and televisions thought Internet e-commerce as the epitome for a bright and wealthy future. In 1994 the Internet was mentioned 1833 times by USA newspapers. In 1995 the word Internet appeared 15,940 times, over 27,000 in 1996, over 250,000 times in 1999[1].

In the couple of years 99-00 we saw a remarkable growth of e-commerce in terms of variety of goods sold, in terms of $ spent for buying those goods. What was also growing, possibly at a higher rate, was the number of companies selling goods and the expenses being made to set up e-warehouses. What weren't growing were … the revenues.

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What did not Work…

- The myth of Replacement

TODAY'S SITUATION

In those glorious heyday of misplaced trust and unreasonable hopes the leading idea was that "technology" (internet, network, software) was so nice that it self explained the expectations.

However seldom, if ever, technology is the reason for market success. You need technology as an enabler but overestimating technology is always a big mistake in the short term. Similarly it is always a big mistake to underestimate technology in the long run.

Internet companies, by large, made the first type of mistake and they managed –thanks to the press- to take on board the large public.

Telecom companies made the second mistake underestimating the impact of technology on their networks[1].

The first mistake was both about a misconception of the time it takes to a new technology to succeed, and the belief that such a technology would quite simply move all markets to the Internet. Buyers will become e-buyers and only those companies that would e-sell would prosper[2].

Examples abounds: the advent of television created a forecast for the disappearance of the radio, the birth of the PC was saluted as the end of the television, the advent of the internet was taken to herald the disappearance of newspapers[3]. Indeed a new technology once it establishes itself (and that takes time) introduces new opportunities and may change some rules.

That goes for the new players and for the existing ones who can usually find a way to leverage their assets even better with the new technology.

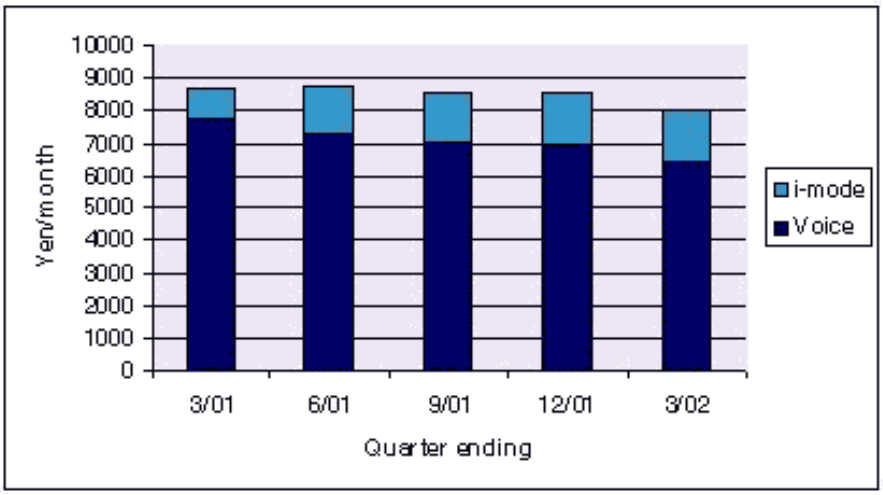
As a result we have seen a coexistence of old business with new ones.

[1] This "mistake" would require a bit of discussion and this paper is not the appropriate place for that.

[2] Intel's CEO declared in 1999 that by 2005 we would no longer be

What did not Work…

- Revenue Ceiling - Revenue Squeeze



DoCoMo ARPU

What did not Work…

- Demand vs Offer

10 TB!

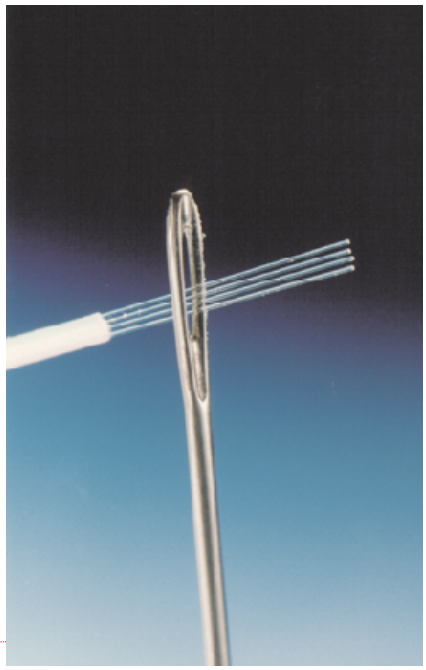
TODAY'S SITUATION

10 TB is the estimated memory storage that each of us will have in the year 2010.

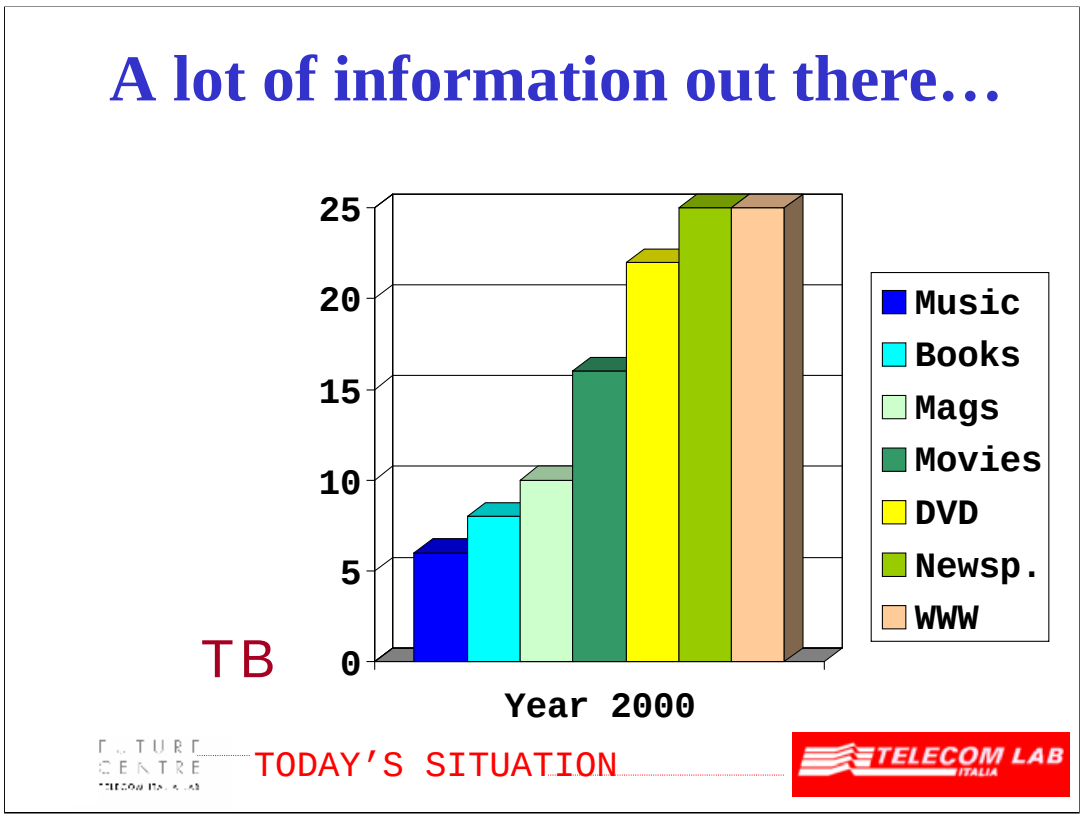
What did not Work…

- Demand vs Offer

0.00006 Erlang



TODAY'S SITUATION



Now, with all this connectivity available we are set to reach information. And information is abundant!

According to a study published by the University of Berkeley at the end of year 2000 in that year the world production of information was staggering. Actually the forecast for the coming years is showing an increase in information production to the point that they estimate in the next three years more information will be produced than in the whole history of humankind.

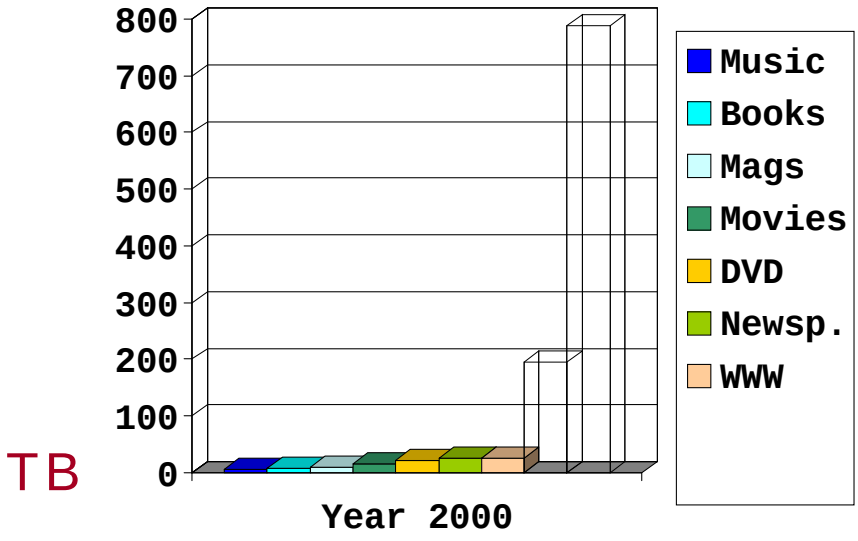
If we look at the amount of information split into categories and represented in graph 1 we are not too much surprised. The information is measured in Terabytes (billion of bytes) where 1 Terabyte is about the volume of space needed to store all the radiographs in a major hospital.

So, looking at the graph we see, as expected, that the WWW is playing star. Actually the fact that information is mostly on the web is a self realizing prophecy: since we believe that then whatever we produce we want to have it on the web where we assume it will be most visible.

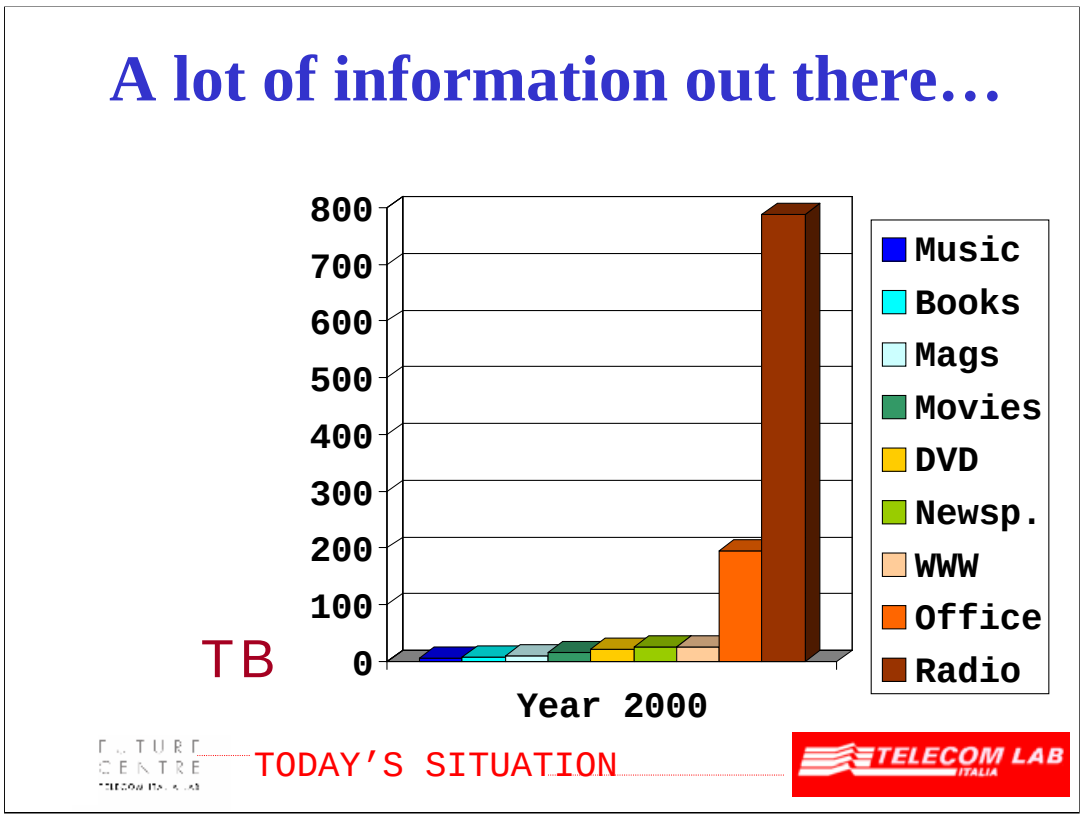
"If it is not on the web it does not exist" it is the new mantra of techies and, unfortunately it risks to become true.

However the Berkely study goes further, and gets more interesting. Let's change scale and look at graph 2.

A lot of information out there…



TODAY'S SITUATION

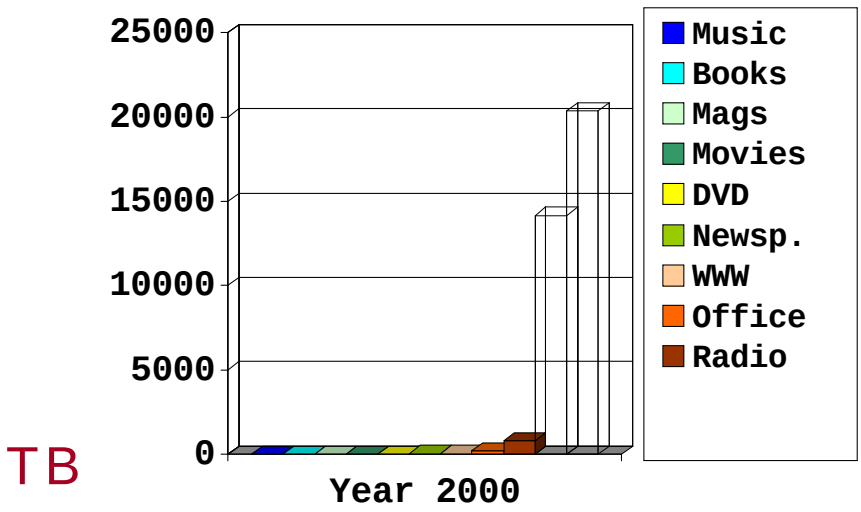


By changing the scale the amount of information in the categories just seen appears much less impressive. If we compare that to the quantity of information produced in the various offices then we start to understand why somebody has started to say the www is just the tip of the iceberg, most information are behind enterprises'data base. This is what is called as the deep web. It is still a web because information is most likely to be stored in html and may potentially be accessed via IP if permission is granted.

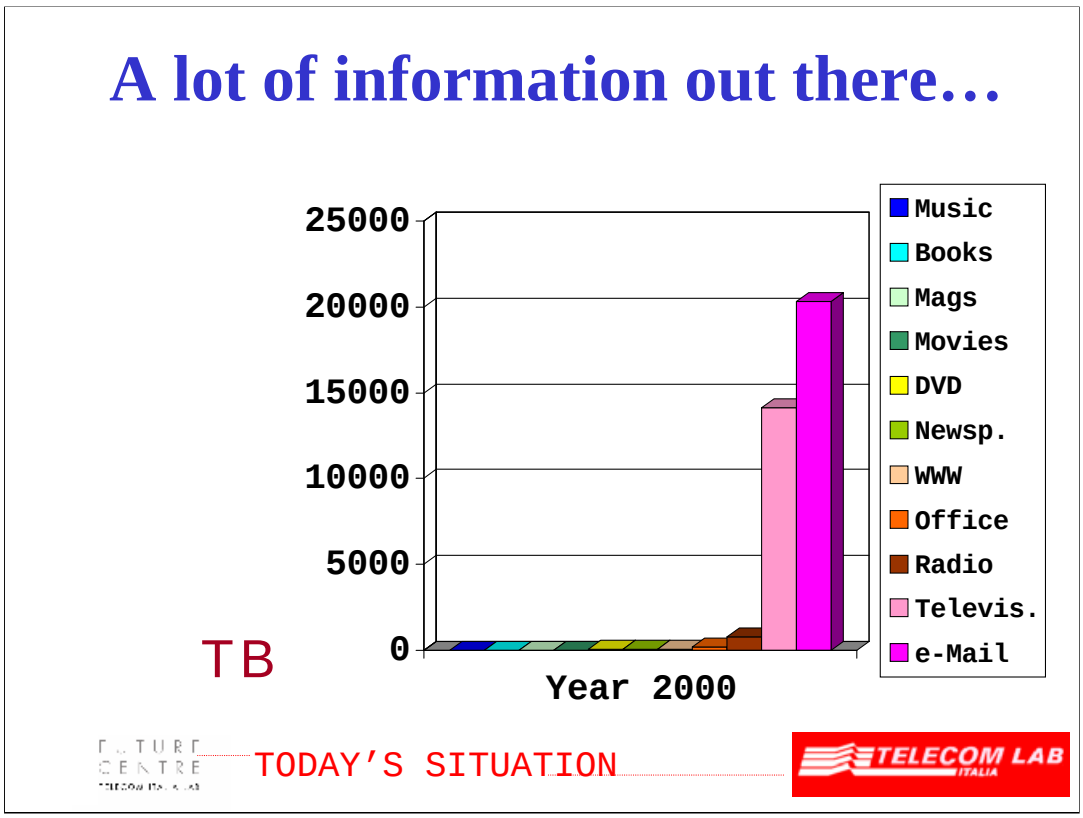
However radio information is much more. Clearly here we are confronting with the fact the the efficiency of bit representation is much higher for textual information than it is for radio information.

Let's change our scale once more.

A lot of information out there…



TODAY'S SITUATION



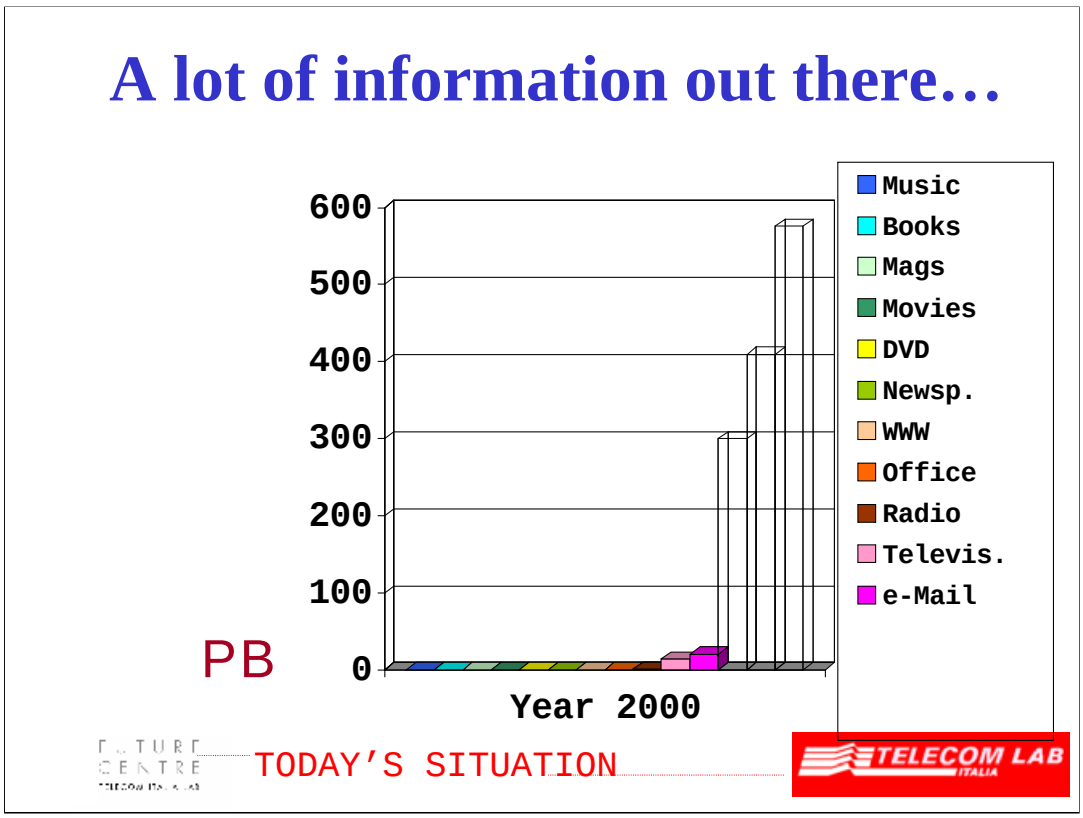
Television related information is much more than radio, again a side effect of the information code efficiency. Actually that is not exactly true. The information conveyed by a spoken voice, the one where voice is supplemented by images as in television, and that conveyed by a text have different expression value and hence in reality represent a different quantity of information from our point of view.

As an example by listening to the radio (or any spoken voice) we can tell the feelings of the speaker, we can get more emotionally involved, we can read between the lines much better. Watching television and hearing at the same time may convey information immediately, much more effectively than several pages of text. Seeing a man hanging from a crumbling bridge and hearing him calling for help is something that can be understood in a flash. To us this is narrowband information (in the sense that it takes very little time to process it).

This is no idle discussion, on the contrary it is one of the central concept of this paper. What is broadband for the network (or better for the technicians "selling" the network) is not necessarily broadband to us.

Broadband for me and you is related to the time it takes to read a page of text, let's say 2 minutes? Well that same page of text is considered narrowband by the network that can zip the 4kB of text in about three seconds on a cellular link. On the other hand the video image that we had processed in a blink of an eye (500 kB) would take over three minutes to go through a cellular link.

We normally value information based on our perception not on the cost it may have to convey such information on the network. This is a crucial issue that is seldom fully appreciated by technical people. Because they overcome so many hurdles to provide network broadband value it very much and believe customers will value it in the same way and therefore will be ready to pay good money for it. This is not so.

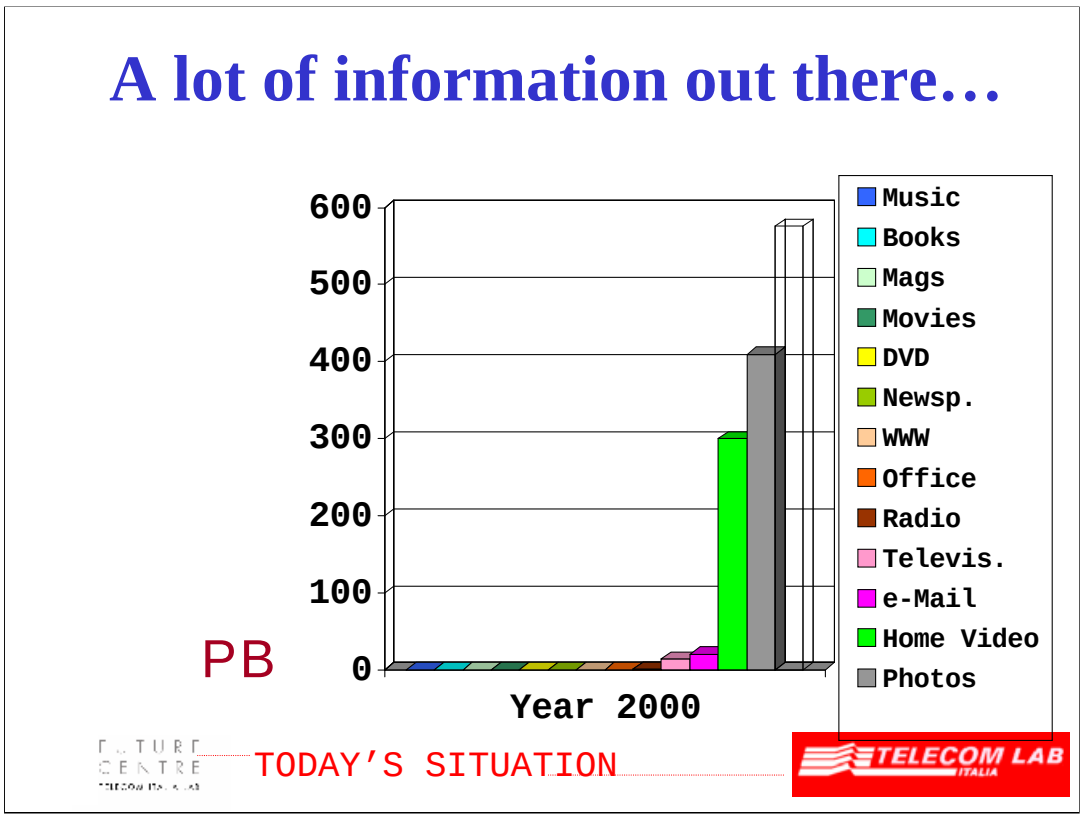


Consider the price we charge for SMS. Very little else can be as narrowband as SMS, still…One MB of SMS is charged in Europe in the range of 1000$. Not bad, from the operator viewpoint whose cost are related to the number of bytes to be transported (in first approximation). On the other hand 1 MB of cellular voice is charged in the range of 1$, 1000 times cheaper and the same 1MB of voice on the fixed network harvest about 10c. Curious about the price of 1 MB of television. Well it is more difficult to say since we enter into a domain of flat rate (even free service in some areas) but assuming the average cost of a pay television and an average use of it we are in the range of some tenth of a cent, one millionth of what it is charged for SMS! And in spite of this anyone feels to get a good bargain on SMS.

I will come back on this in a few moments.

What is surprising, I feel, from looking at graph 3 is the amount of information conveyed by e-mail. It is actually more then the one conveyed by everything else we have seen so far. Collectively speaking individuals produce more information that the one produced by the majors!

Let`s change scale one more time, 'cause we are in for some strengthening of what we have seen so far and also for some surprise.



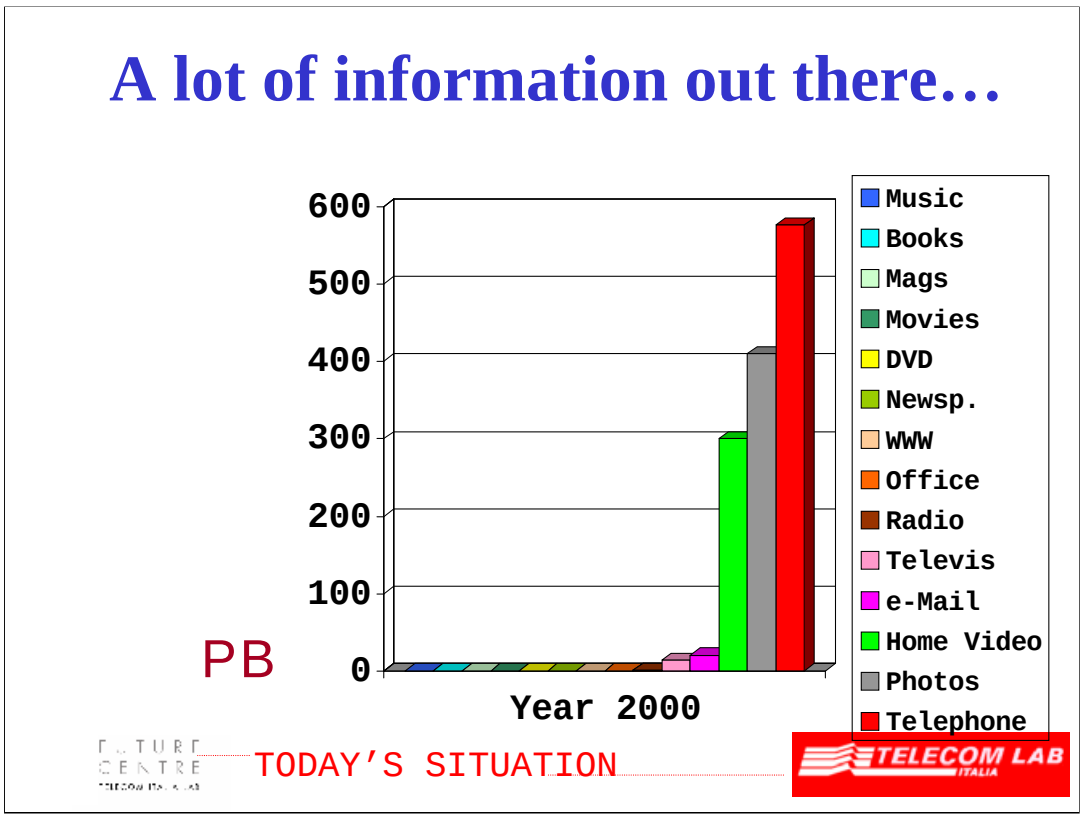
Our scale, graph 4, is now in the PetaByte range, millions of billions of bytes. All radiographs from all the hospital in the world are not sufficient to fill 1 PetaByte of memory space. But home video and photos snapped around the world in the year 2000 are, and by far. Kodak calculated that every second over 20,000 pictures are taken around the globe. That's impressive.

Again we see the contribution to information generation by individuals tops the one of industry and organization.

And the big surprise. Telephone calls, by far, represent the largest amount of information generated in the world, dwarfing most of the others.

How is it that many techies have and are declaring data have overtaken voice? That's because they are looking at it from the network point of view. Nowadays most of the network is digital and everything, voice included, is bit. But if you look at it from the user side the story is quite different.

And remember, the view from the user side is the view you need to have if you are interested in the market.



This categorization of information is telling us something more.

It tells us that most of the information produced are not accessible to everybody at any time. In general this is good (you don't want to have other people eavesdropping your conversation, won't you?) but in many cases this is not. So there is a tremendous potential from networking information, eg. wouldn't you like to have access to any television program ever produced? Not to anyone of course but to some particular one.

This brings in another issue. Today we basically don't have tools allowing us to retrieve most of this information. Retrieving pictures, movie clips, music is mostly impossible unless you label it with text, an impossible task for that amount of distributed information.

The prevalence of voice is also telling a good news to people in the wireless business. People like to talk and the cell phone is the ideal companion for establishing communications.

Also the fact that people like to shoot photos is a good news for the cellular business. You take a picture on an impulse and what is more natural than sending it over to your friend at the other side of the wireless connection. This requires a spike of broadband, a burst of data transmission for which you may be willing to pay a dollar, then you resume your slow pace (from a network point of view) conversation at 9.6 kb per second (or even less).

A potential market of 20,000 dollars a second is a good market indeed and short video clip to show grandma the smile and waving hand of the little one may be worth the 50c a second it may cost.

People are willing to spend what they feel is petty cash for momentary satisfaction and all that petty cash together means billions in revenues. Here we start to see some promises from 3rd generation wireless systems: it does not come from broadband capability but from the flexible use of bandwidth.

The network itself can evolve in different ways depending if are looking for high capacity or broadband. Before discussing this let's look at service types.

Consider:

- In this century we have seen the birth of the Nuclear Age, the Petrolchemical Age (plastic…), the Space Age, the Telecommunication Age, the Computer age, the DNA age and we are just getting the first glimpse of the Internet age and of the MEMS age.
- Our expectation for the future is: bigger, faster, cheaper. What if it is just "different?"
- We keep placing innovation into the context we are used to. The result?

  - This telephone has too many shortcomings to be seriously considered as a means of communication. The device is inherently of no value to us. Western Union internal memo, 1876

  - The United Kingdom do not need the telephone. We have plenty of young boys that can deliver messages everywhere in London. UK Prime minister in 1900.

  - The wireless music box (the radio) has no imaginable commercial value. Who would pay for a message sent to nobody in particular? Reply to David Sarnoff responding to a request for investment financing.

  - The concept is interesting and well-formed, but in order to earn better than a "C" the idea must be feasible. Yale professor response to Fred Smith's paper proposing reliable overnight delivery service. That paper formed the bases of Federal Express…

Beyond the barriers of space and…time

- Beyond the Blackboard …

A POSSIBLE FUTURE

Consider:

- How much has the school changed with respect to the rest of our society?
- What difference can make education to an area? Bangalore for example…
- Experience versus evolution, a network of knowledge
- Bring expertise where it is needed, offer services thousands of miles away
- Cluster people, foster culture evolution, emphasize difference to create value

See paper "Defeating Space and Time" excerpt from the IEEE book "The Disappearance of Telecommunications" available December '99, by Roberto Saracco et al.

Beyond the barriers of space and…time

- BEYOND THE BLACKBOARD …
- Be there, staying here

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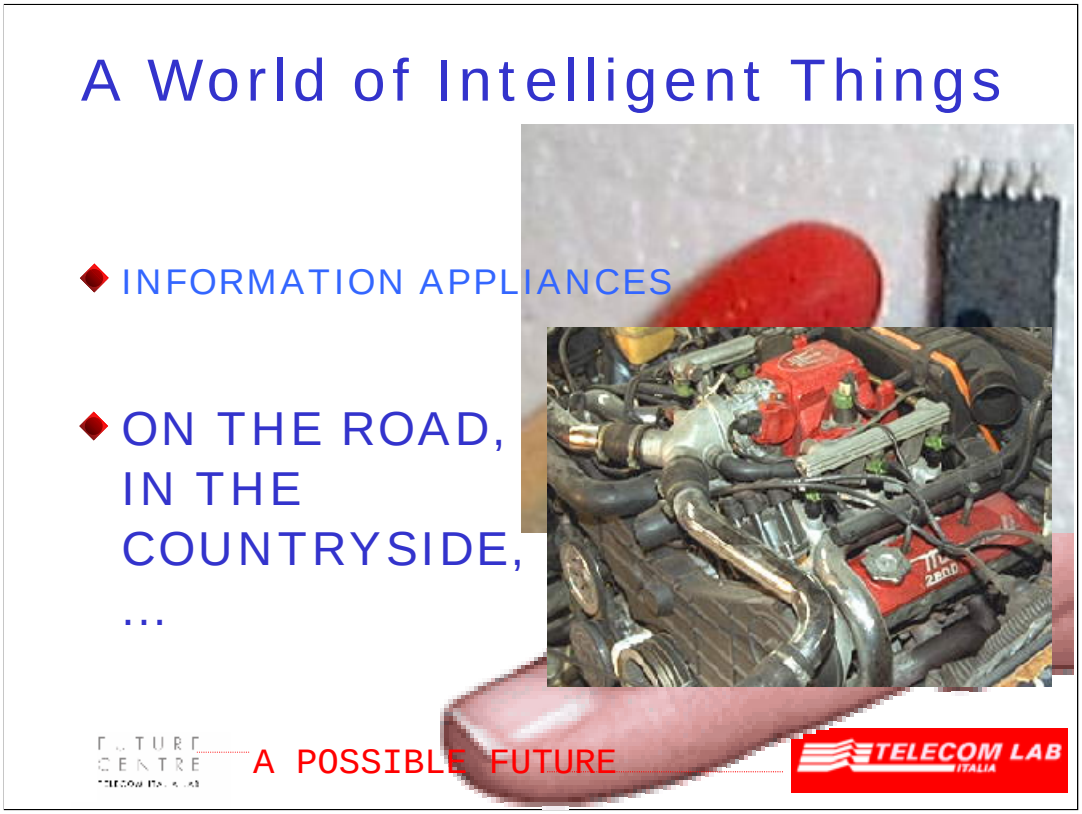
A World of Intelligent Things

- INFORMATION APPLIANCES

- A partire dal 1996 in USA si vendono più computer che televisori. Lo stesso capitain Inghilterra a partire dal 1998. Si prevede che le Information Appliances saranno più numerose dei computer a partire dal 2005 e per il 2010 vi saranno 10 appliances per ogni computer.
- La Cisco, il maggior costruttore mondiale di apparati per Internet, ha annunciato a fine luglio di partecipare alla creazione di un prototipo delle abitazioni future a Playa Vista, un quartiere di West Los Angeles. Una volta terminato il progetto, a fine 2001, gli abitanti del quartiere vivranno in ambienti domestici in cui ogni elemento dell'abitazione parlerà con tutti gli altri e con loro. Il frigorifero li avvertirà tramite lo schermo del televisore che la porta è rimasta aperta, da un qualunque computer collegato ad Internet sarà loro possibile osservare la casa e dialogare con i vari componenti, ad esempio per aprire la porta di casa al figlio che torna da scuola in anticipo. Il costo di questa cablatura si aggira sui 1000$ per abitazione. La Cisco fornirà il cuore del sistema, Home Gateway Box, e da mesi sta lavorando insieme a aziende come Microsoft, Sun e Whirlpool per creare un mondo domestico interconnesso ad Internet.
  http://live.altavista.com/scripts/editorial.dll?efi=900&ern=y&ei=2025474



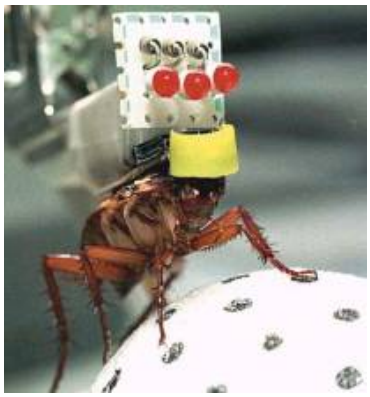
Consider:

- Computer sale overtook Television sale in 1996 in USA. Same happened in UK in 1998. Information appliances are bound to overtake computer sale in 2005 and by 2010 there will be 10 Info Appl. for every computer sold. How is life going to change?
- What if you have a dress that keeps you in touch with your children, with a medical center, with your business partners?
- Think of the walkmen. Sony has trade-marked the Netman. What will it be?
- Localization: a pandora box for new services. Think at the advantages for countries with low population density, think at the advertisement revolution for high density urban areas...

See paper "A world of Intelligent Objects" excerpt from the IEEE book "The Disappearance of Telecommunications" available December '99, by Roberto Saracco et al.

Computers Evolution

1960… ◆ MAINFRAME
1970… ◆ MINICOMPUTER
1980… ◆ DESKTOP
1990… ◆ LAPTOP
1998… ◆ PALMTOP
2002 ◆ ROACHTOP



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A POSSIBLE FUTURE

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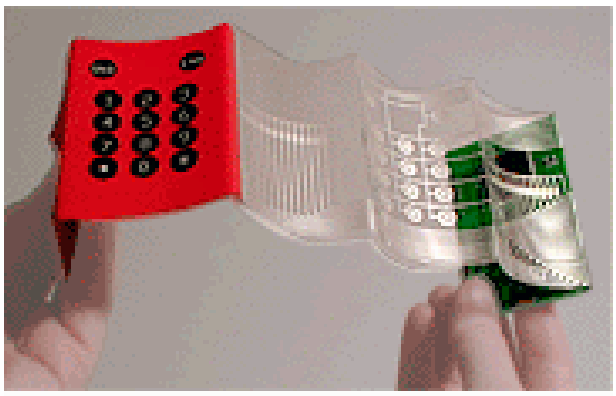
Computers Evolution

1960…
1970…
1980…
1990…
1998…
2002
2005

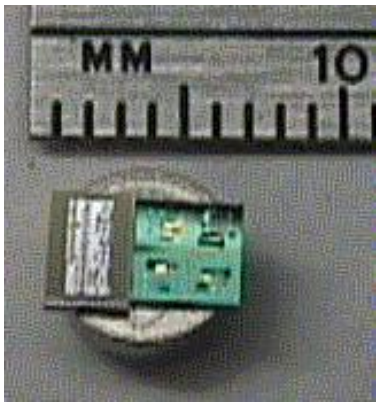


- PAPERTOP

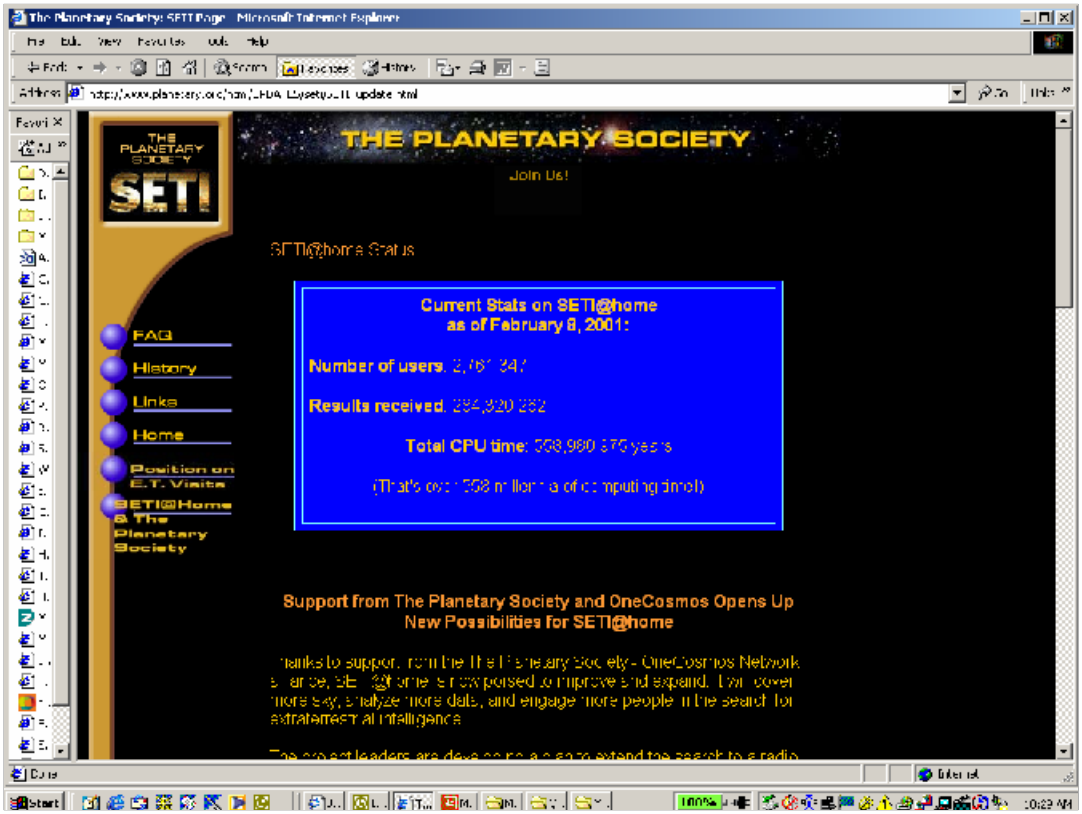
Computers Evolution

1960… ◆ MAINFRAME
1970… ◆ MINICOMPUTER
1980… ◆ DESKTOP
1990… ◆ LAPTOP
1998… ◆ PALMTOP
2002… ◆ ROACHTOP
2005… ◆ PAPERTOP

2012… ◆ TOP

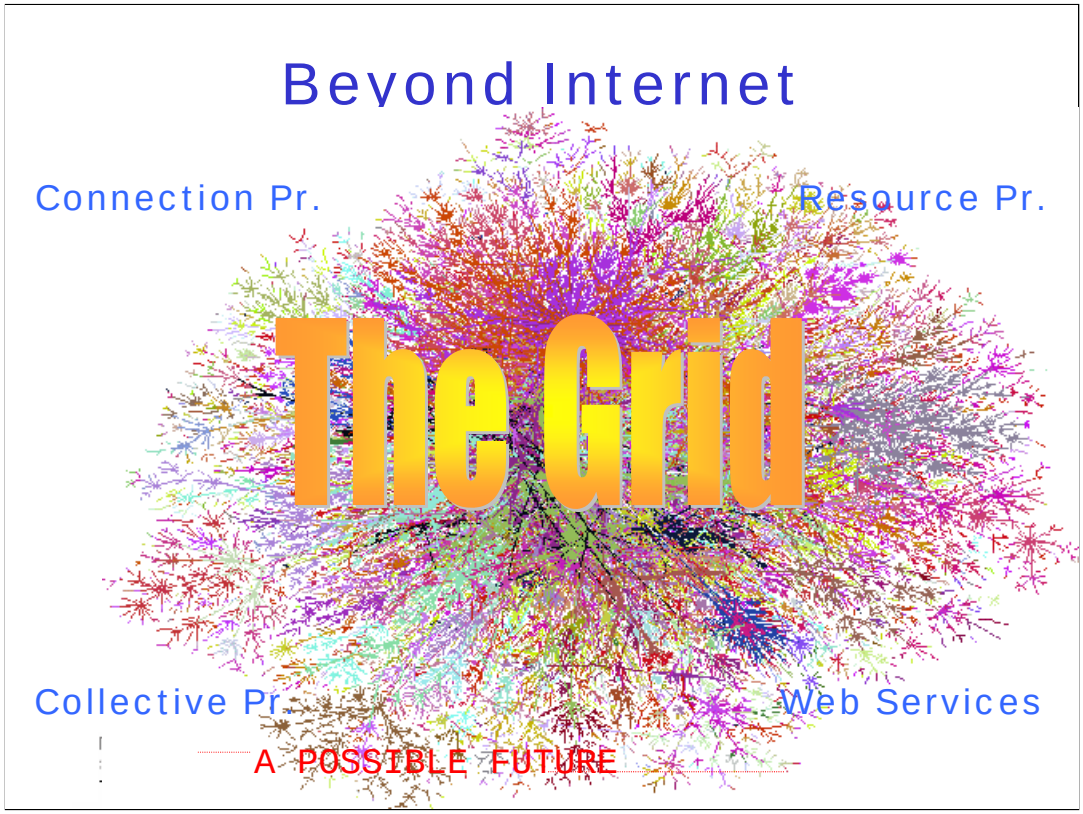


A POSSIBLE FUTURE



Citare importanza della connettività, SETI@Home

Per il 2004 La Compaq prevede di portare la capacità di elaborazione di un computer multiprocessore che sta sviluppando per il dipartimento dell'Energia USA da 30.000 miliardi di operazioni al secondo della prima versione (2002) a 100.000.



Consider:

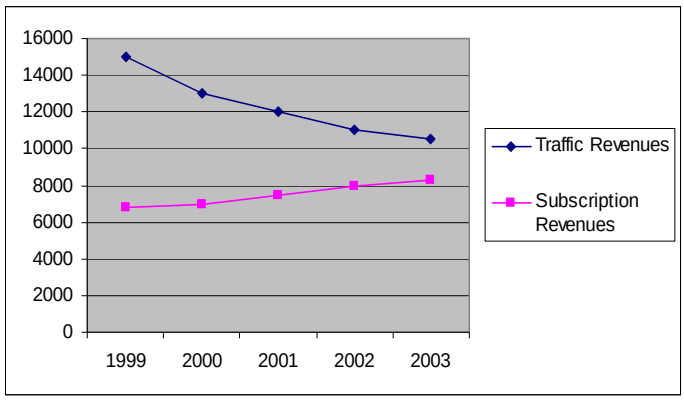
- In 1998 an average of 1.5 million pages was published, each day, on the Web! How much of it was relevant to your country? How much was it accessible to your country given the physical and cultural barriers?

- As of August 1999, Northern Light, Snap, and AltaVista were the search engine with the better coverage of the Internet information: but they covered only 16% of it individually and slightly more all together. How do we get the information we want? How can we make our information widely available?

- Bringing information to where and when it is needed. What information is needed and by whom? How can it be brought to the potential users? Think first in terms of communities (students, agricultural producers, truck drivers, people with impairment…) and then in terms of business offering.

A crumbling world

- Time / distance based pricing



FUTURE CENTRE — CHALLENGES AHEAD — TELECOM LAB ITALIA

A similar impact is going to result from the Wireless Always-on (scheduled in the 2002).

Wireless manufacturers are shaking hands with PDA manufacturers to make Internet access seamless and with bandwidth in the range of several hundreds of kbit per second. PDA have the advantage over the cellular phone of a bigger screen that better accommodate web pages. Today's drawback of PDA, the lack of a keyboard to input text, should be overcome in the coming years through voice recognition. At the same time the integration of entertainment (music players and e-books) with PDA is likely to further increase their use.

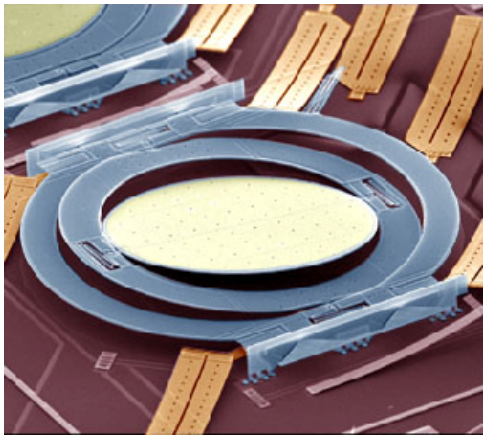
It is difficult to say if the PDA will overtake the function of the cellular phone, although it is easy to foresee that most PDA will be Internet enabled and connected wireless. Probably we will still continue to have a cellular phone (that in turn will be always on in terms of SMS reception but that cannot qualify as internet connection).

DSP technologies (Digital Signal Processing) keep evolving rapidly and will enable wireless information appliances (since cost will keep decreasing and performance increasing). The car market seems to be one of the first to be connected always-on, of course using wireless.

www.wired.com/news/technology/0,1282,34167,00.html

A crumbling world

- Time / distance based pricing
- Bandwidth based pricing



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www.wired.com/news/technology/0,1282,34167,00.html

A similar impact is going to result from the Wireless Always-on (scheduled in the 2002).

Wireless manufacturers are shaking hands with PDA manufacturers to make Internet access seamless and with bandwidth in the range of several hundreds of kbit per second. PDA have the advantage over the cellular phone of a bigger screen that better accommodate web pages. Today's drawback of PDA, the lack of a keyboard to input text, should be overcome in the coming years through voice recognition. At the same time the integration of entertainment (music players and e-books) with PDA is likely to further increase their use.

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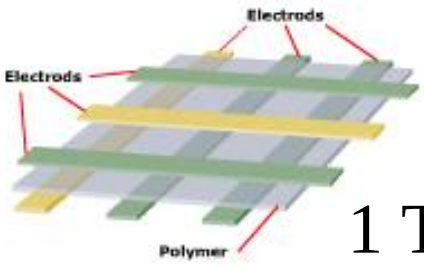
Outer Evolution

- Storage

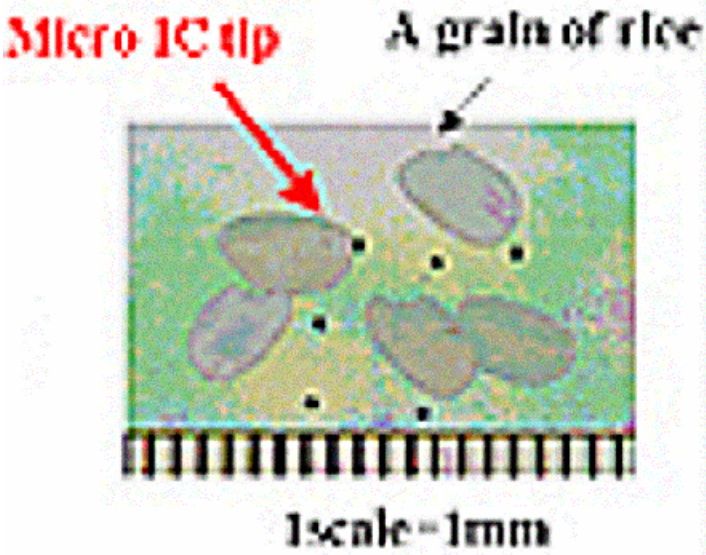
52 MB



1 TB

Outer Evolution

- Storage
- RF Tag

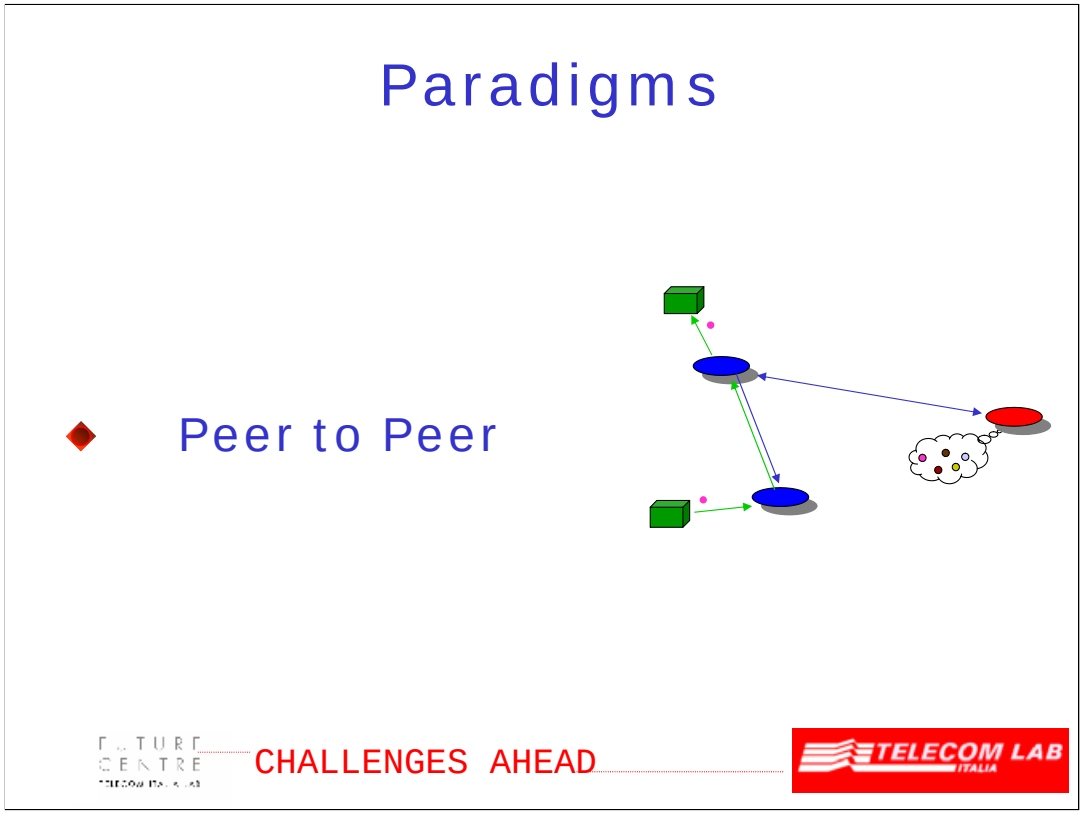


Outer Evolution

- Storage
- RF Tag
- Display

Outer Evolution

- Storage
- RF Tag
- Display
- Battery



Radio, television (both cable and broadcast) and electricity are services always-on (in many houses the television is always on, even if there is just the cat on the couch). Telecommunications is different: when you need it you ask for it, you wait to be connected and you pay for the connection as you use it (there are some exception -flat rate in some part of the world for local calls, pay per view for television...).

New transport technologies on the local loop, such as ADSL and VDSL, open the door to always-on connectivity. By the end of year 2000 there is a forecast of 1 million ADSL lines in the USA and over 200.000 in Italy.

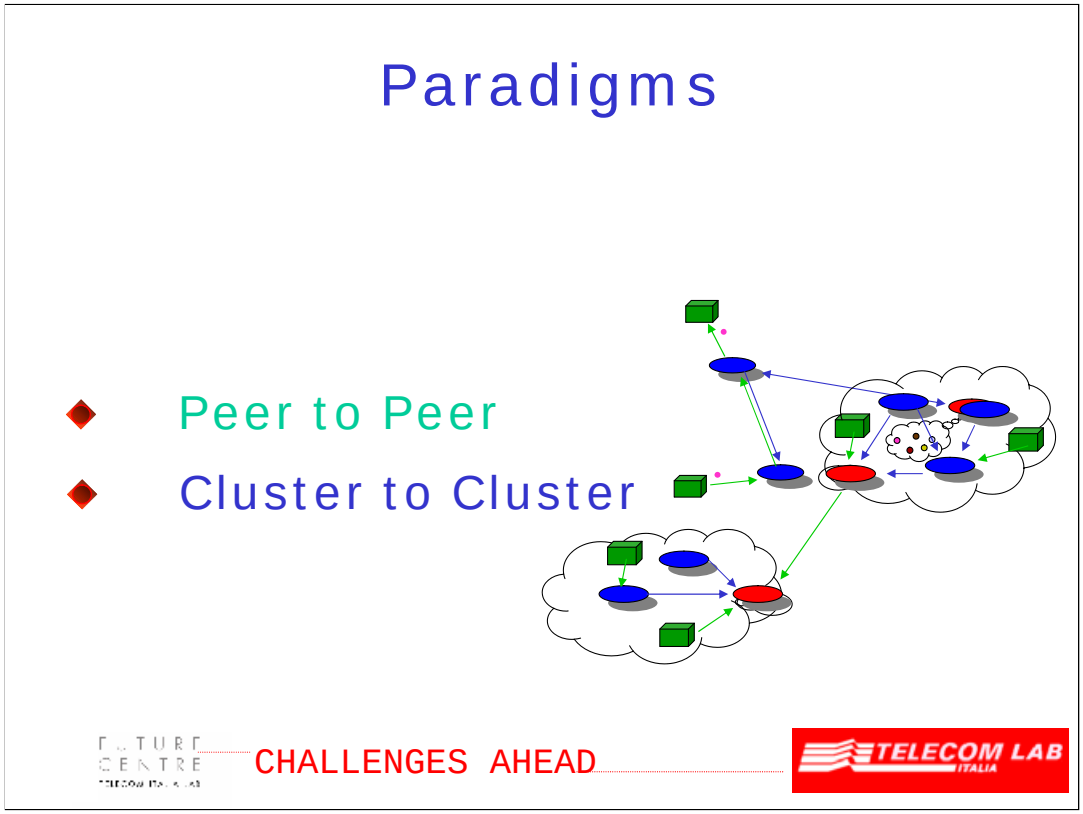
Always-on in telecommunications provides a bi-directional channel and hence it supports interactivity (television and radio are unidirectional).

Being always in touch with the Internet is likely to affect significantly the way we use it. We are going to turn to the Internet more and more for things as different as cooking recipe, yellow pages, checking on the toddler at the kindergarten, videoconferencing with friends...

This evolution is fostered by the emergence of the home networks and conversely it will stimulate their deployment.

IBM has announced in Feb.2k a new line of products, EON -Edge Of Networks, that plug into the Internet and are always on. They expect these products to pick up the market from PCs.

http://www.wired.com/news/technology/0,1282,34223,00.html?tw=wn20000209



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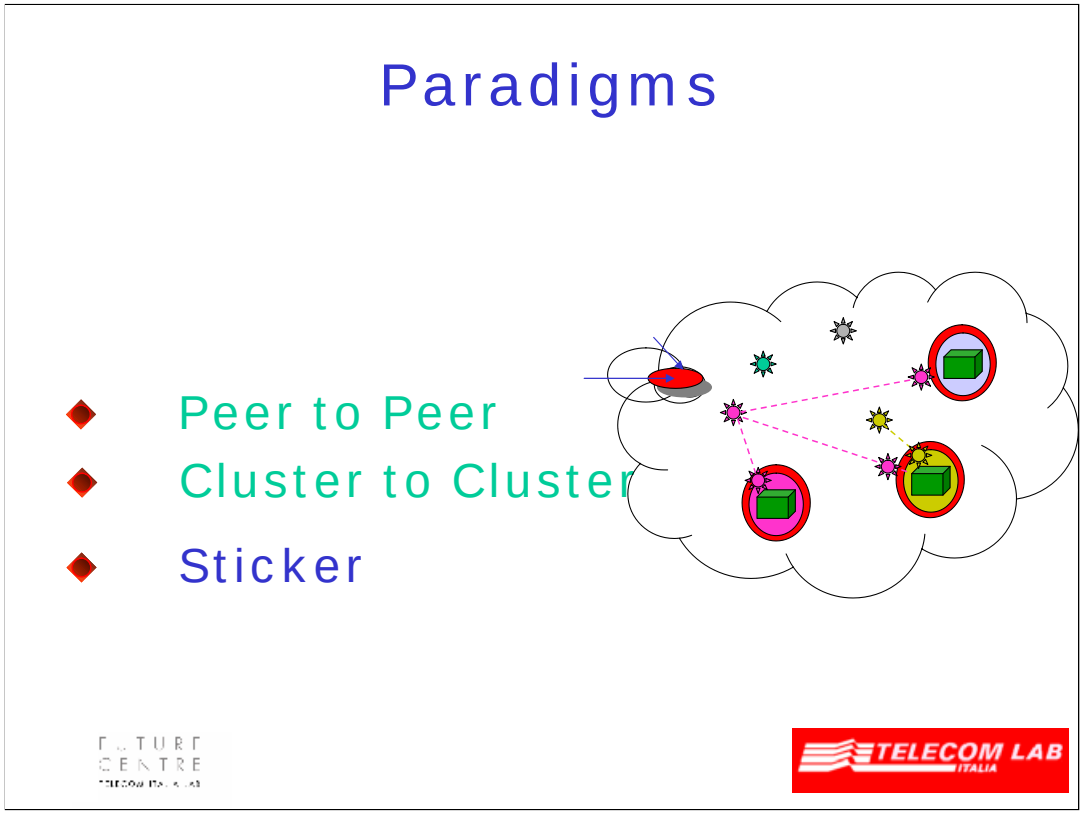

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Expectations…

The goal is to have data rates up to 20 Mbps, even when used in such scenarios as a vehicle travelling 200 kilometers per hour(*)

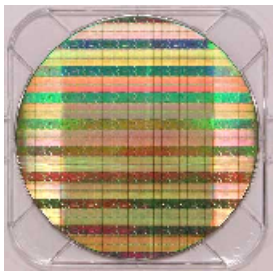
WHY?

(*) http://www.commsdesign.com/story/OEG20010626S0065

Disruptions Ahead

- Increase in storage

  • **Dynamic Memory**



FUTURE CENTRE CHALLENGES AHEAD TELECOM LAB ITALIA

With applications environment we mean the functionality provided by a software platform to support services for a particular client, independently of his/her location adapting the interaction to the specific facilities available and to the client's profile.

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Disruptions Ahead

- Increase in storage
  - Dynamic Memory
  - **Hard Disk**

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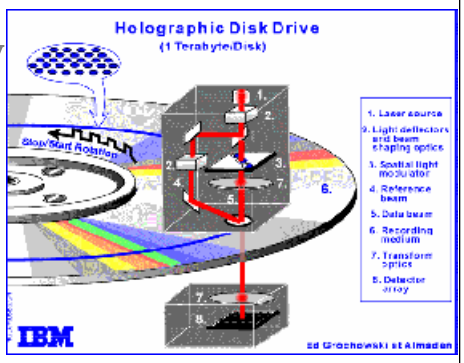
Disruptions Ahead

- Increase in storage
  - Dynamic Memory
  - Hard Disk
  - **Read Only**



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Disruptions Ahead

- A consumer market

  - **Squeezing Margins**

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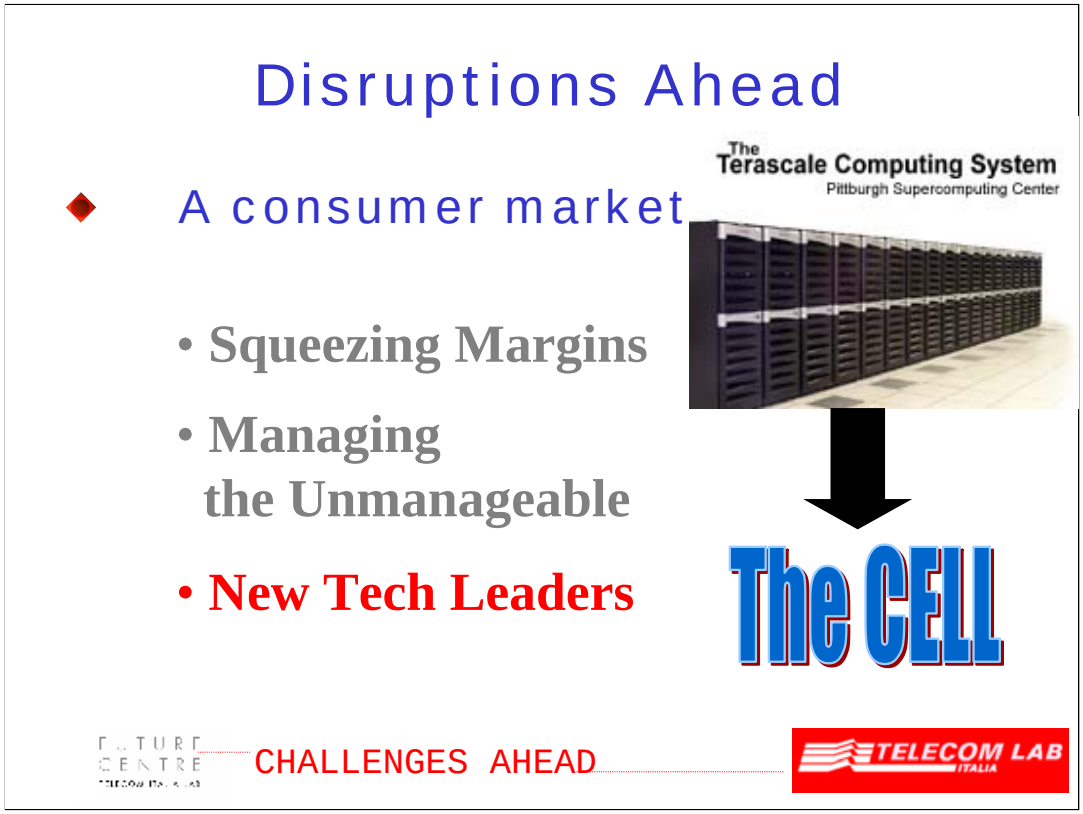
Disruptions Ahead

- A consumer market
  - Squeezing Margins
  - **Managing the Unmanageable**

Profiling is key, along with the fostering of communities helping themselves



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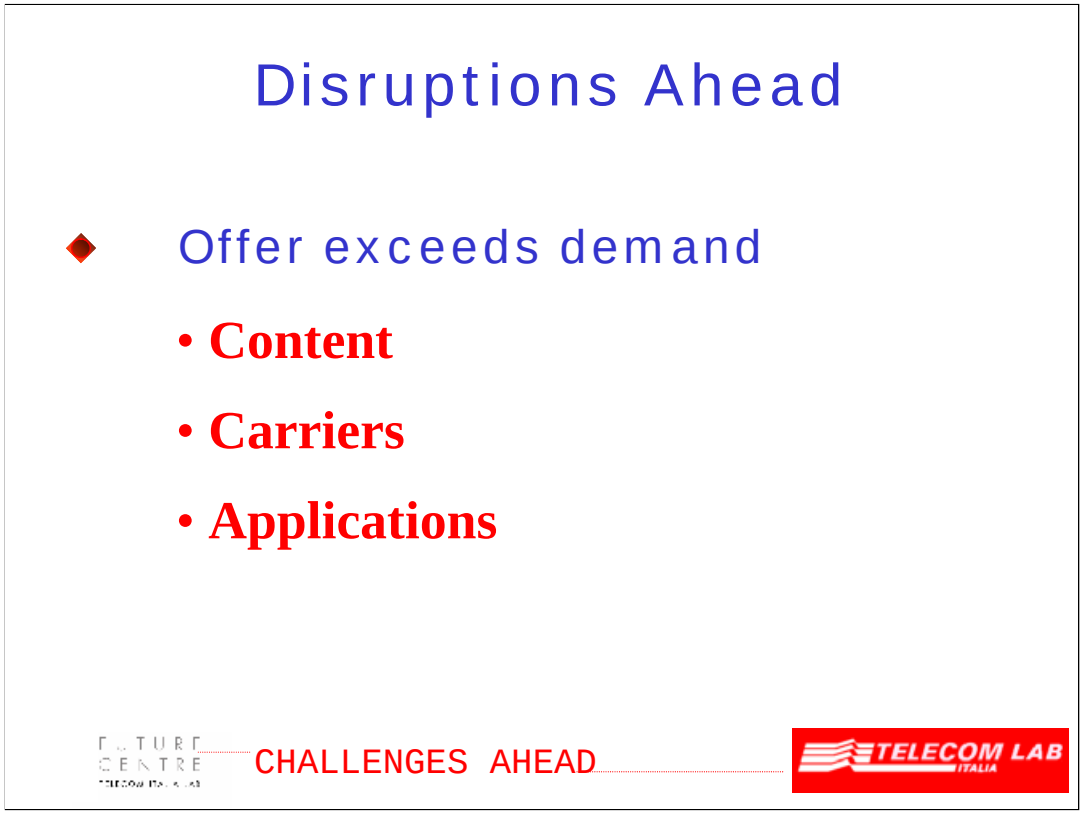

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Disruptions Ahead

- Pin-pointing
- **Zooming**

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Disruptions Ahead

- Pin-pointing
  - Zooming
  - **Localization**

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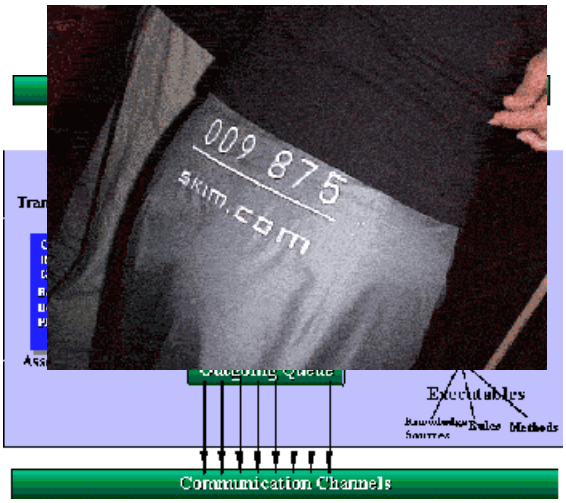
Disruptions Ahead

- Pin-pointing
  - Zooming
  - Localization
  - **Tagging**



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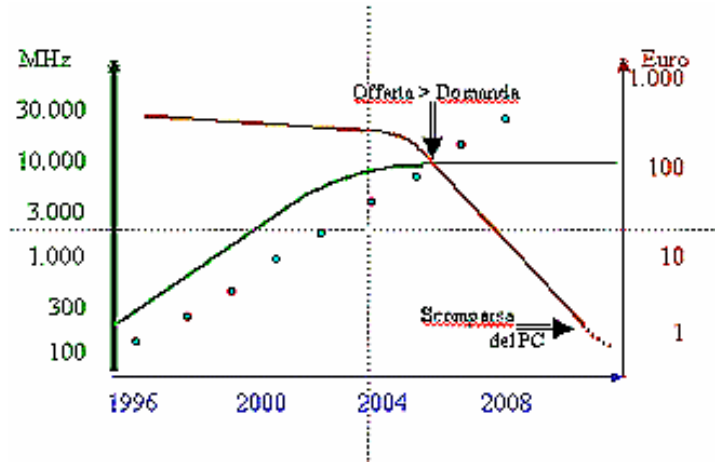
Disruptions Ahead

- Moore's Law reversed



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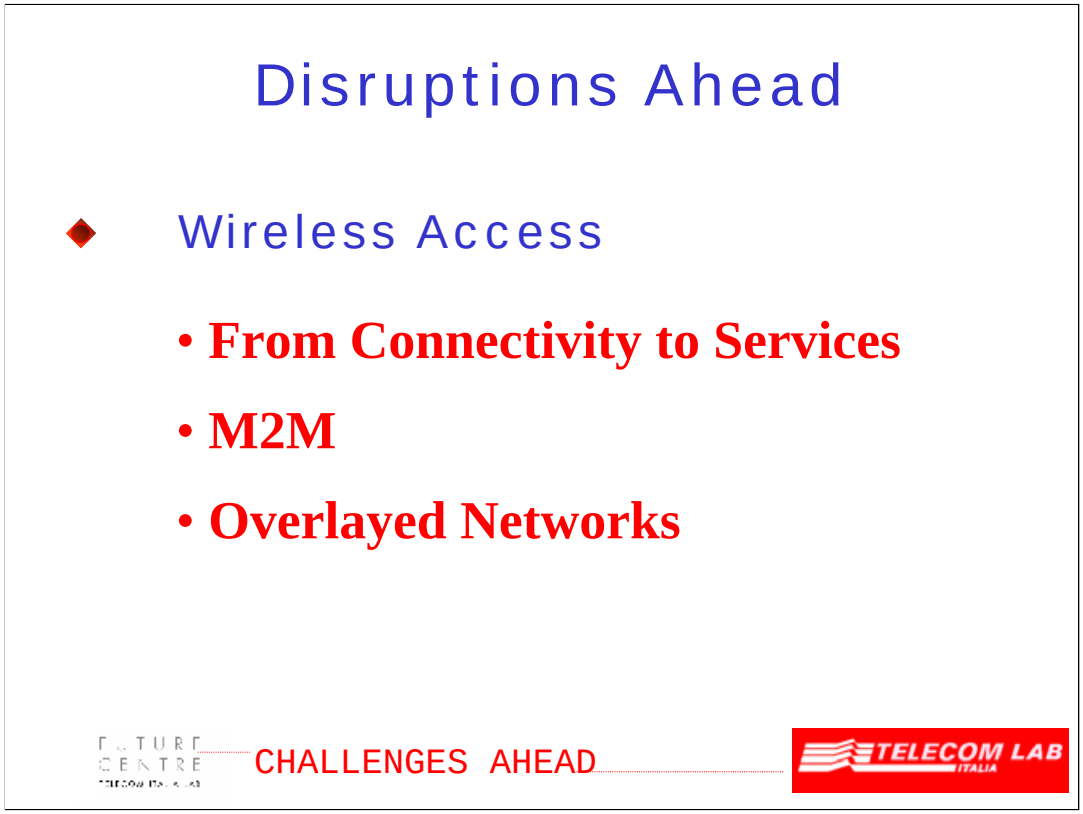

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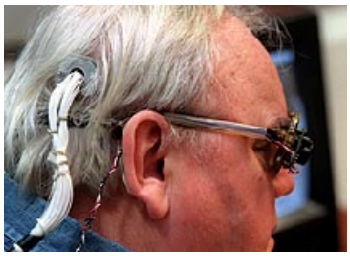
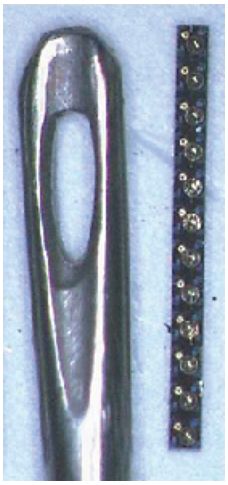
Disruptions Ahead

- Displays





FUTURE CENTRE

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Disruptions Ahead

- Ubiquitous Connectivity

- **Communications Environments**

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Disruptions Ahead

- Digital Television
  - **Eyeballs**
  - **Interactivity**
  - **Advertising**

Television is and will be grabbing the lion share of eyeballs. Over 10 years television gained 80 hours a year on average in the US with Internet gaining 40. What's more television (in the US) gets 1580 h per year average versus 40 of Internet.

Interactivity, is not likely to be the same as the one we experience on Internet. Television is more a point of attraction for people to mutually share entertainment. PC is more for peer to peer interaction

With TIVo and its followers we are starting to see the need for a new business model for advertising..people may end up paying to get focused advertisement.

Disruptions Ahead

- From Bits to Atoms
  - **Printing bits**

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Disruptions Ahead

- From Bits to Atoms
  - Printing bits
  - **Packaging services into atoms**

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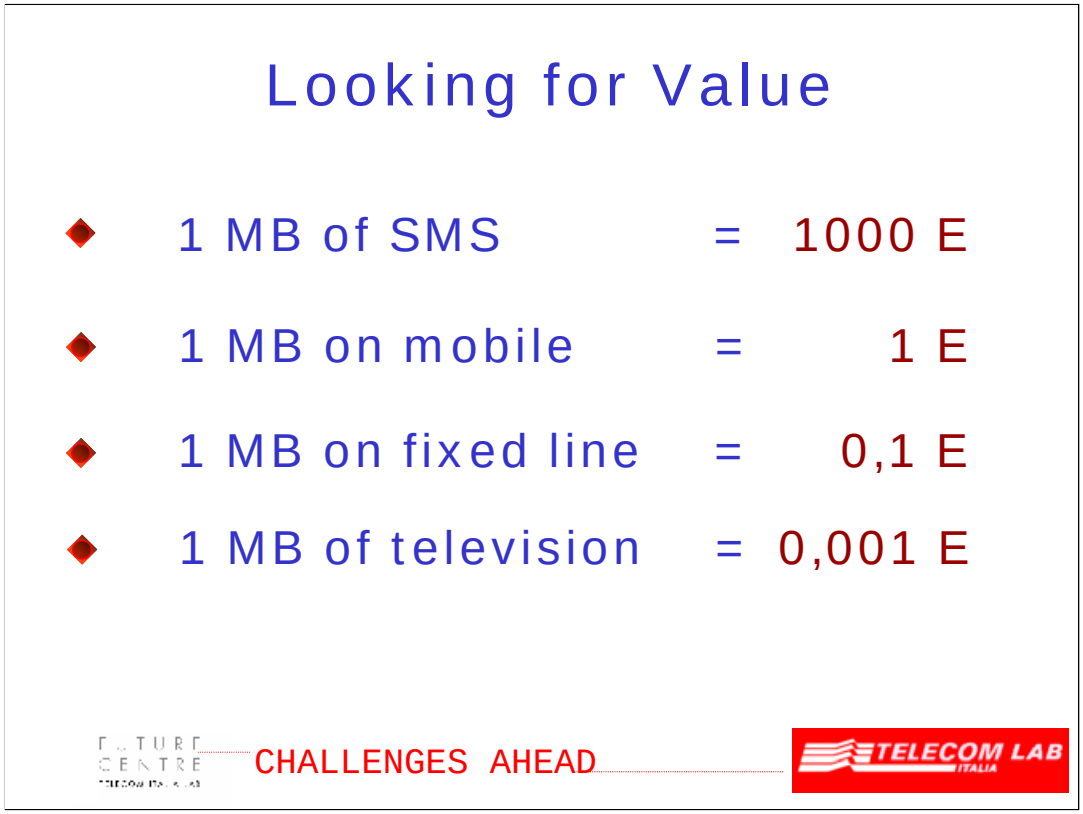

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Looking for Value

- Context

FREE

1 E per mc

1.000 E per mc

CHALLENGES AHEAD

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The concept is similar to the one of Portal although here it relates to the services provided by infrastructures.

One of the characteristics of the applications infrastructure is the awareness of the user environment and the capability to adapt to it the provisioning of services and information. This latter characteristics is also part of advanced local networks that try to adapt users request to what is available and interact accordingly with the access networks.

The trade-off between what is/can be done at the applications infrastructure and what through the local network is something that will change in the coming years: the bet is on advanced local network in the long time frame but that lives plenty of opportunity to applications networks in the coming years (it is a "deja vu": remember the fight between PBX and Centrex).

Looking for Value

- Context
- Internet

Internet is in Infancy. If this were not so we can pack it up and go home. No viable business model.

Looking for Value

- Context
- Internet
- Embedded Telecommunications

Where is telecommunications? Hidden in a variety of services and objects. As more and more of this communicate and let us communicate in a seamless way we lose track of the provider behind.

4 or 40 millions Operators?

- The Bigger the Better?
- Software Radio

FUTURE CENTRE — CHALLENGES AHEAD — TELECOM LAB ITALIA

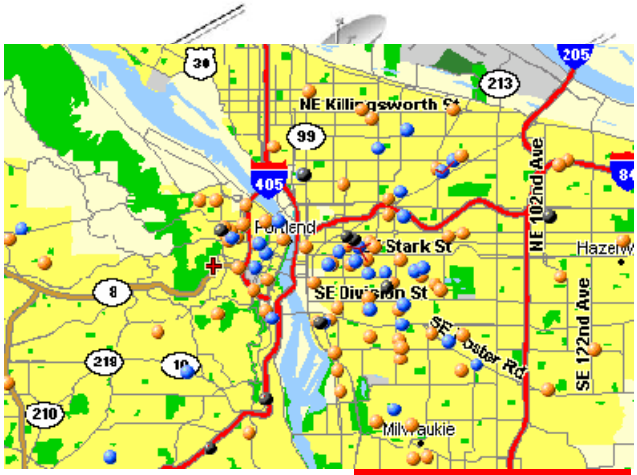
Future cars are more likely to run on hybrid powering: electrical and gasoline. Hydrogen based cells are not only difficult but over the complete fuel life cycle are less competitive. New technologies, like flywheel batteries may further boost hybrid architectures.

Let's assume that by 2007 we will have a significant number of hybrid cars. Most of the time these cars will be plugged in the grid. Hence they can act as local energy storage for the power utilities and the owner may get compensated since it would relieve the problem of balancing micro differences in power request on the grid.

Clearly this requires some sort of communication connectivity between the cars and the grid control system. Wireless connectivity is likely to be the one used although IP over power line may be an option in some areas.

4 or 40 millions Operators?

- The Bigger the Better?
- Software Radio
- WLAN



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4 or 40 millions Operators?

- The Bigger the Better?
- Software Radio
- WLAN
- Wireless Routers

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SUMMING IT UP

$$\mathrm{Log}\left(1+\frac{S}{B*n_0}\right)$$

The future is in the fixed-network

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SUMMING IT UP

$$\mathrm{Log}\left(1+\frac{S}{B*n_0}\right)$$

The future is in the fixed-network

The future of services is in the wireless access

Future cars are more likely to run on hybrid powering: electrical and gasoline. Hydrogen based cells are not only difficult but over the complete fuel life cycle are less competitive. New technologies, like flywheel batteries may further boost hybrid architectures.

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