Forecasting the Growth of Internet Services Demand and the Network Capacity Requirements

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Abstract

The forecasting of the Growth of Internet Services Demand and the correspondant Capacity requirements through traditional techniques, such as econometric modeling (different kind of Regression Models and Simultaneous Equation Models) or Time Series (Box & Jenkins, Exponential Smoothing, …), fail to accurately predict the future of this market. In fact, the past history of this market may not holds true for future state and performance since it fails to capture some new key drivers and changing factors.

The alternative forecasting approach should take into account the impact of the rapidly changing within economic and social factors, new usages and proliferation of new technologies (MPLS, DWDM, ADSL, RSVP, 3G protocols, …) and applications (streaming video & radio, VoIP, Downloading MP3, Software, …).

In this paper, we present a forecasting method based on the S-Curve Analysis and New Product Penetration. Many qualitative factors/drivers for the Internet Service Demand Forecasting (technology, new usages, QoS, ….) for each segment of customers are also integrated in the models..

In the last part of this paper, we will measure the forecast accuracy and ensure that the models are sufficiently flexible.

AGENDA

- Introduction
- The state of the Internet Market
- The Explanatory Variables and Key Drivers of Internet Demand
- The forecasting methodology
- Main Results
- Conclusions

Introduction

- This paper is aimed to forecast the required bandwidth for Internet Services in France (capacity requirements). These forecasts are very essential for many needs :

  - to anticiapte the very importants investments in underwater cables;
  - to anticiapte the demand and meet the customers needs;
  - ...

- For this aim, we use growth curves models (mainly Logistic and Gompertz) and, in the other hand, forecasts issued from consultancy companies.

- This Forecasting methodology could be used for any other ISP or carrier

- We run forecasts using assumptions and scenarios on some key drivers

THE STATE OF THE INTERNET MARKET - WORLDWIDE

- **Exponential and rapid growth in traffic, number of users, number of Hosts and number of connections :**

World	1997	2000	2003	2005
Internet Users (000s)	72 500	241 500	516 600	775 700
Internet Penetration (%)	2.3	4	9	13
Internet Terminals & Hosts (000s)	46 800	200 800	598 400	1 154 200
Internet Connections (000s)	39 400	109 700	405 000	824 400

Sources : OVUM- 2000

- **Proliferation of new services and uses :**

  - *E-commerce, E-Business, ...*
  - *E-mail, Web surfing, ...*
  - *Video & Streaming (image and sound)*
  - *Mobile Internet*
  - *Telephony and Voice over IP*

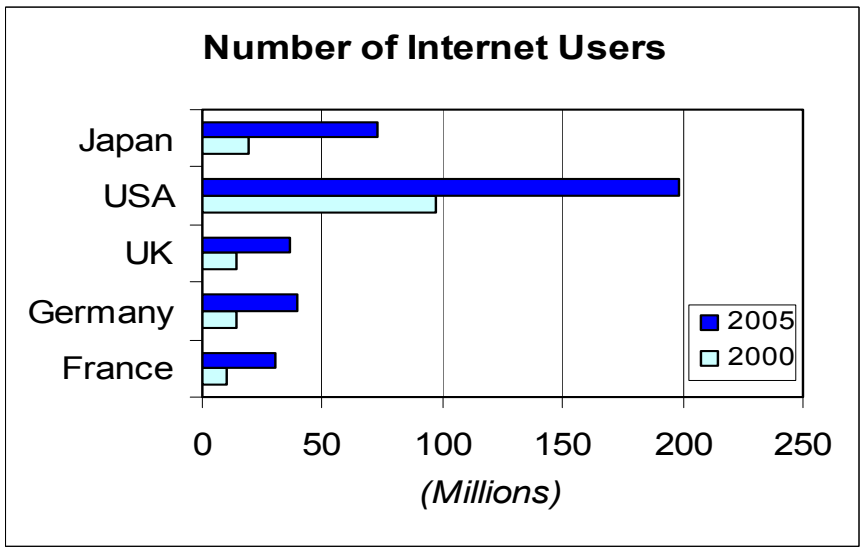
THE STATE OF THE INTERNET MARKET - FRANCE

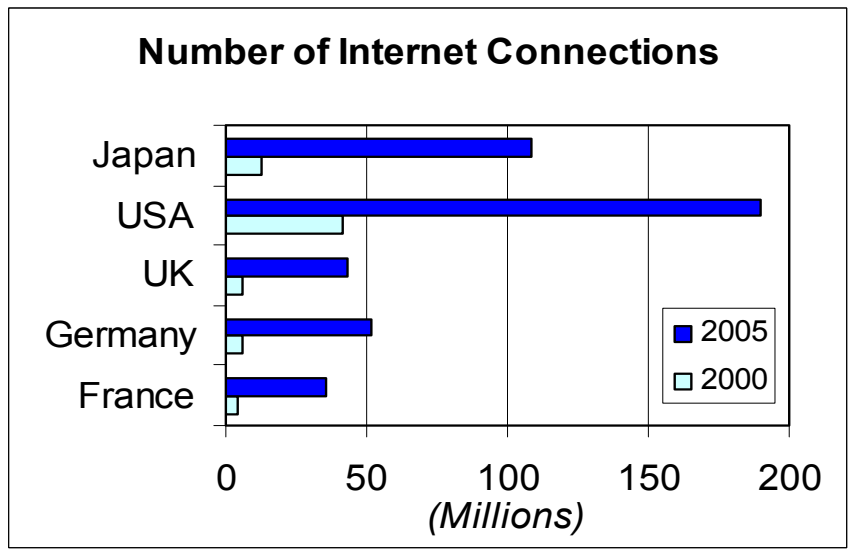
- The Internet growth measures show various evolutions :

  - high increase of the Internet Users and Internet Penetration
  - dramatic growth of Internet connections and Hosts (Usage & Adoption)

France	1997	2000	2003	2005
Internet Users (000s)	3 500	10 500	20 600	29 900
Internet Penetration (%)	6	19	36	52
Internet Terminals & Hosts (000s)	2 600	8 500	26 500	50 100
Internet Connections (000s)	1 820	4 500	17 600	35 100

- France will be one of the major worldwide players in the Internet market :



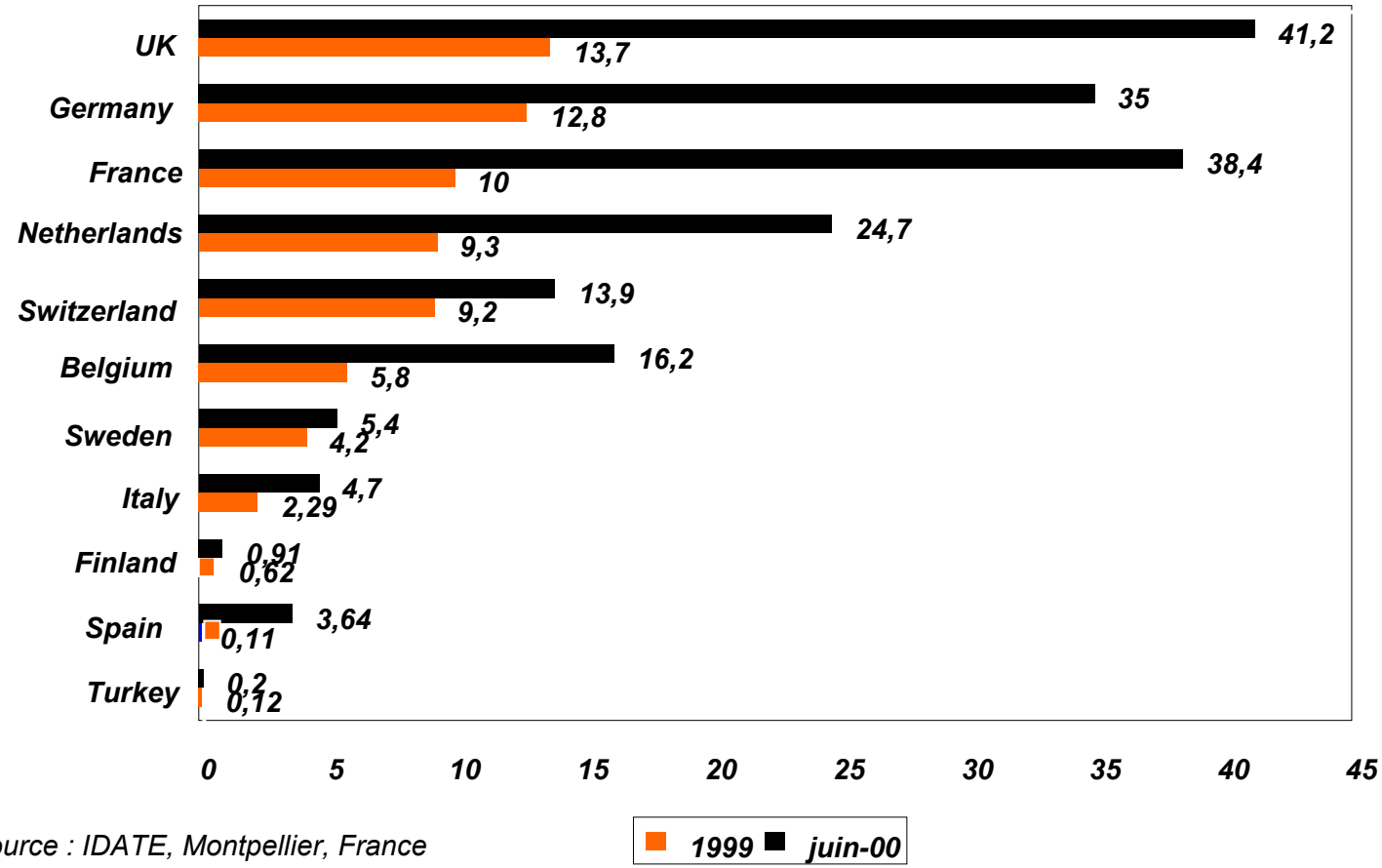


Sources : OVUM- 2000

INSTALLED CAPACITIES FOR INTERNET IN EUROPE

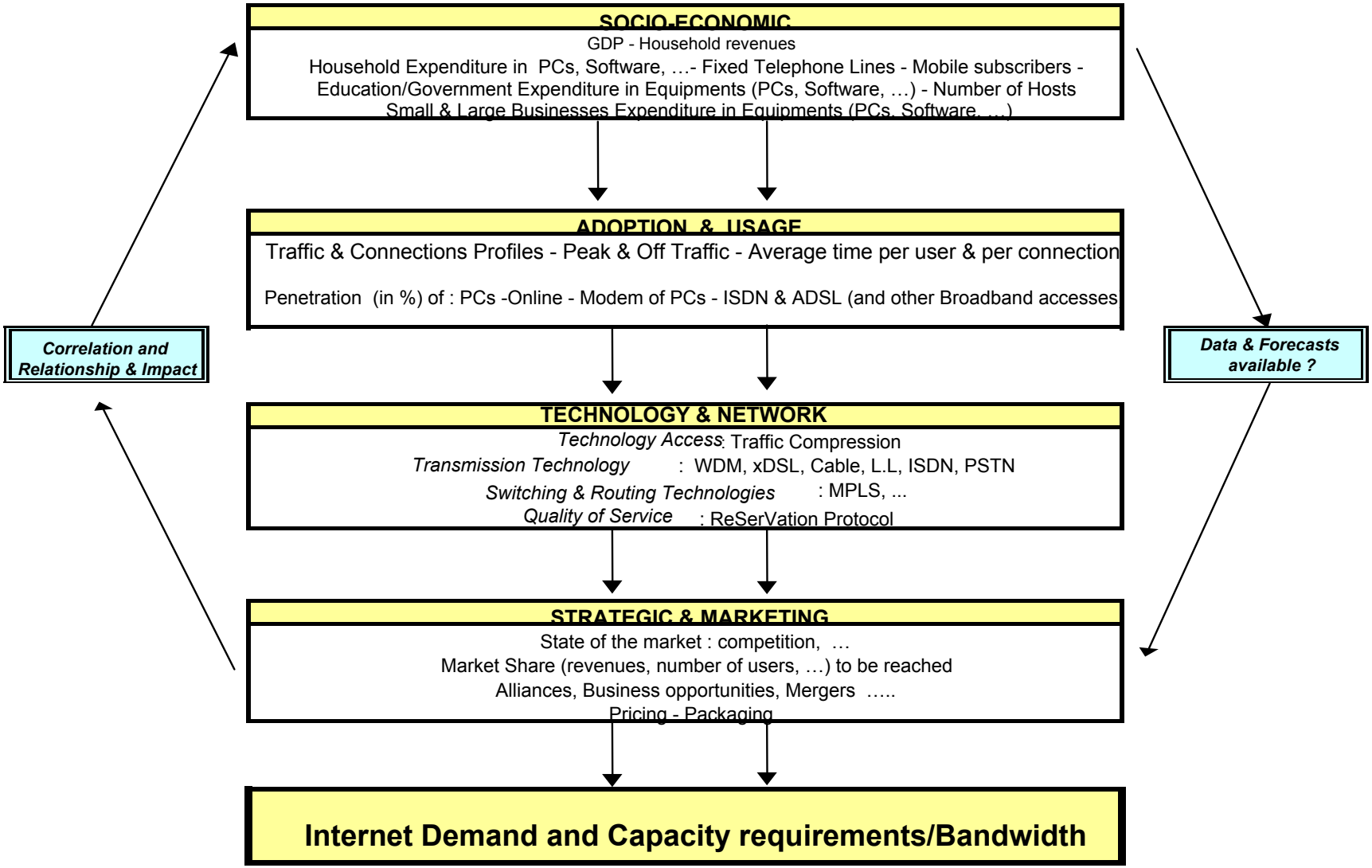
To face the exponential growth of the Internet demand, carriers have highly increased their capacities :

Installed Capacities for Internet in Europe in 1999 and 2000 (In Gbp/s)



Source : IDATE, Montpellier, France

THE EXPLANATORY VARIABLES AND THE KEY DRIVERS OF INTERNET DEMAND AND CAPACITY



FORECAST METHODOLOGY (1)

- **We assess that Demand is primarily driven by Bandwidth :**
  - **per Host for Outbound Internet Traffic**
  - **per connection for Inbound Internet Traffic**
- **Hosts and Connections are defined as :**
  - **Host : any server (SMTP, e-mail, Web Hosting)**
  - **Connection : an end-user relationship with the Network**
- **We take into account also :**
  - **Voice over IP (VoIP)**
  - **Broadband (mainly ADSL)**
  - **Mobile Internet : WAP Phones, 3G (GPRS, UMTS)**
- **We take into account the Peak Traffic :**
  - **The required capacity is dimentionned by the larger of the Inbound or the Outbound Traffic**

FORECAST METHODOLOGY (2)

- **Forecasting Hosts, Connections and Users :**
  - **Using a simple modelling based on Growth Curves Models :**
    The Logistic and Gompertz models
  - **Using also forecasts provided by some consultancy Companies :**
    Probe Research, Ovum, Gartner, ...
- **Forecasting Average Peak Bandwidth for Hosts and Connections:**
  - **Using forecasts provided by some consultancy Companies for the Global market :**
    Probe Research, Ovum, Gartner, …
  - **Carrier 's and ISP 's APB are confidential and not provided**
- **Forecasts of Internet Users is used to check the consistensy of Hosts and Connections forecasts**

FORECAST METHODOLOGY (3) : MODEL & METHOD SELECTION

Variable	Data	Models	Model Evaluation	Other Sources	Forecast Method used
HOSTS	**Annual 1997 to 2000**	**Logistic** : estimate of Hosts potential to be about 29.5 Millions in 2005 **Gompertz** : estimate unduly high, over 55 millions in 2005	**Logistic** : taken as an Expected Scenario **Gompertz** : Failed	**OVUM 2000 & Probe Research 2001**	**Derived from the ratio of Connections to Hosts, wchich based on research into connection/Host ratios in differents markets**
CONNECTIONS	**Annual 1997 to 2001**	**Logistic** : estimate of Connections potential to be about 28 Millions in 2005 **Gompertz** : estimate unduly high, over 39 millions in 2005	**Logistic** : taken as an Expected Scenario **Gompertz** : Failed	**OVUM 2000 & Probe Research 2001**	**Connections forecasts are produced along with the average bandwidth per connection and percentage of connections online at peak.**
USERS	**Monthly 1/1997 to 3/2001**	**Logistic** : estimate of Users potential to be about 14.2 Millions in 2005 **Gompertz** : 26.2 millions in 2005	**Logistic** :Seems to be low, so rejected **Gompertz** : taken as an Expected Scenario	**OVUM 2000 & Probe Research 2001**	**Based on a detailed survey (face to face interview) with ISPs and carriers in 30 countries**
AVERAGE PEAK BANDWIDTH PER HOST	**----**	**A.P.B/Host per carrier and ISPs as a Confidential matter is not provided**	**----**	**OVUM 2000 & Probe Research 2001**	
AVERAGE PEAK BANDWIDTH PER CONNECTION	**----**	**A.P.B/Connection per carrier and ISPs as a Confidential matter is not provided**	**----**	**OVUM 2000 & Probe Research 2001**	

FORECAST METHODOLOGY (4) : ASSUMPTIONS

- **Rules and Assumption on access and transmission technologies will also drive the assumptions on the average Bandwidth per Host and Bandwidth per Connection**

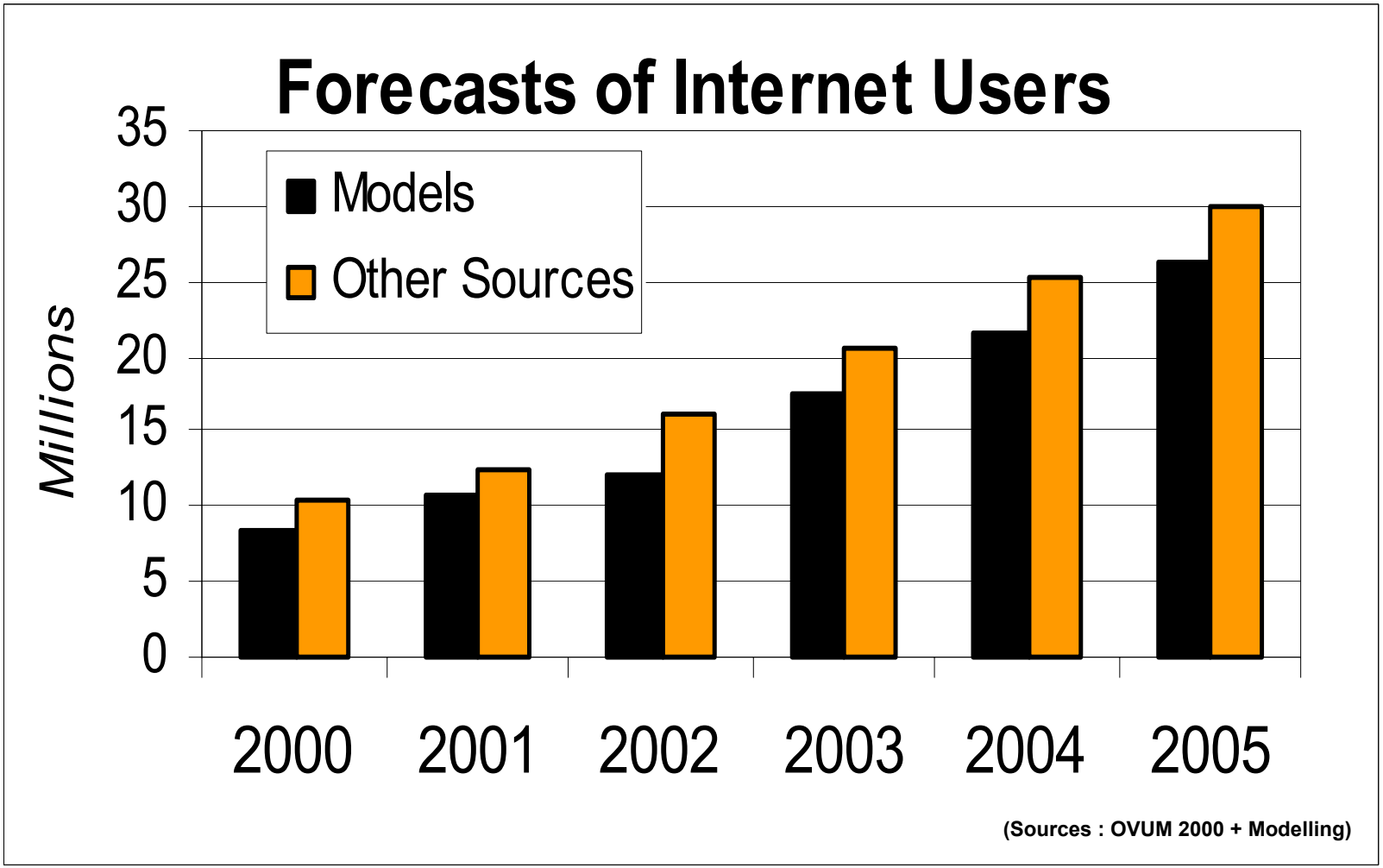
Switching & Routing Technologies	MPLS (Multi Protocol Label Switching) : for a better and faster routing of the IP data
Transmission Technology	ADSL (Asymetric Digital Subscriber Line) : for a higher access debit HDSL (High Digital Subscriber Line) : for a higher access debit SDSL (Single Digital Subscriber Line) : for a higher access debit VDSL (Very High Digital Subscriber Line) : for a higher access debit WDM (Wavelength Division Multiplexing) : for a higher capacity DWDM (Dense Wavelength Division Multiplexing) for a higher capacity Caching technique : for a lower bandwith requirements
Transmission Technology	PSTN - ISDN - Cable - Satellite
Quality of Service	MPLS, RSVP (ReSerVation Protocol) : for a better QoS of online applications
Technology Access	Traffic Compression

- **The Rules and Assumptions are provided by the carriers and ISPs**

FORECAST METHODOLOGY (5) : ASSUMPTIONS & SCENARIOS

Scenario	*Main Events*
HIGH	No Major Worl and France Events 3G Wireless Rollout Happens
EXPECTED	Broadband Access rollout Occurs Faster then expected/predicted Minor Slowdown in World anf French Economies Broadband Access Rolls Out as expected
LOW	Financial markets Tighten considerably Regulatory Environment Favors Incumbents High prices for Speed Access

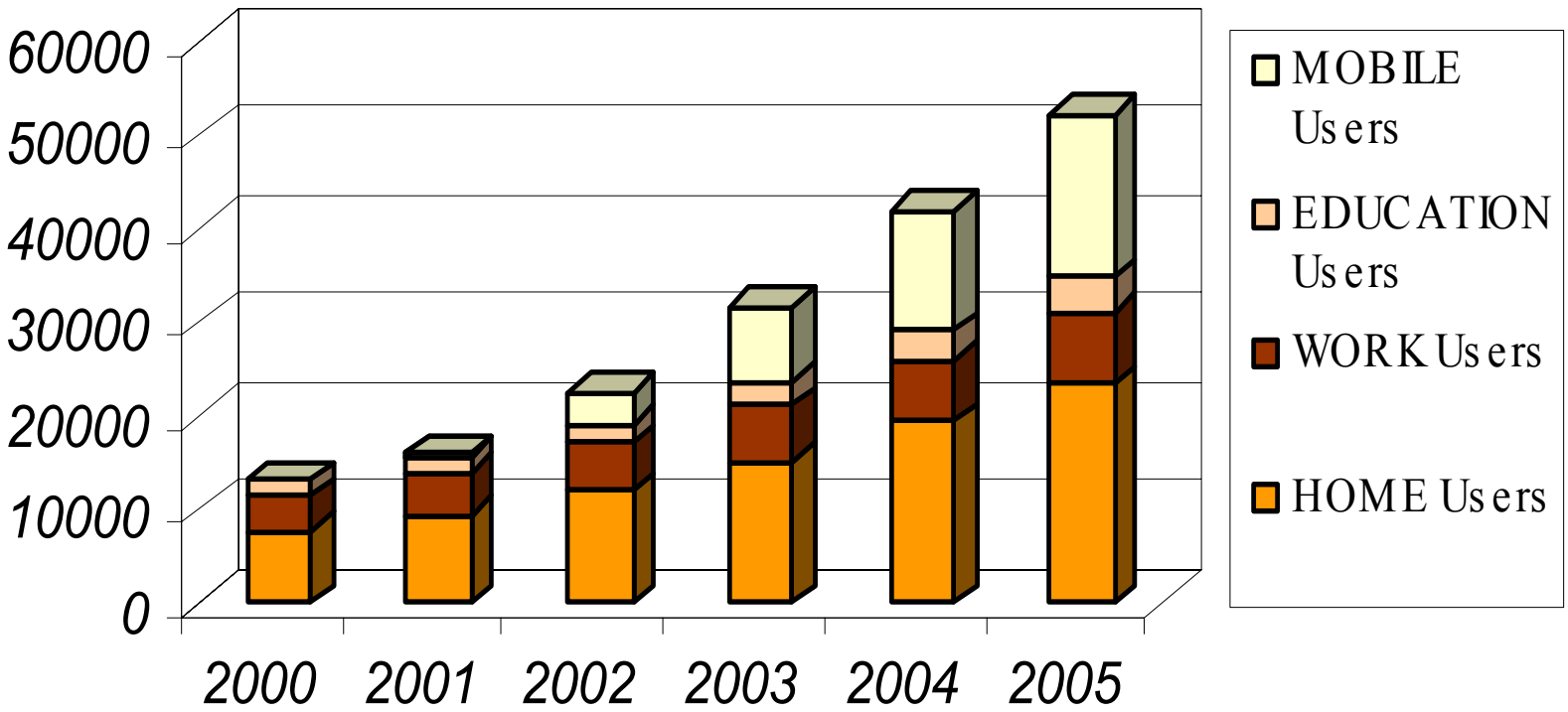
MAIN RESULTS : FORECASTS OF INTERNET USERS



(Sources : OVUM 2000 + Modelling)

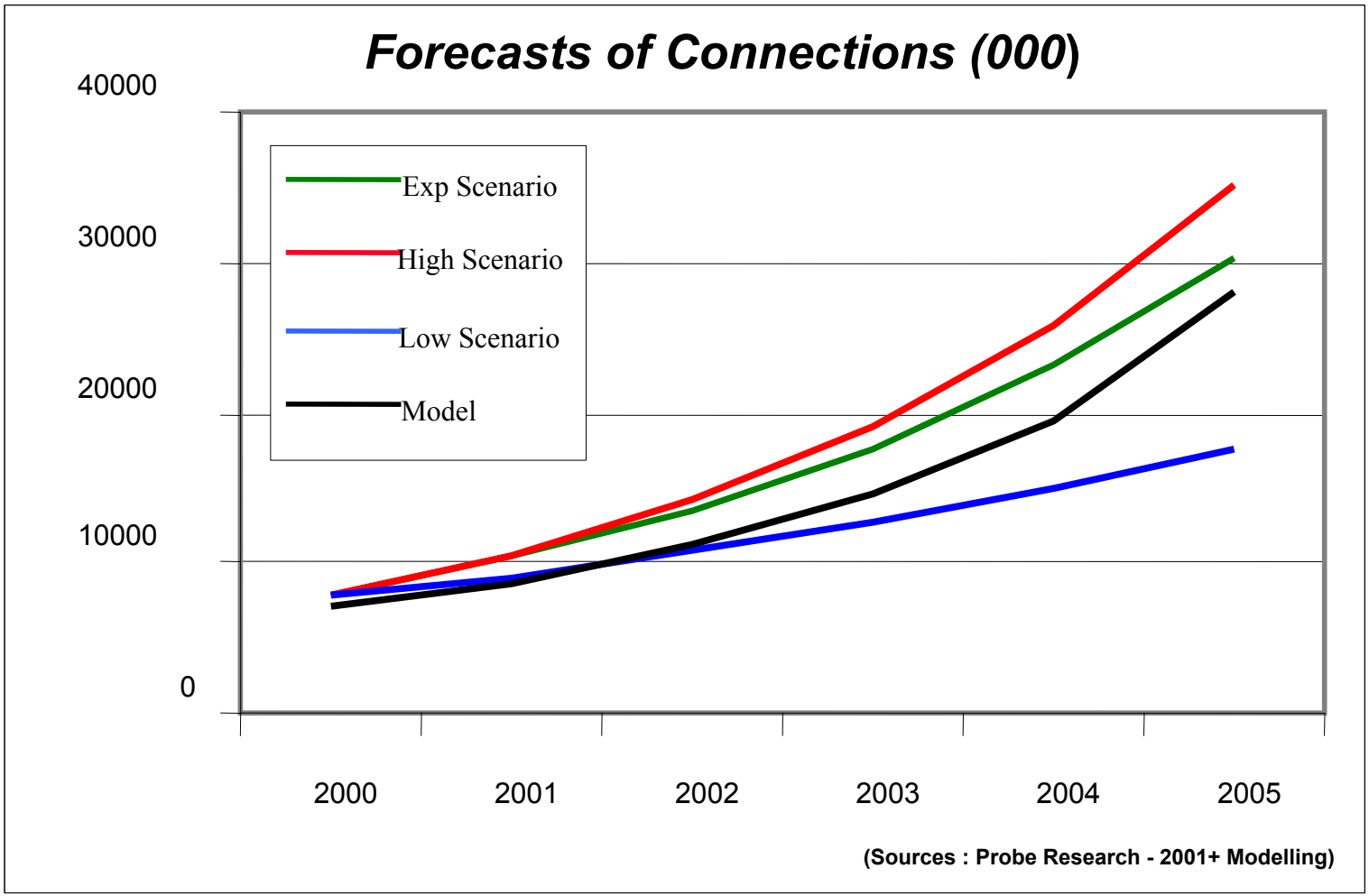
MAIN RESULTS : FORECASTS OF INTERNET USERS

Internet Users by Customer Segments (000s)



(Source : OVUM 2000)

MAIN RESULTS : FORECASTS OF INTERNET CONNECTIONS



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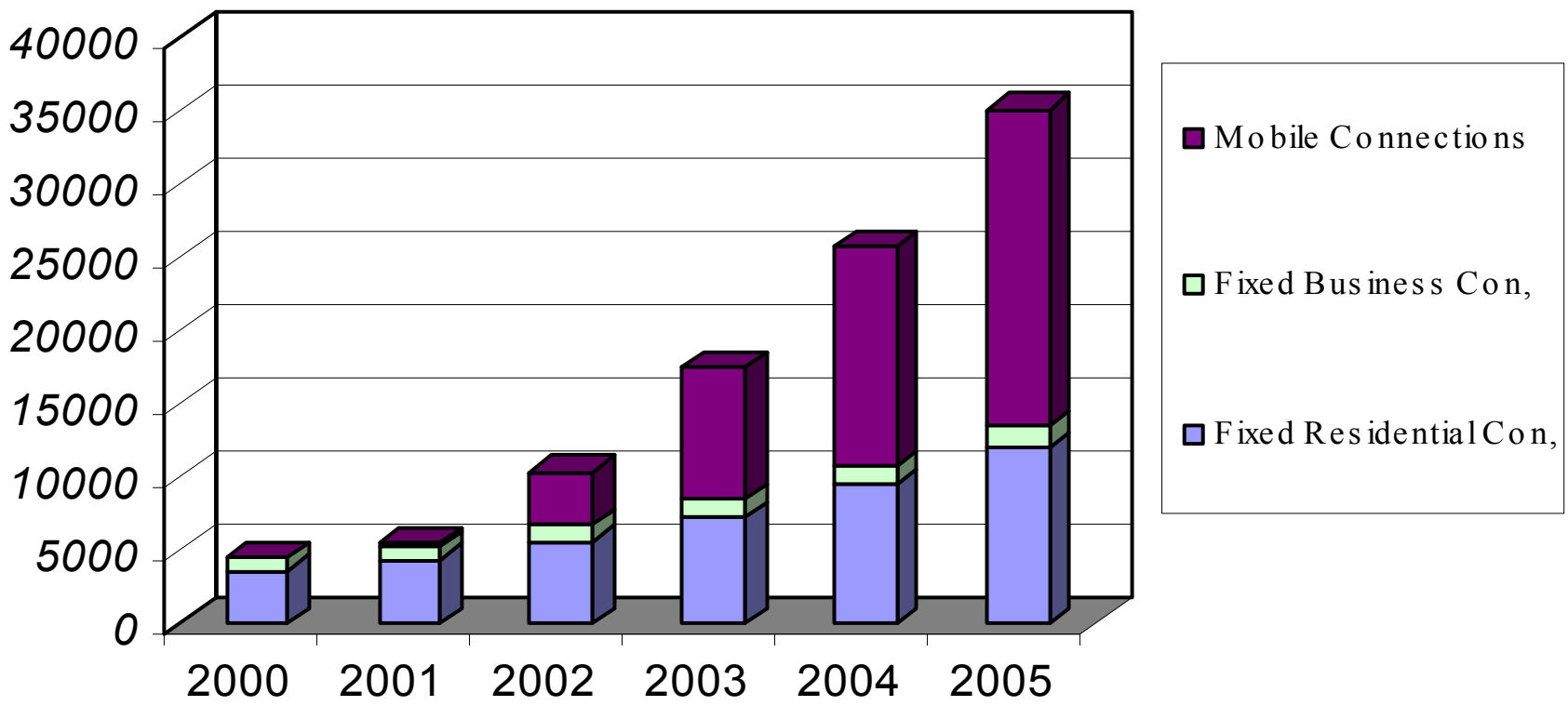
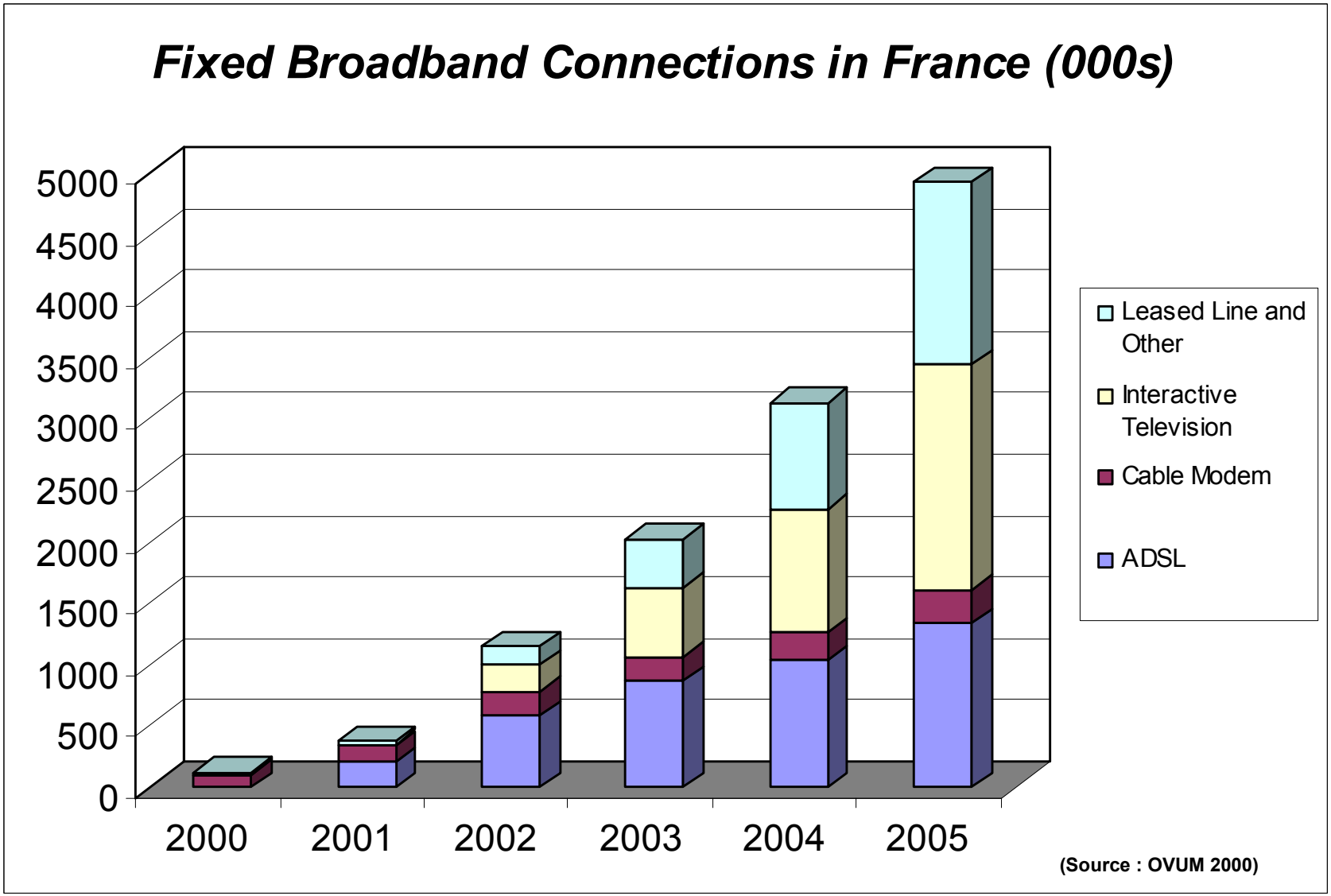
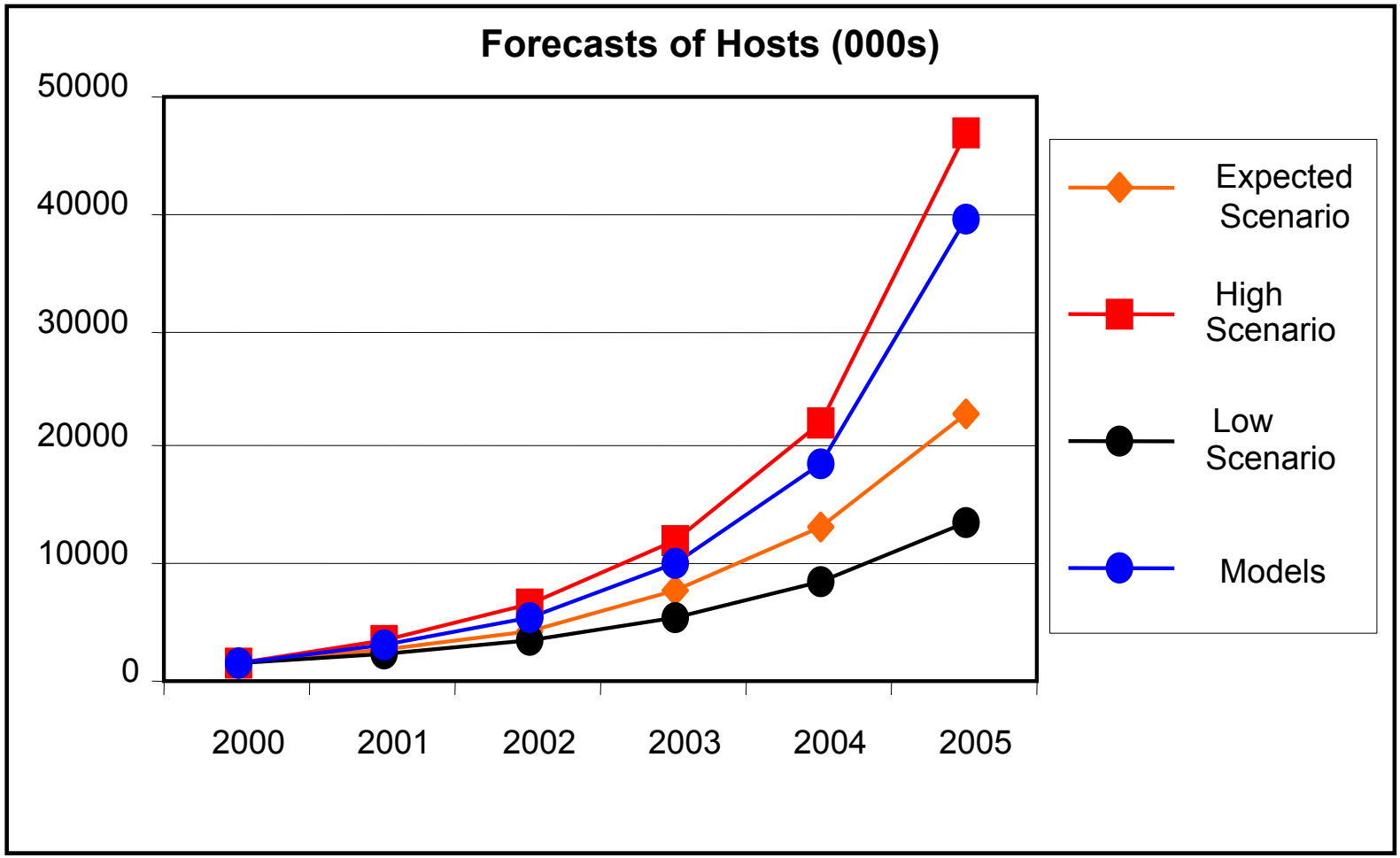


(Source : OVUM 2000)

MAIN RESULTS : FORECASTS OF INTERNET CONNECTIONS



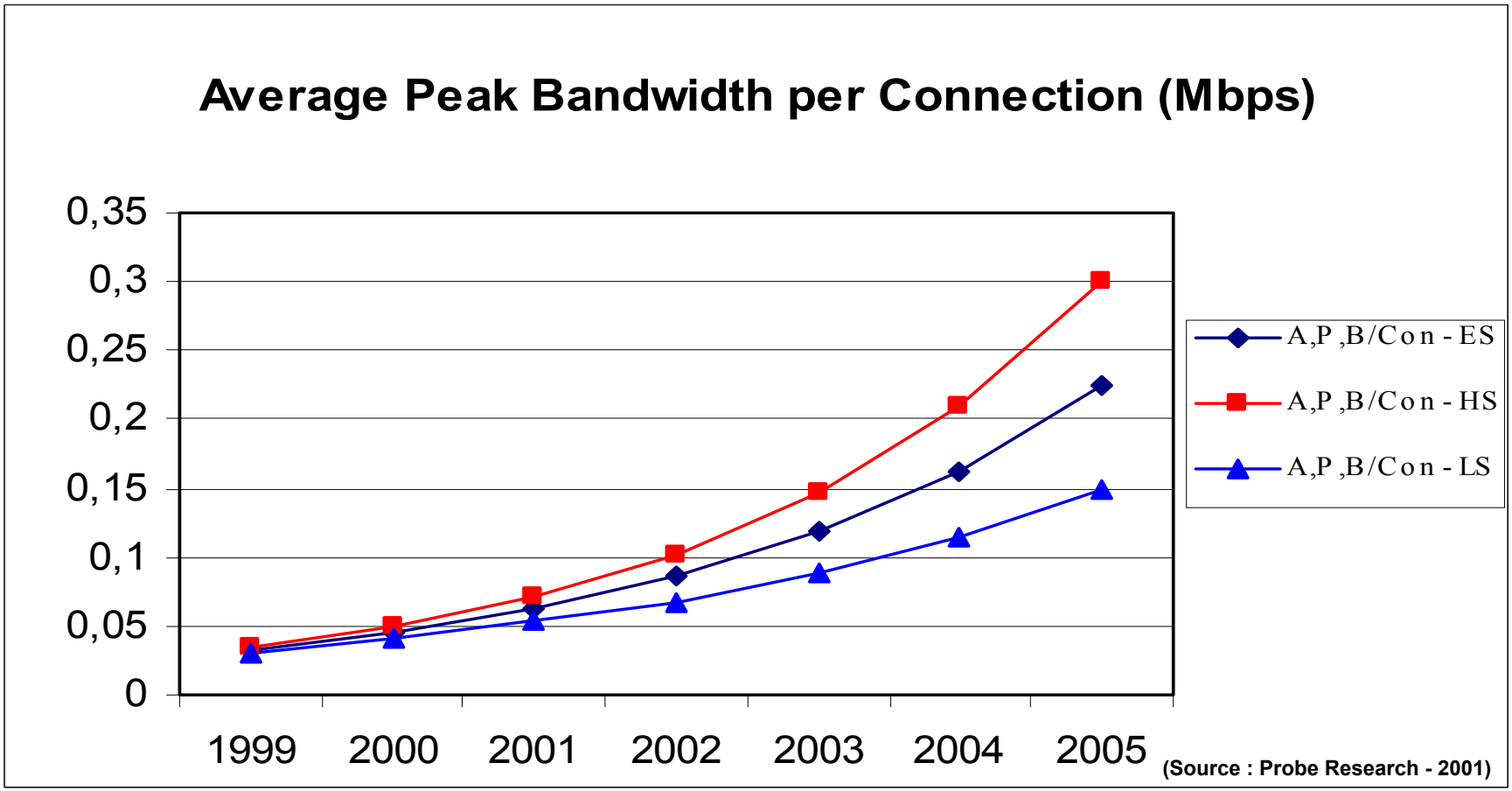
MAIN RESULTS : FORECASTS OF HOSTS



(Sources : Probe Research - 2001+ Modelling)

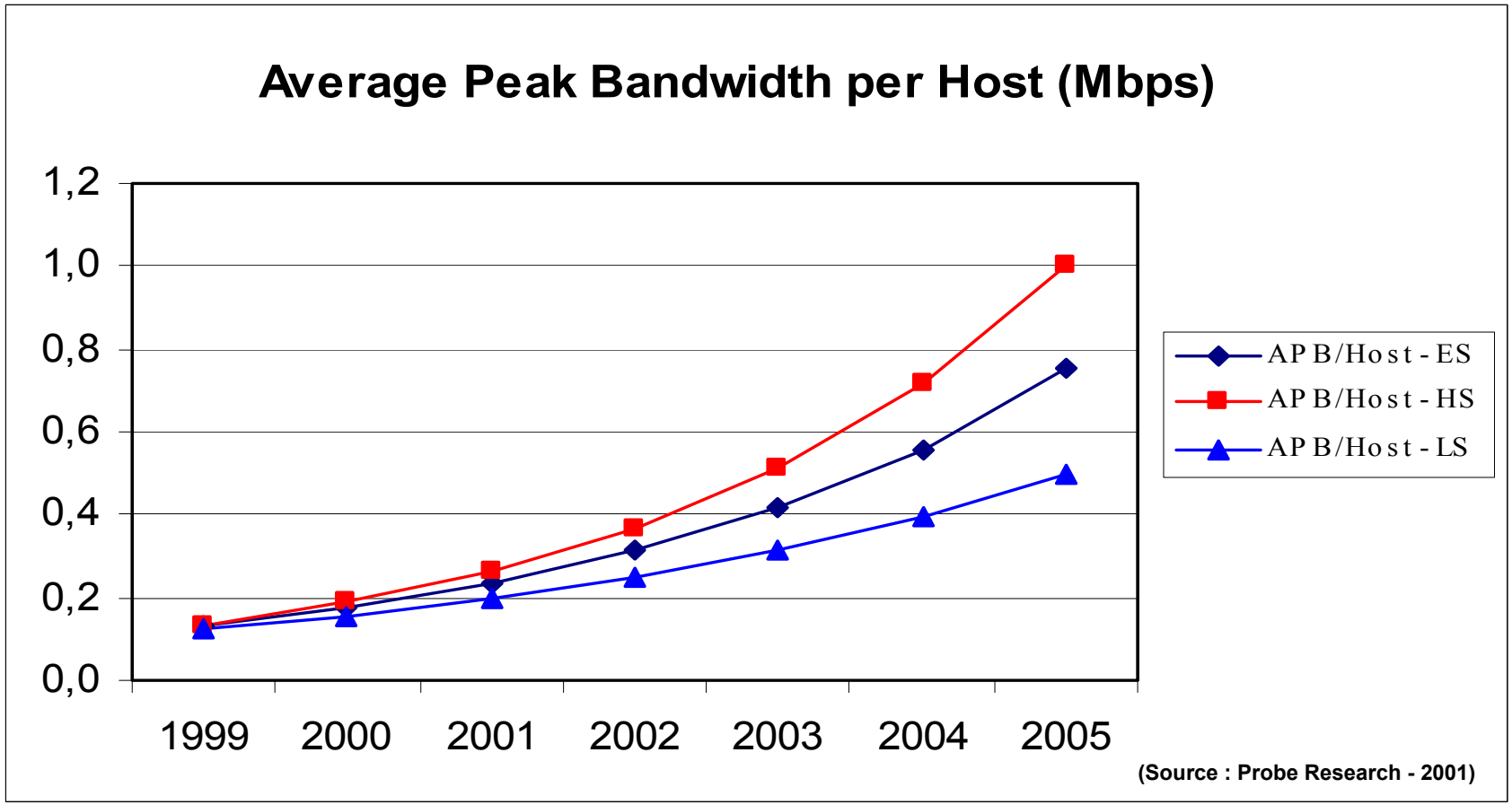
FORECASTS OF THE PEAK BANDWIDTH PER CONNECTION

Average Peak Bandwidth per Connection (Mbps) is provided by ISPs and Carriers. The following scenarios could be assessed as an average for the Global French Market :



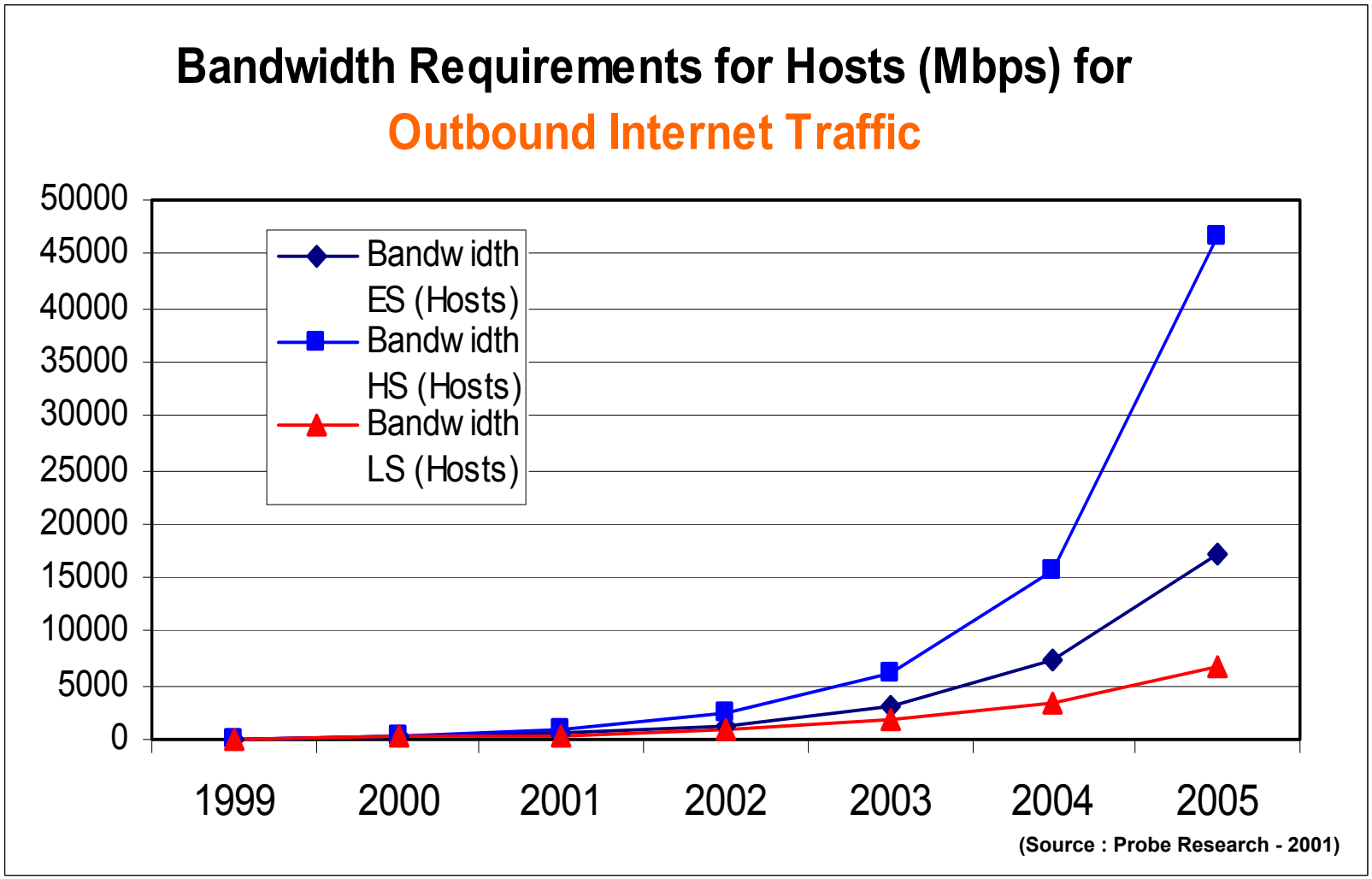
FORECASTS OF THE PEAK BANDWIDTH PER HOST

Average Peak Bandwidth per Host (Mbps) is provided by ISPs and Carriers. The following scenarios could be assessed as an average for the Global French Market :

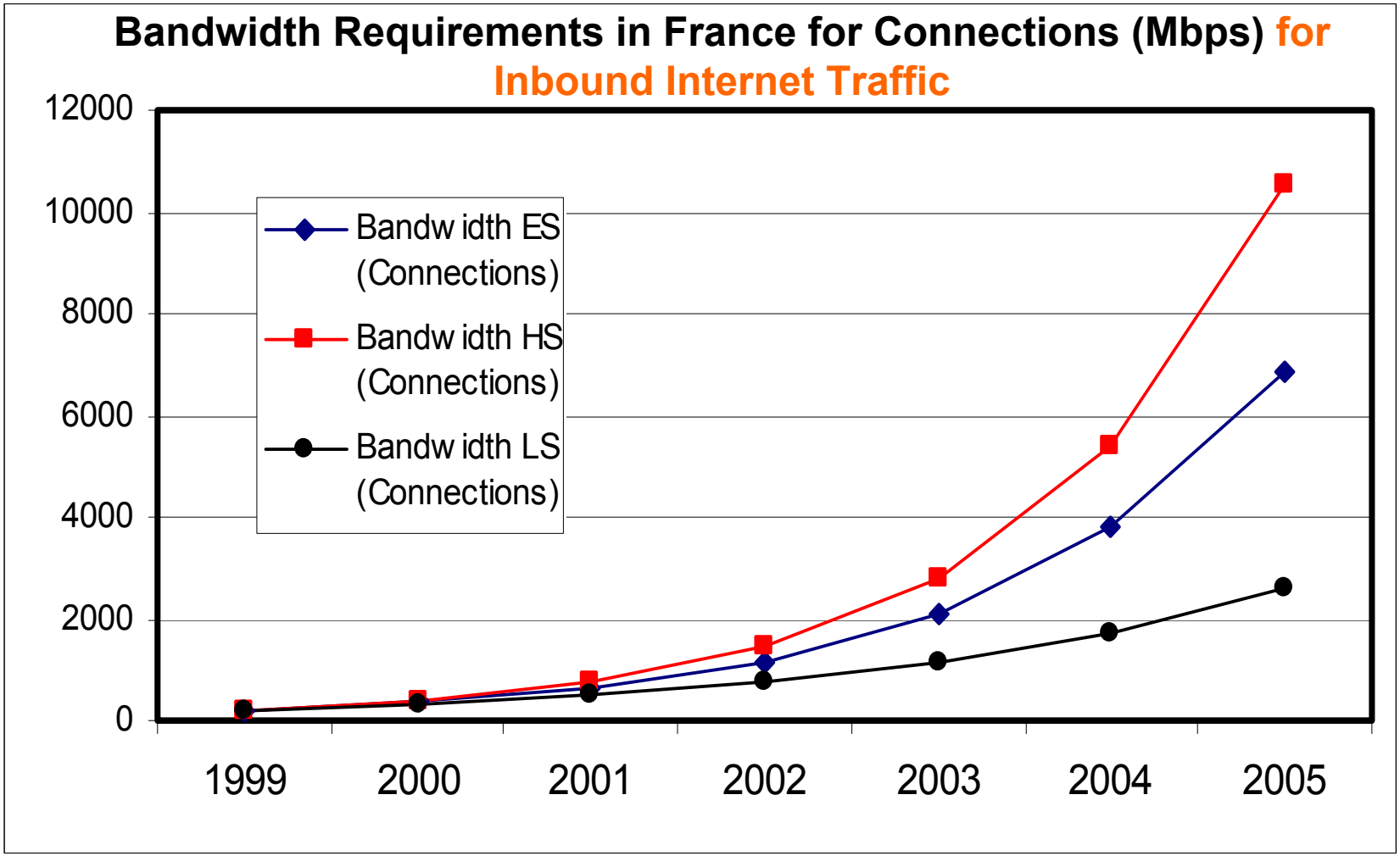


(Source : Probe Research - 2001)

FORECASTS OF THE REQUIRED CAPACITY FOR HOSTS



FORECASTS OF THE REQUIRED CAPACITY FOR CONNECTIONS



FORECASTS OF THE REQUIRED CAPACITY FOR INTERNET

- **The required capacity for All Internet Traffic in France (International + National) is dimentionned by the larger of the Inbound or the Outbound Traffic**

	1999	2000	2001	2002	2003	2004	2005
Bandwidth ES (Hosts)	145	243	606	1368	3184	7398	17192
Bandwidth HS (Hosts)	151	264	915	2353	6074	15686	46718
Bandwidth LS (Hosts)	137	216	431	854	1702	3387	6873
	1999	2000	2001	2002	2003	2004	2005
Bandwidth ES (Connections)	198	350	656	1168	2112	3782	6828
Bandwidth HS (Connections)	204	381	746	1448	2801	5419	10512
Bandwidth LS (Connections)	186	319	485	732	1127	1713	2628

- **Capacities by carriers and by ISPs are derived from market shares.**

CONCLUSIONS

- Top Down Forecasts for the Global required capacity seems to be equivalent with the Bottom Up forecasts (i.e by custumer segments).

- The accuracy of models is low due to the own nature of the Internet evolution.

- It is necessary to create a dynamic learning environment to consolidate the forecasts and their accuracy.

- It is very useful to run the alternative scenarios to assess the impact of different strategies (marketing, network) on the Internet services

THANK YOU FOR YOUR ATTENTION

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