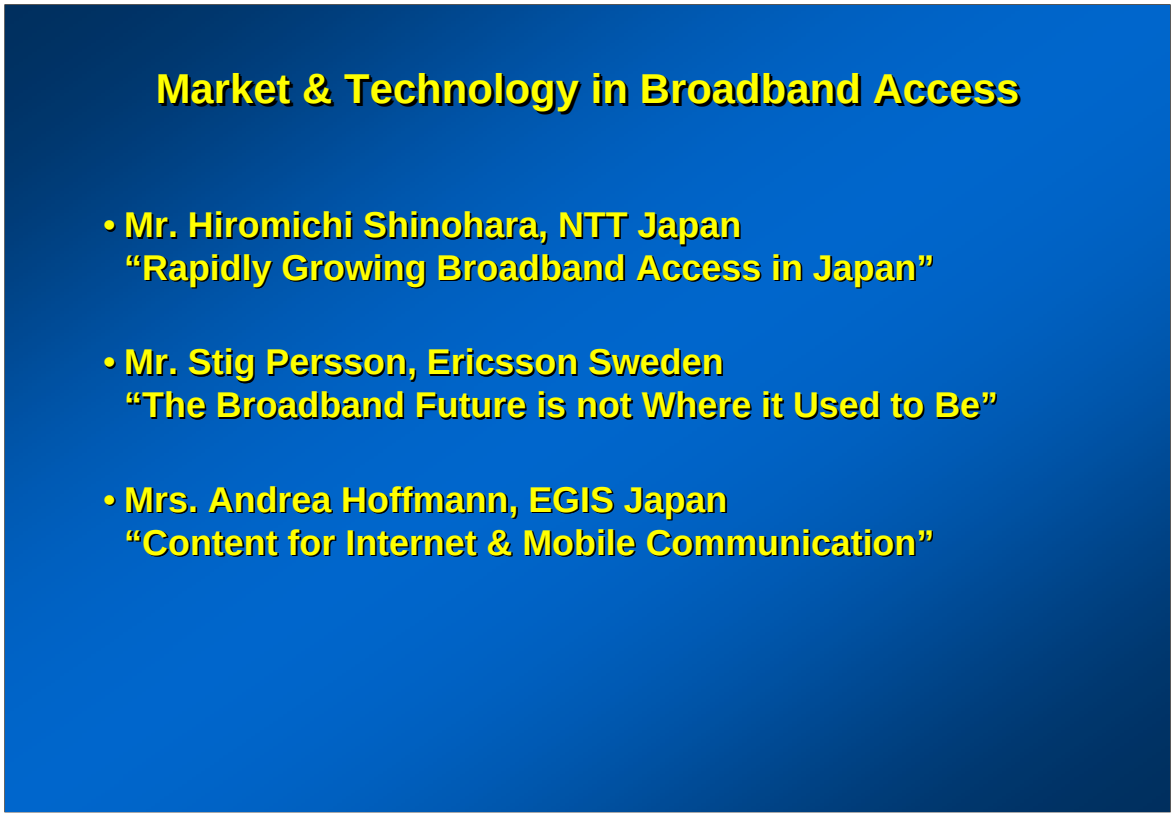
Good morning everybody.

Thank you very much for joining our session this morning for “Market and Technology Broadband Access”. Broadband should be one of the most promising technologies in the IT industry right now. The number of internet and broadband subscribers is growing very rapidly over the world. However, there are still some controversial aspects of the technology and market.

Today we want to focus on some of these issues. The first one is a comparison of the broadband access technology such as ADSL, FTTH and cable television, because there is some competition among these technologies in all regional markets.

Secondly the migration of the fixed wire and mobile telephony should be a key agenda item. In order to anticipate a conclusive growth of broadband markets, the migration becomes very essential technically as well as commercially.

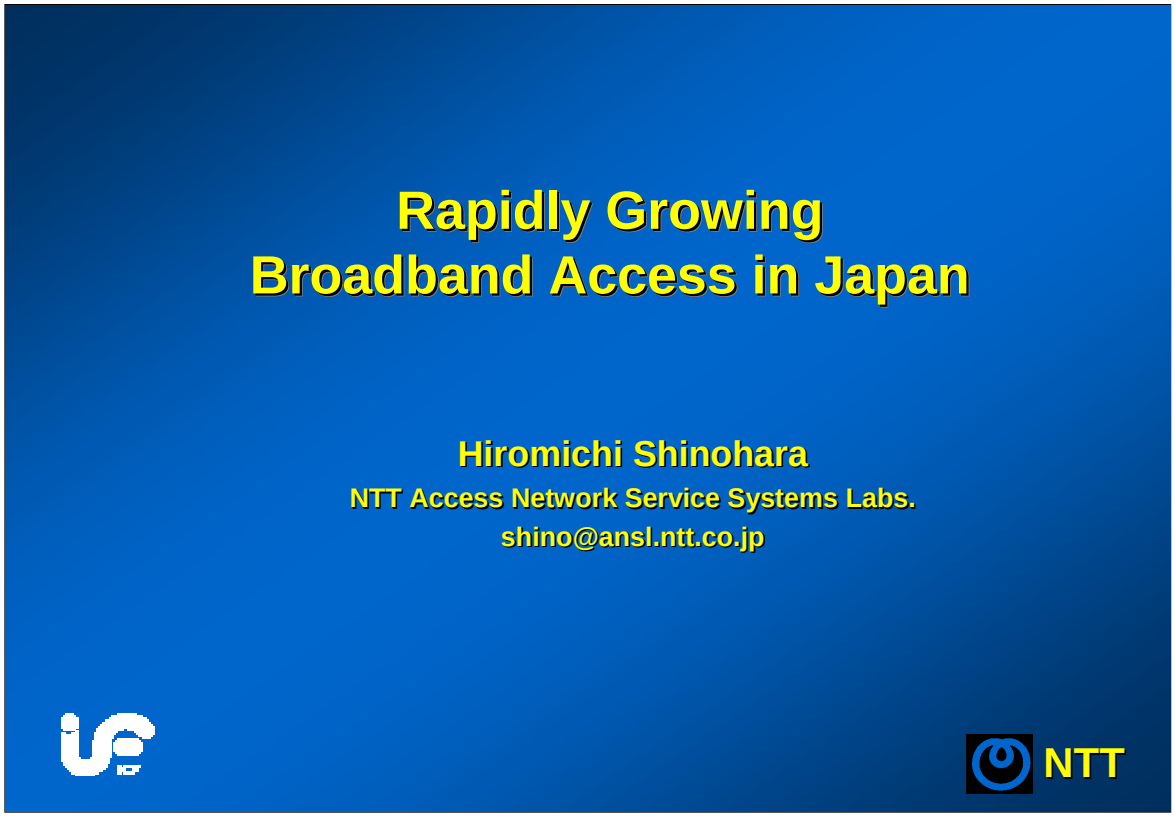
Suddenly, software and the contents for broadband can be very interesting to know because everybody has been wondering about what can be the killer content for broadband in the future.



This morning we have three outstanding specialists to address such questions from different perspectives. They will show us some clear views for broadband technology in the market.

The first speaker is Mr. Shinohara, Director of Nippon Telegraph and Telephone corporation. Presently he is responsible for the access network service system laboratory in the company. As a well-known researcher he has been leading the telecommunication technologies in Japan and in other countries. Today Mr. Shinohara will focus on the Japanese broadband access network, which has rapidly grown in the past several years. In addition, his presentation covers comprehensible comparisons between FTTH and the other technologies, also the cycles in the broadband industries. Finally, he will tell us about the existing opportunities for the cable suppliers and the future technologies.

Mr. Shinohara, please be so kind to start your presentation.



Good morning.

Today, I like to talk about broadband access in Japan. Although the title says Japan, I will be speaking primarily from the standpoint of NTT worldwide.

The outline of my speech is as follows:

Broadband access market in Japan

Optical access services and optical access network

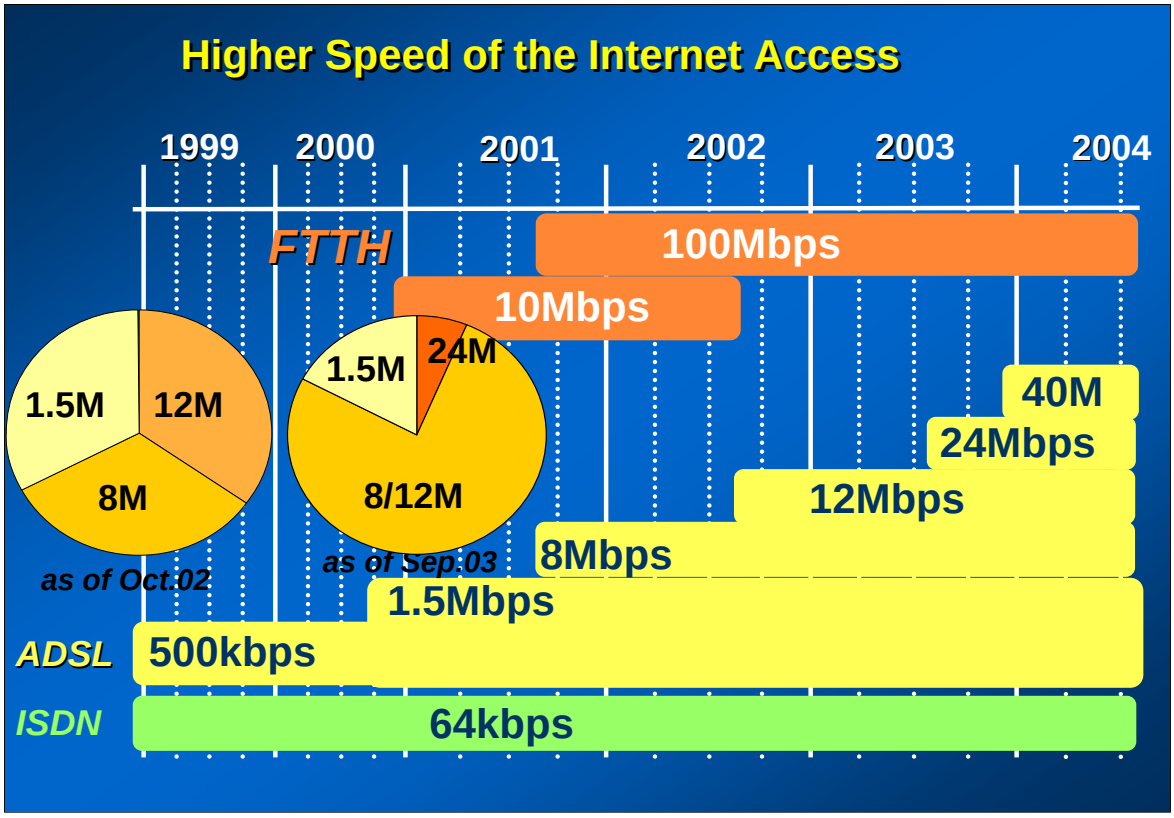
Obstacles to prompt a massive FTTH service offering, typical R&D

issues to overcome the obstacles.

In Japan, the access network market has been rapidly growing and changing.

So, first, let me show you the trend of telecommunication services and the competitive environment of the access network market in Japan.
Secondly, I will introduce the optical access services, NTT currently offers. I will touch on NTT's optical access network.

At last I will discuss the obstacles to prompt a massive deployment of FTTH. Also I will introduce typical R&D issues to overcome the obstacles.



This slide shows the trend of higher speed of the internet access in Japan.

The peak speed of ADSL was one and a half. ADSL service providers have been offering higher speed ADSL services successively in these years. In October of 2002 the percentage of ADSL users is one third for 1.5 Mbit, one third for 8 Mbit and one third for 12 Mbit.

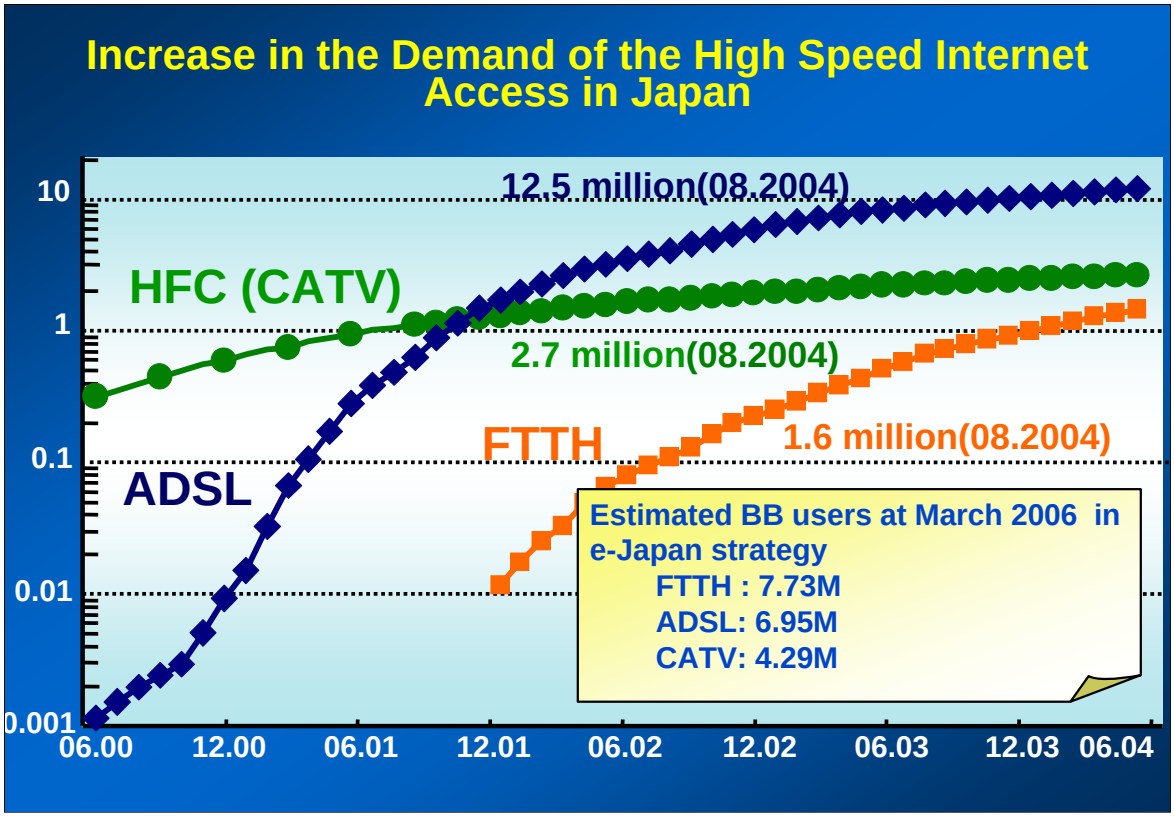
On the other hand, in September last year they are 17% for 1.5 Mbit, 76% for 8 Mbit and 12 Mbit and 6% for 24 Mbit. This indicates that many of the ADSL users do shift to even higher speed ADSL services.

In addition to ADSL, the FTTH service with the bit rate of 10 Mbit was launched in December 2000.

About 8 months after the FTTH service was launched, 8 Mbit ADSL service started and 10 Mbit FTTH service became unattractive. Then FTTH providers added a service menu of 100 Mbit. Since then 100 Mbit has been a major service in FTTH.

As you listened to my speech so far, you would have questions such as “Why is such a high speed access needed?” or “What kind of application requires such a high speed access?”

I think so far there is no killer application for the rapid growth of the high speed access market. The Japanese government has implemented strategies of promoting competition based on e-Japan. There is no doubt that these strategies form the basis for a higher speed access market environment. But I think a hard competition which is among new players other than telecommunication carriers is a main factor of leading higher speed access market. New players of the market make their strategies of offering higher speed service in order to assure predominance in the competition over NTT. This caused a higher speed service to be a central issue in the competition.



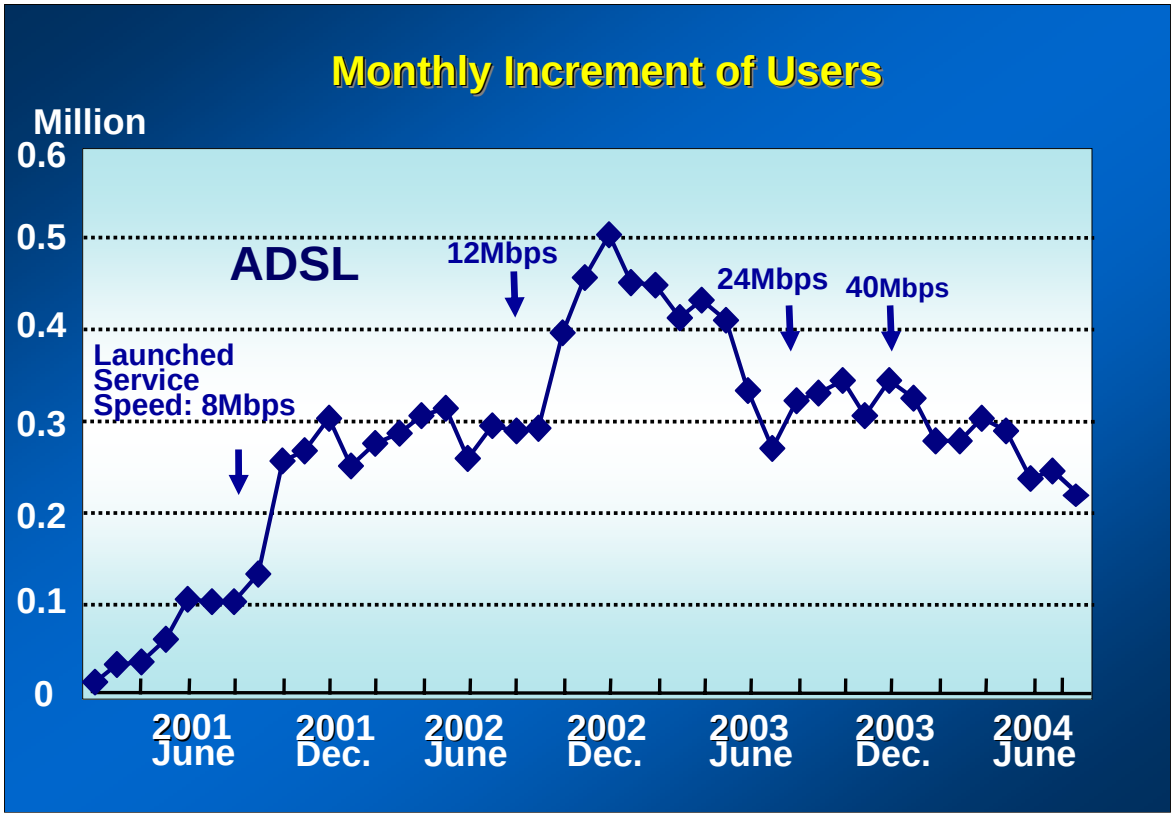
This slide shows the increase in the demand of high speed internet access in Japan. The number of high speed internet users has been growing in an incredible speed.

It was CATV who started offering high speed internet access service earlier than anybody else. They have 2.7 million users at present. However, it does not show a great increase in demand.

It is ADSL where the number of users has increased most in these years. The ADSL service has been offered extensively since mid 2000. Since then the service has been growing at a high speed. The number of ADSL users exceeded 12 million in June of this year.

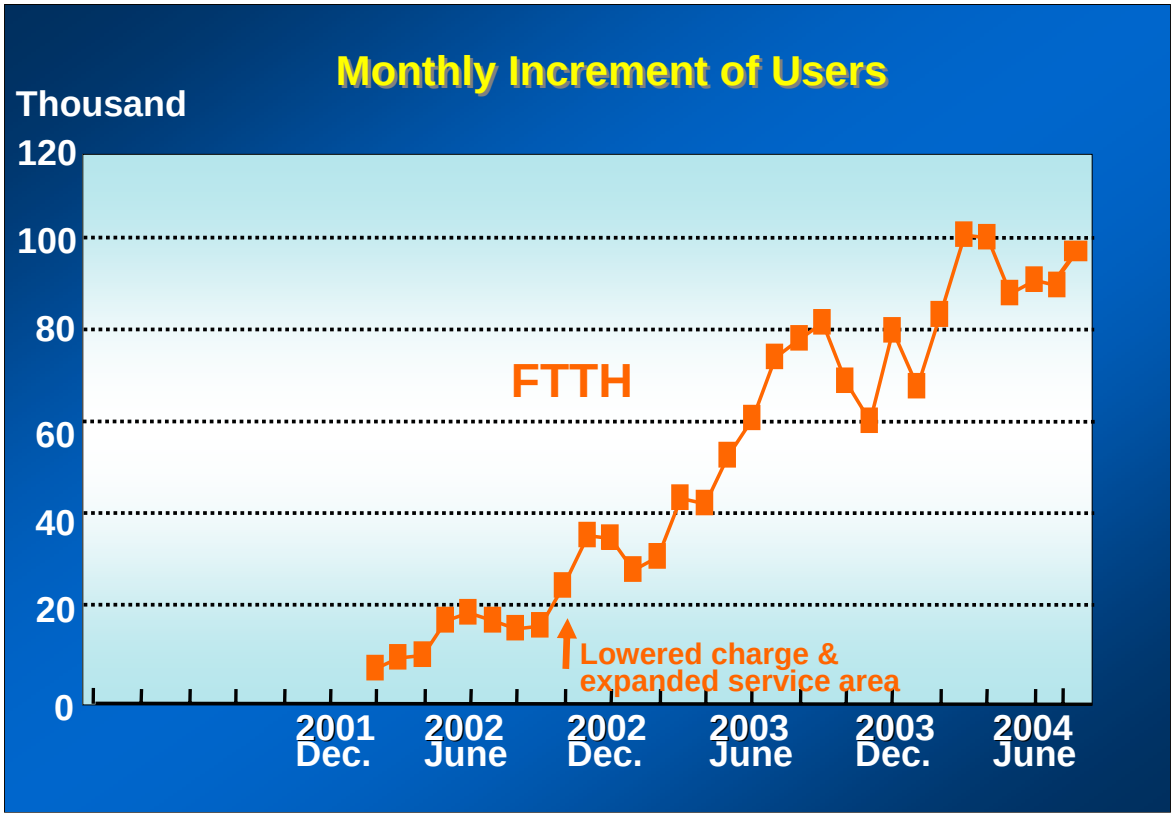
Recently higher speed internet access service offered by FTTH comes into the spotlight. The number of FTTH users has increased 4 times within a year and exceeded 1.6 million in August of this year.

The Japanese government targeted the number of broadband users at March 2006 to be close to 8 million for FTTH, 7 million for ADSL and around 4 million for CATV.

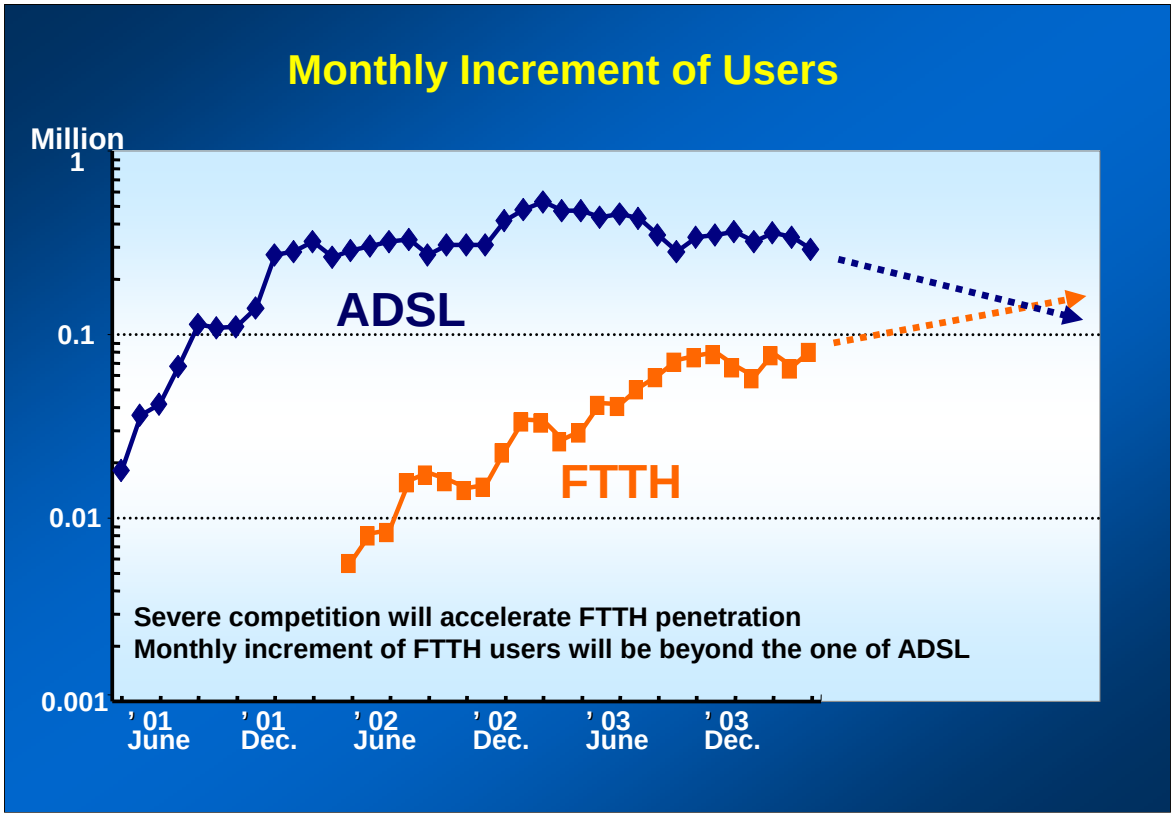


This slide shows the monthly increment of users. From 2001 to 2002, the number of ADSL users has jumped every time the higher service was launched.

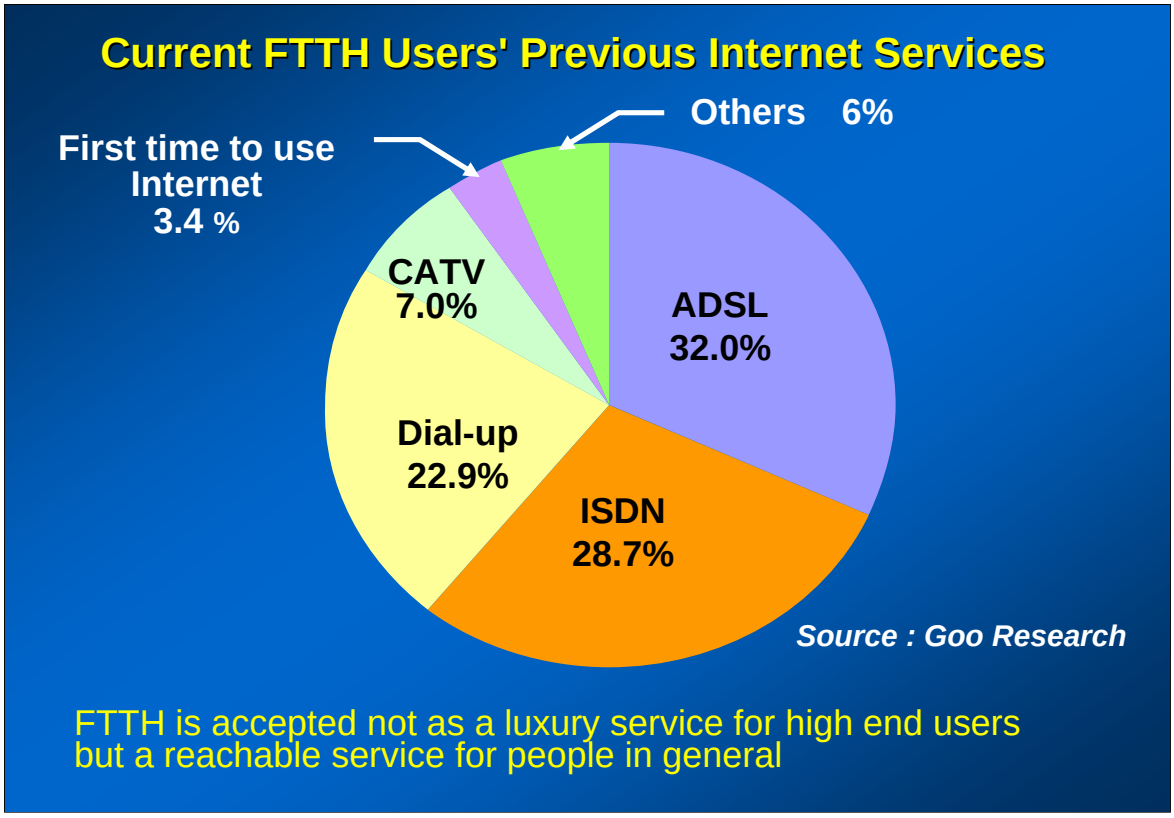
However, since April of last year, ADSL market growth has slowed down. Although the 24 Mbit service was launched in July of last year and 40 Mbit service started in last December the number of ADSL users did not grow by much. This is probably caused by the fact that most users realized that only part of the users can enjoy the benefits of higher speed ADSL service.



The FTTH market is going up. At the initial stage, the service offering area was limited and the service charge was high. So the increase in the number of FTTH users was small. But in autumn of 2002 NTT lowered the service charge and expanded the service offering areas, since then the FTTH service has been expanding rapidly. In these several months, the number of FTTH users increased by more than 80 thousand every month.

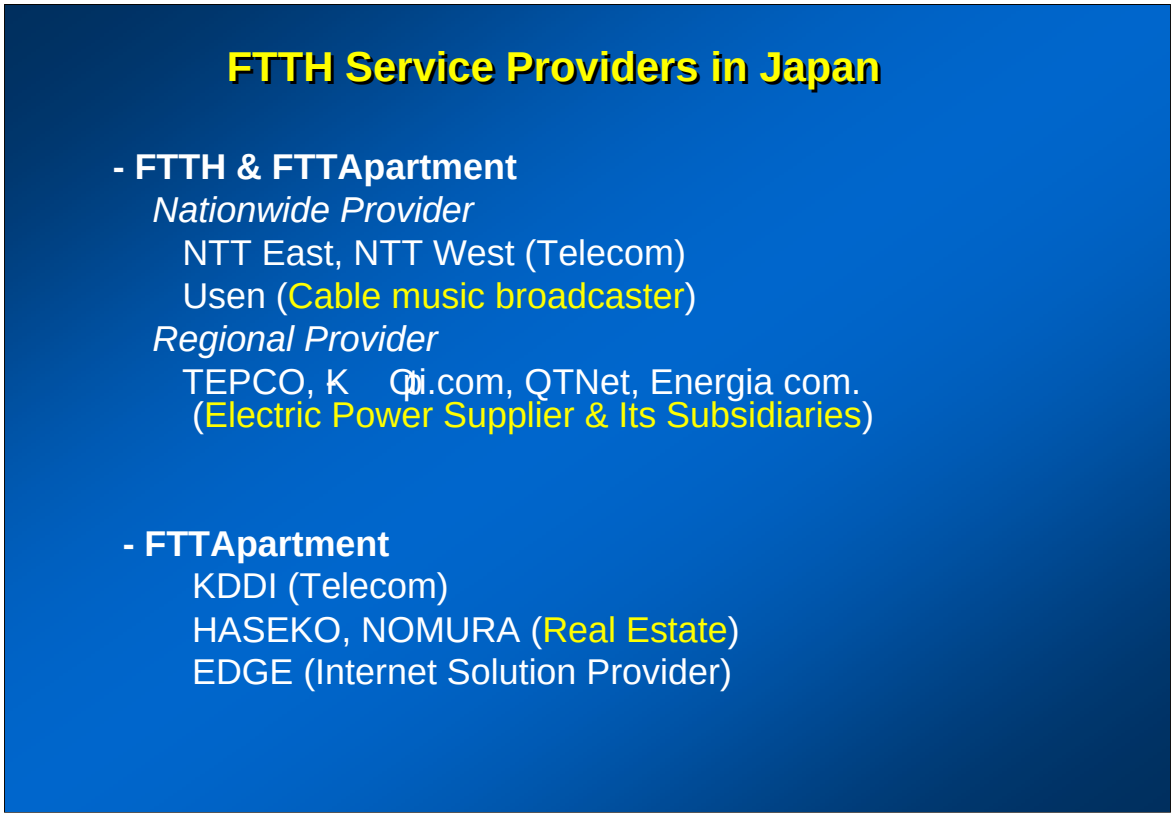


We are expecting that the monthly increment of FTTH user will be beyond the one of ADSL within a year or two. NTT ‘s business plan for this year states that we will have obtained 2 millions of FTTH users in total by the end of this fiscal year.



This slide shows the internet services, which the current FTTH users used prior to FTTH. As you can see a third of the current FTTH users were transferred from ADSL and half of them were transferred from dial-up and ISDN. These users seem to have switched to FTTH service because of their desire to use higher quality and higher speed service. It should be noted that ISDN users and dial-up users have jumped from narrowband services to FTTH directly.

Also it should be emphasized that there are some first time internet users among the FTTH users. This shows that FTTH is accepted not as a luxury service for high end users but a reachable service for people in general.

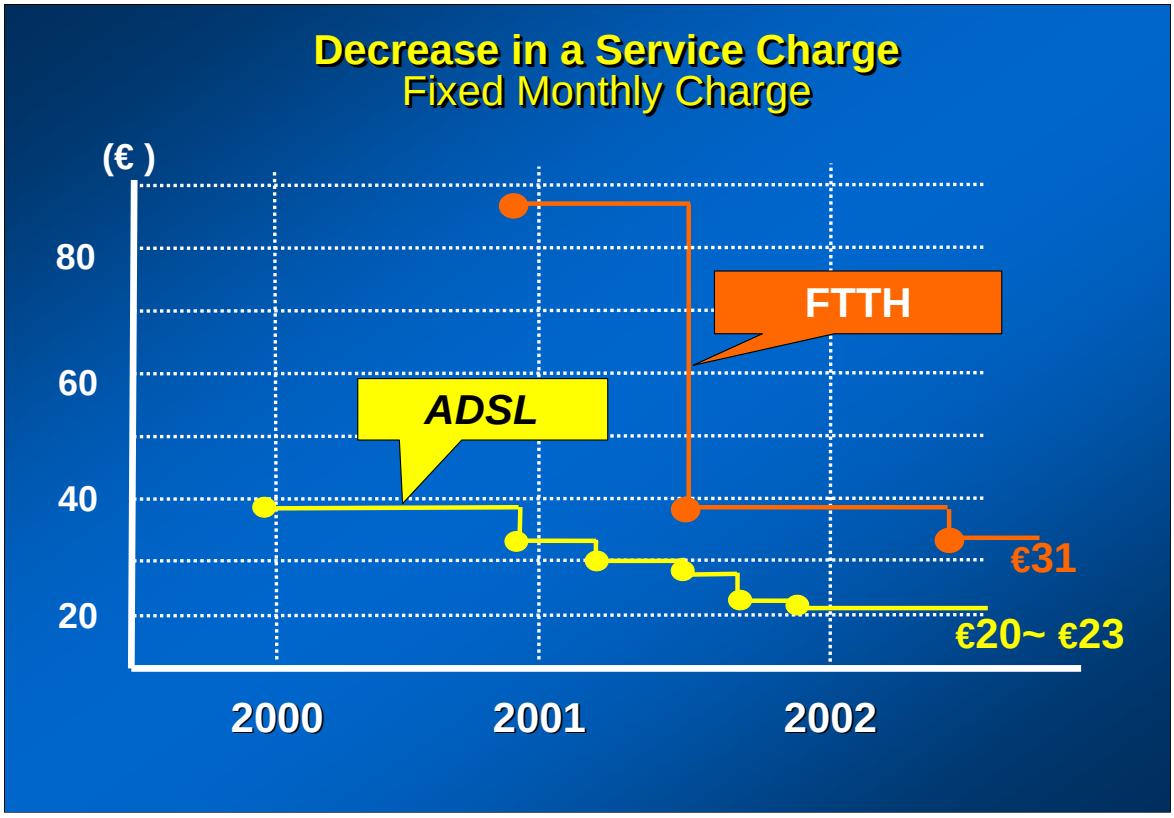


This slide shows typical FTTH providers in Japan.

Besides NTT many players from various industries, such as cable music broadcasters, utility companies and their subsidiaries, have entered this market.

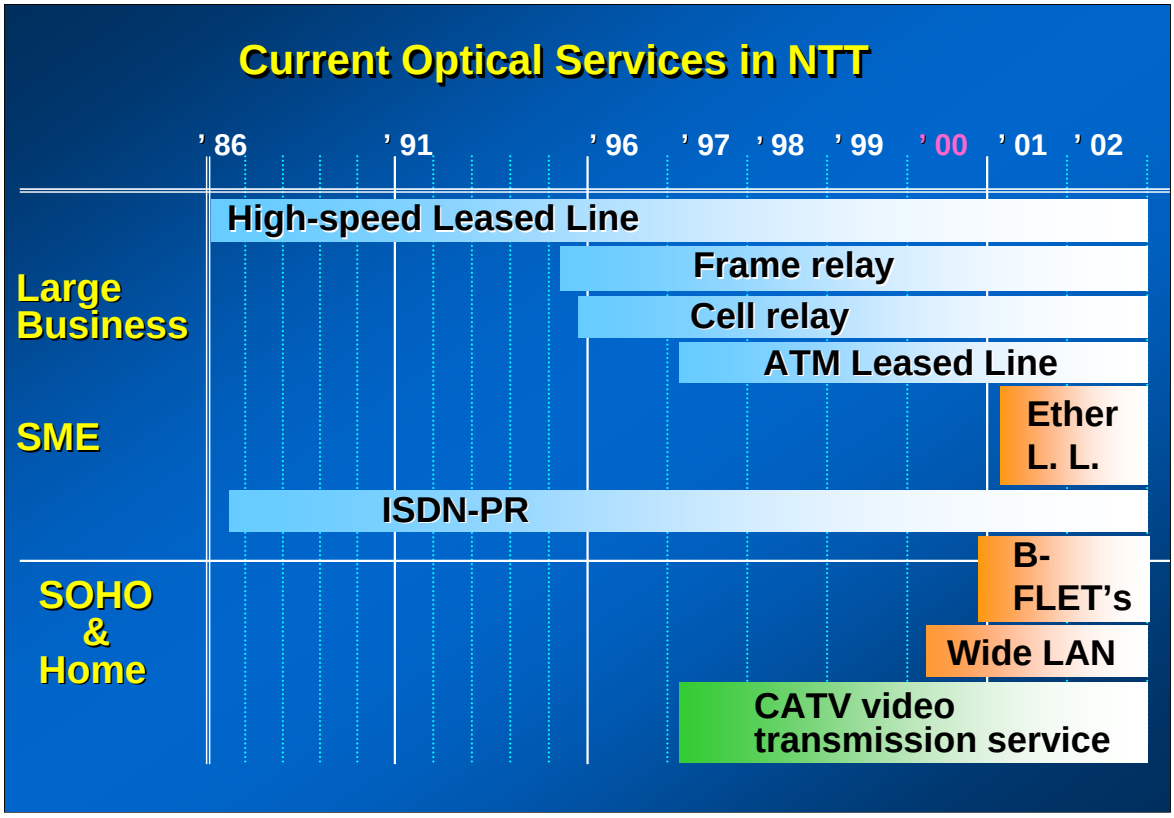
These new players have different ideas from NTT with regard to a charge system as well as service expansion. NTT set a charge considering consistency with the existing service charge and assuming service expansion almost all over Japan.

On the other hand these new players limit their service offering area and set a charge from users' trend. As a result the service charge has been greatly lowered.



This slide shows the decrease in the fixed monthly charge.

An ADSL charge was lowered to half and FTTH service charge was lowered to one third in just two years. As we can see from these data the fixed monthly charge is fairly low. I think this is a result from the keen competition.



Next, I will introduce optical access services NTT currently offers. And also I will touch on NTT's optical access network.

NTT started offering optical access services in 1986.

At the initial stage, these services were for business users, such as high speed leased line, frame relay and so on.

In 1997, NTT launched its first FTTH service and CATV video transmission service. In this service, multi channel video signals are transmitted from CATV operators to users via NTT optical fibers. A telephone or ISDN provided by NTT can be transmitted with multi channel video signals simultaneously via a single optical fiber. NTT started offering this service aiming to share the cost for FTTH with the CATV operator. However, this idea was not much accepted by the CATV operator. So the service offering area of this service is very limited right now.

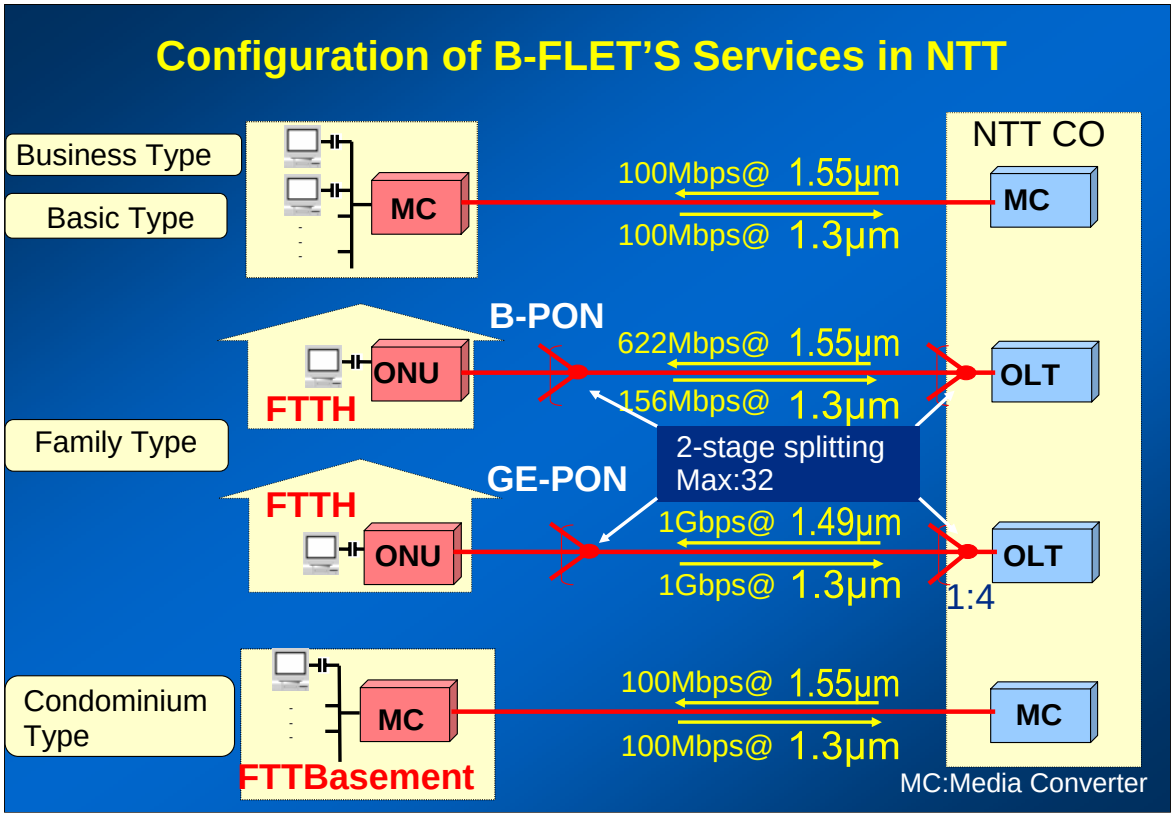
In December 2000, NTT launched its high throughput, flat rate internet access service named B-FLET's.

B-FLET's : NTT's Main FTTH Service

- ***FLET's* Service (*F*lat, *F*lexible, *F*riendly, *L*et's start)**
  - *FLET's ISDN, FLET's ADSL, B-FLET's*
  - Internet Access Service
  - Users can access to their contracted ISP
  - A best effort network service
  - Fixed monthly charge
- ***B-FLET's* Line-up (Peak rate : 100Mbps)**
  - Business type *(For Large Businesses)*
  - Basic type *(For SME & Heavy Users)*
  - Family type *(For Mass Users)*
  - Condominium type *(For Mass Users)*

B-FLET's is one of the FLET's services. There are FLET's ISDN, FLET's ADSL, B-FLET's. FLET's enable customers to access their contracted ISP. So FLET's is an internet access service. It is a best effort network service. A fixed monthly charge is applied.

Depending on the target users, B-FLET's offers four types of service: Business type, basic type for SME and heavy users, family type for mass users and condominium type service. The peak speed of B-LET's is 100 Mbit/s. BFLET's is the main FTTH service in NTT.



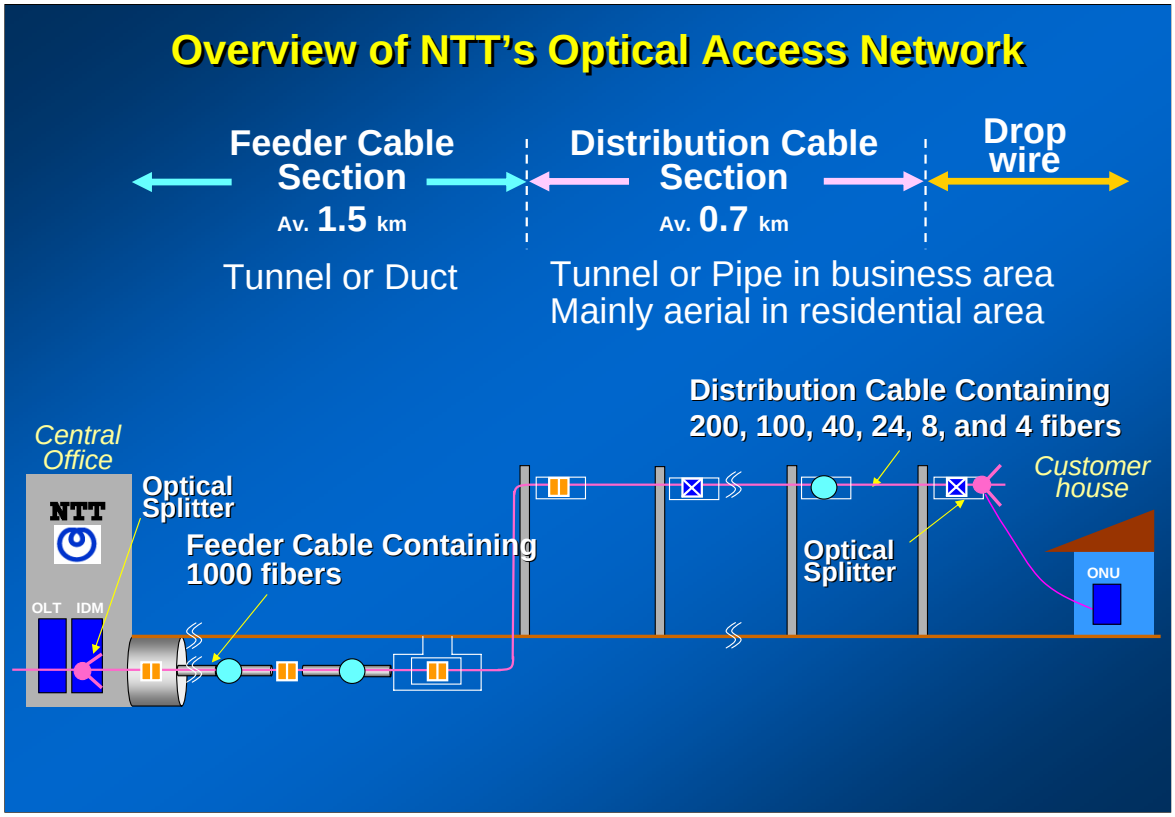
This slide illustrates the configuration of B-FLET's services.

Media converter (MC) has been used to provide B-FLET's business type, basic type and condominium type services. The peak speed of a media converter is 100 Mbit/s.

In offering condominium type service, MC is installed in the basement, namely FTTBasement or FTTAppartment. In most cases other than these, MC or ONU are located inside each home, namely FTTH. A B-PON system has been introduced on a large scale to provide B-FLET's family type services since December 2002. The transmission speed of the B-PON system is 622 Mbit/s for downstream and 156 Mbit/s for upstream. The service speed for the B-PON system is 100 Mbit/s.

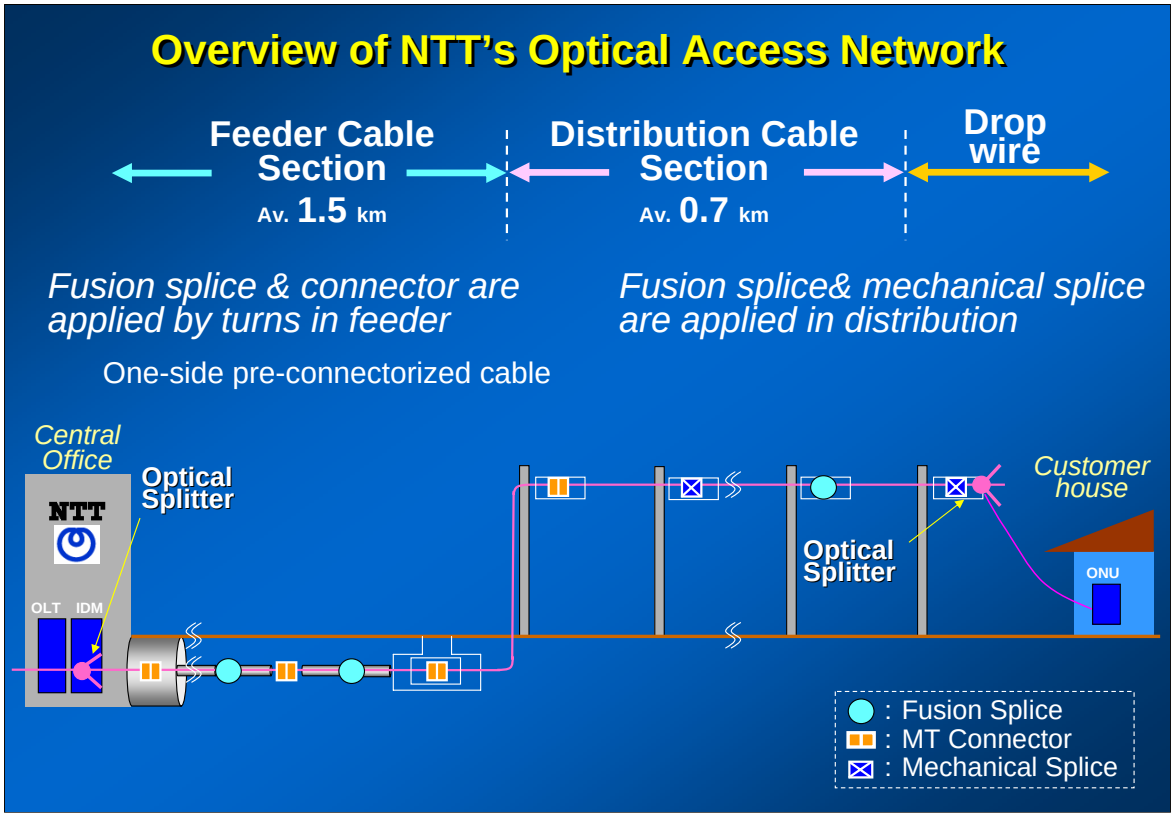
Recently, one of NTT's competitors is starting to advertise superiority of its dedicated 100 Mbit/s point-to-point (P2P) system against B-PON. At NTT laboratories we have developed the GE-PON system following B-PON to reinforce our competitiveness. NTT will start introducing the GE-PON system in place of the B-PON system this autumn. The transmission speed of the GE-PON system is 1 Gbit/s for both ways.

Upon the implementation of B-PON and GE-PON, we employed 2-stage splitting, 1 by 4 and 1 by 8. This is because one stage splitting could lower the take rate under the present density of demand and which results in a cost increase.

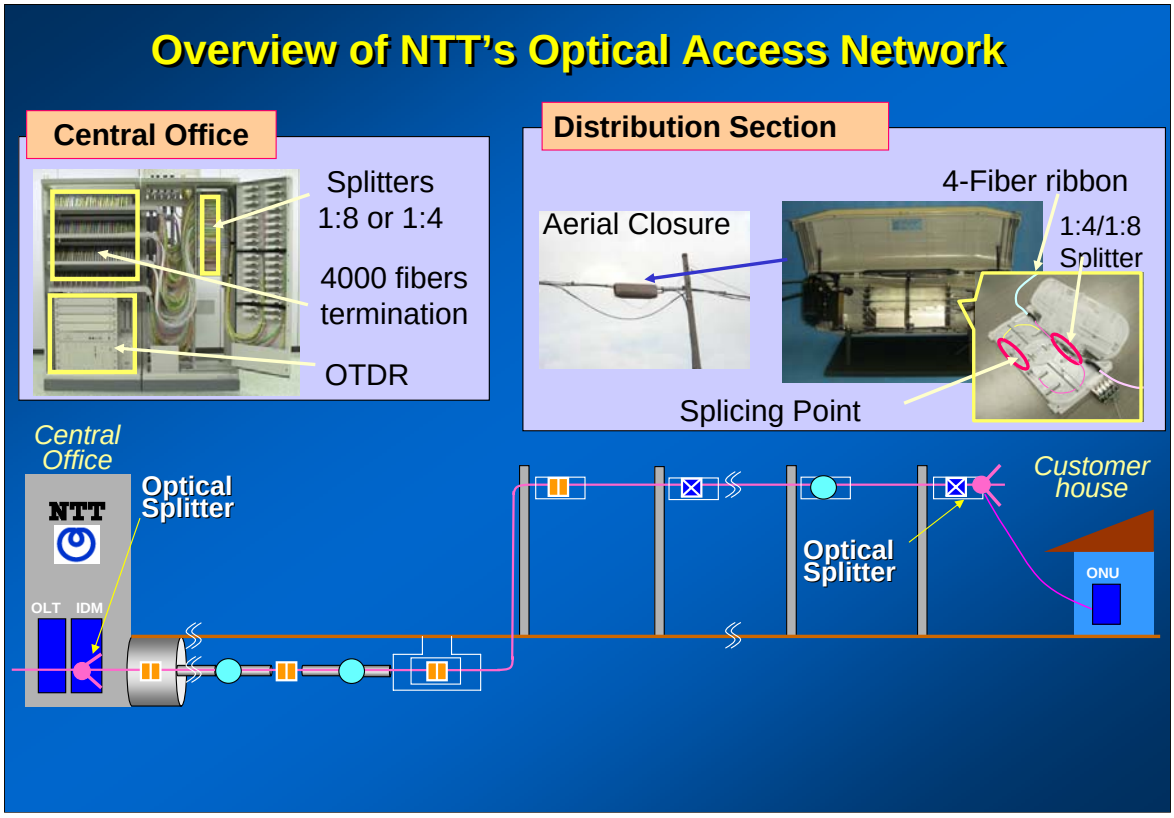


This slide shows an overview of NTT's optical access network.

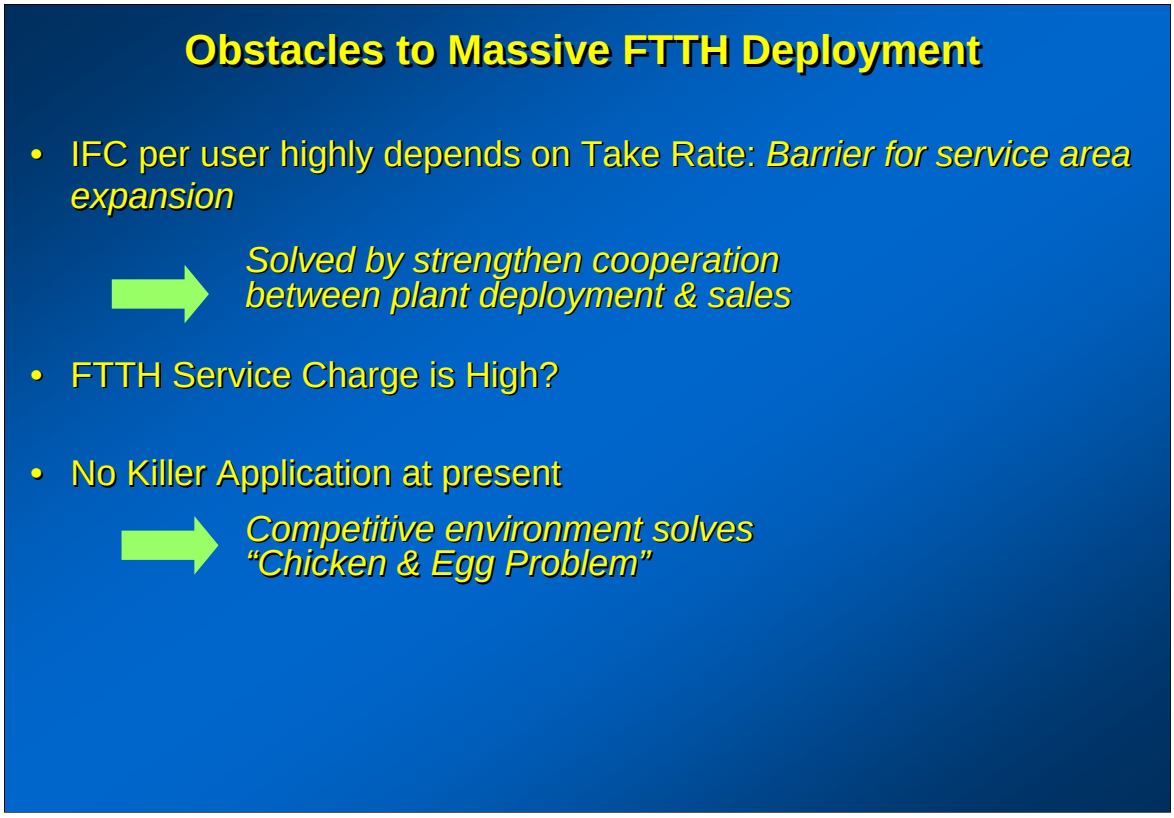
The average length of the feeder cable is 1.5 km and that of the distribution cable is 700 m. Feeder cables are installed in tunnels or ducts. In business areas distribution cables are installed in tunnels or ducts, too. On the other hand, distribution cables are mainly aerial in residential areas.



To connect feeder cables, fusion splices and connectors are applied in turns, one by one. One side of the feeder cable is pre-connectorized. To connect distribution cables, fusion splices and mechanical splices are used. Previously only fusion splices were used. However, to achieve massive FTTH deployment, too many fusion splice machines were needed. So recently we started to introduce mechanical splices, too.



You can find 1 by 4 optical splitters in 4.000 fiber termination frames. 1 by 8 optical splitters are installed in aerial projects.

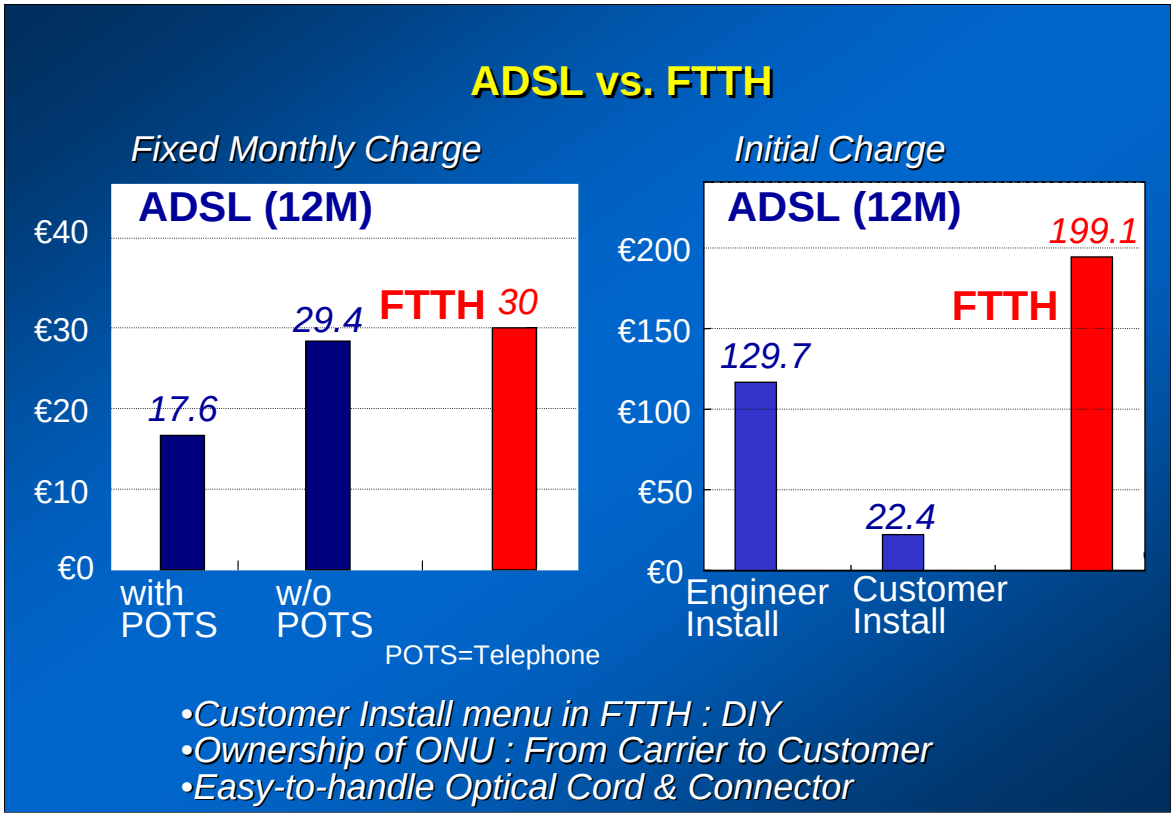


At last, I will discuss the obstacles to prompt massive FTTH service offering. It is said, that there are several obstacles to widely spread FTTH service.

The first one is regarding service area expansion. Total cost per user highly depends on the take rate. This could be an obstacle when we start offering FTTH service in new areas. But I think this obstacle must be overcome by strengthening cooperation between prime deployment and sales.

The second one is the service charge. FTTH charge is expensive compared to the ADSL charge. It is generally said that higher charge will be an obstacle for widely spreading FTTH. I will discuss this point under the service charge later.

The third point is that there is no killer application for FTTH so far. It is often said that ADSL is sufficient for broadband access. But I think this will be a "chicken and egg" problem. As we have seen, a hard competition lead to a higher speed access market. As FTTH service becomes more popular to the competition, the "chicken and egg" problem will be solved.



This slide compares the service charge of ADSL and FTTH.

The graph on the left compares the fixed monthly charge. The FTTH charge is about 1.5 times the ADSL charge. In ADSL the package service with conventional telephone is a precondition of a low service charge. If the telephone service is not used, ADSL differs only a little from the FTTH charge.

Recently, cellular phones are the main communication devices among the young. There are many young people who do not use POTS. The number of such people tends to increase.

In addition to that, Voice over IP (VoIP) is getting popular in Japan. For these users, there is little difference in the monthly charge between FTTH and ADSL. So, I think that the difference in the monthly charge is no longer an obstacle.

The graph on the right compares the initial charge. The initial charge of FTTH is much more expensive compared to that of ADSL. This is probably because the in-house wiring and ONU installation take a while. Also ADSL has a service menu of customer install it and this is very cheap. So I think the difference in the initial charge will be a barrier to widely spread FTTH. To remove this barrier, it is indispensable to improve in-house optical wiring technology and also it is important to offer a service menu of customer install also in FTTH. Therefore, our next R&D target is to realize “Do It Yourself” (DIY) in FTTH.

Obstacles to Prompt Service Offering

- **Difficulties in Prompt Service Offering After User's Subscription**
  - from several weeks to a few months
- **Cause of the Delay**
  - Need optical cable installation in the new users' area : *Facility (OLT, Cable)*
  - Network Element Allocation Takes from days to weeks : *OAM&Provisioning*
    NE : Feeder cable, Distribution cable, Splitter, OLT
    Carried out manually & separately in several divisions
  - First Mile Bottleneck : *Construction work*

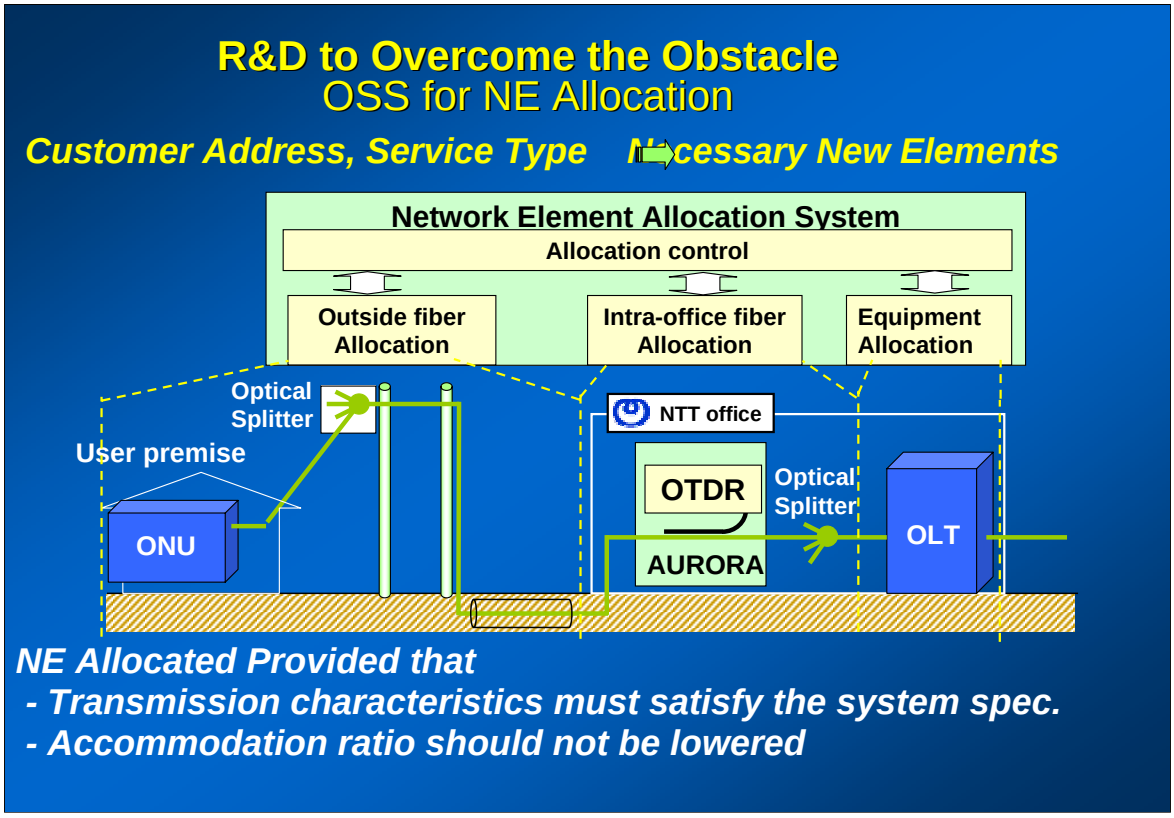
As I mentioned in the beginning, in Japan FTTH service is growing rapidly. We are now facing a problem in providing FTTH service. We may not be able to offer FTTH service immediately according to user demand. For example, NTT West is offering FTTH service to more than 8.000 users every week. However, there are much more potential users who ordered service. It takes from several weeks to several months to offer FTTH service after user's subscription.

This delay is caused by three factors.

The first one is that, if the optical cables have not been installed in the new user's area, we have to begin with the primary step of the construction.

The second one is that it takes from several days to several weeks to allocate necessary network elements such as feeder cable, distribution cable, splitter and OLT. This is because network element allocation is carried out manually and separately in several divisions.

The third one is the so-called first mile bottleneck.

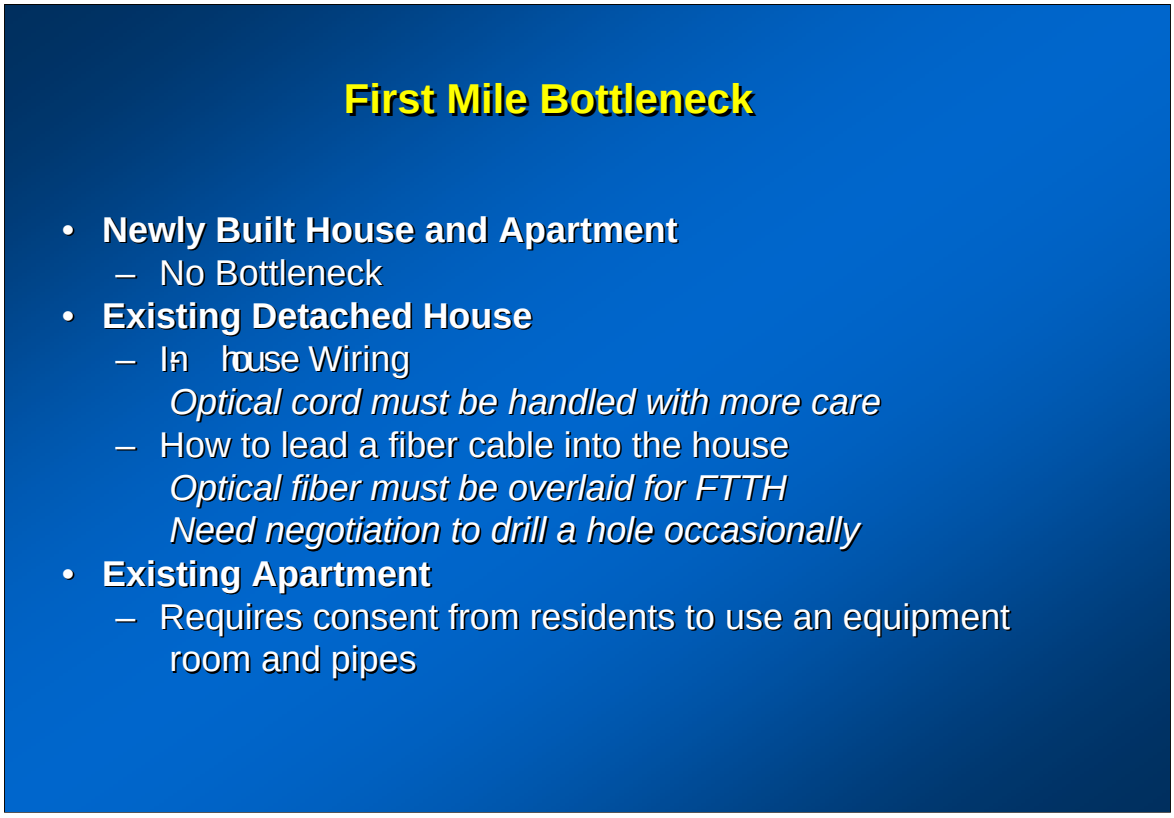


If optical distribution cables have already been installed, the FTTH service can be started within 9 days. However, it is only a quarter of the area available for service at the time of March 2003. In the area where only feeder cables were installed, we need to install distribution cables. Following the user's subscription it will take a few weeks to start. In areas without optical cables it will take a few months to start.

To give a prompt service provision, we will install distribution cables, starting from the area with high demand. Consequently, we aim to expand the area where FTTH service can be provided within 9 days after user's subscription.

Now we are working to shorten the time for the network element (NE) allocation. To do this we have developed an operation support system (OSS) for network element allocation. By inputting customer's address and service type, all necessary network elements can be allocated within 2 minutes.

Network elements are allocated considering two points. Firstly, transmission characteristics such as total loss or type of filter inserted must satisfy the system specification. Secondly, take rate and accommodation ratio should not be lowered. This operation support system is expected to reduce the required time for service offering drastically.



The first mile bottleneck depends on the type of houses. Newly built houses and apartments do not have any bottlenecks.

In existing houses the difficulty of in-house optical wiring is the greatest bottleneck. This is because the optical cord must be handled with more care than the metallic wire, when we bend or staple to the wall.

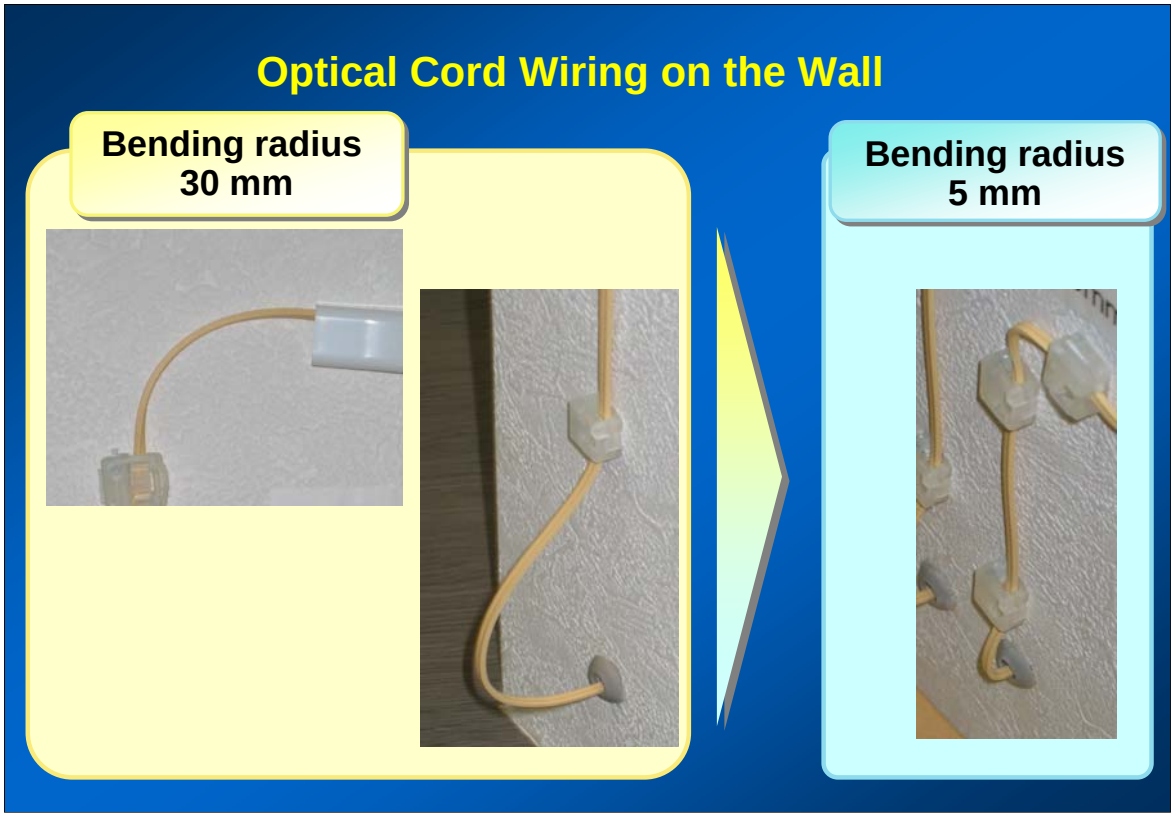
How to lead optical cables into the house is also a bottleneck. In Japan telephone is offered by other metallic wires. Therefore we have to overlay optical cables for FTTH. It is easy to overlay optical fiber cables to the outside wall of the customer's house. The problem is how optical fiber cables can be put through the outside wall. If there is already a hole in the outside wall cables can easily be put through, but in case there is not a hole we must negotiate with the customer to drill a hole.

In the existing apartment, more than a certain amount of residential consent is required to use an equipment room or pipes. In case the residential consent cannot be obtained overhead cables must be wired directly to each home. But in the existing apartments wiring overhead cable to each home cannot be accepted, because it is considered to spoil the appearance. These are the first mile bottlenecks we are now facing.

R&D to Solve First Mile Bottleneck

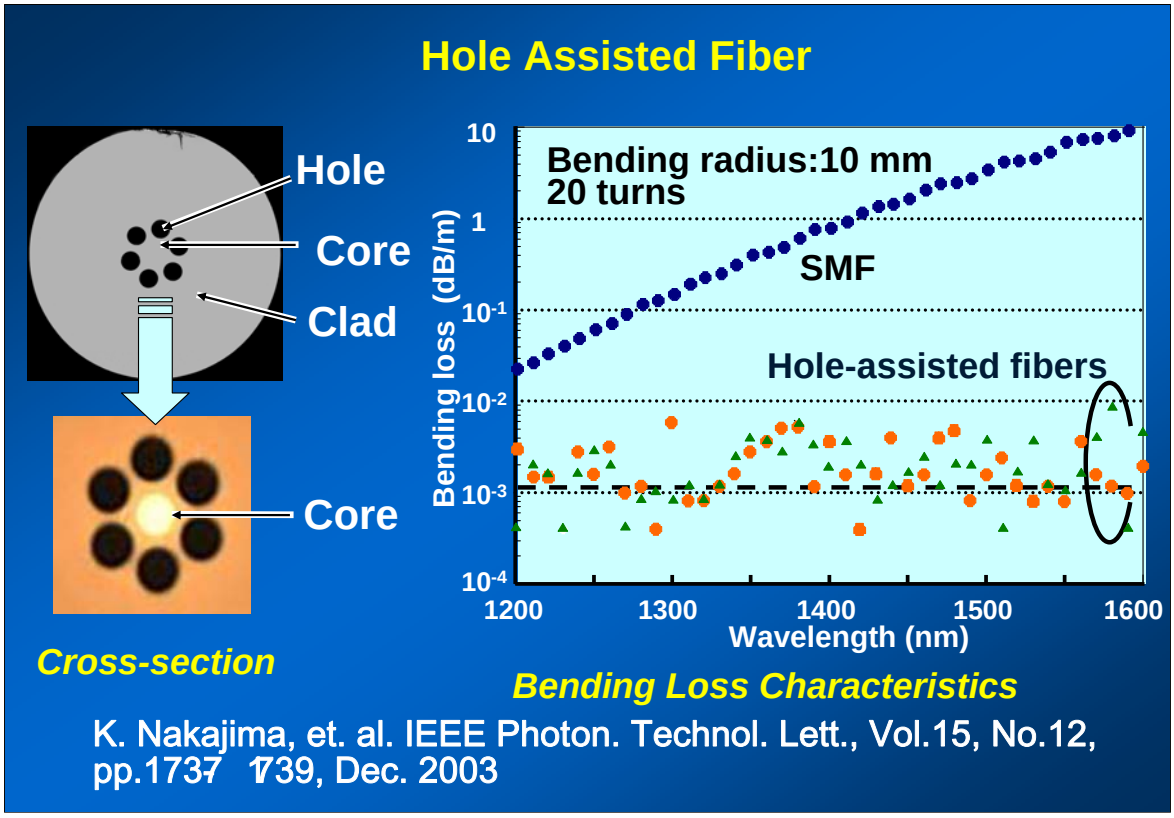
- **Solutions for First Mile**
  - Flexible Fiber Cord
    Min. Bending radius : 30mm → 15mm → 5mm
  - Improved Wiring Method Through the Bending Pipe
  - Improved Splicing Technologies
  - Fixed Wireless Access System
  - Easy to handle optical cord & connector

To solve the first mile bottleneck, I think we should develop various measures depending on user's housing condition. We have under development several solutions as listed in the slide. Among them I like to introduce an optical cord that can be bent at a small radius. Our target for minimum bending radius is 5 mm, tentative target is 15 mm.



These photos show optical cord wirings on the wall. The photo on the left shows the current optical cord with a minimum bending radius of 30 mm. As you can see, this optical cord does not look neat and also there is a possibility of pulling it when something catches in it.

This is the main reason for taking time on in-house optical wiring. The photo on the right shows an optical cord with a minimum bending radius of 5 mm. This optical cord can be wired almost in the same way as a metallic wire.



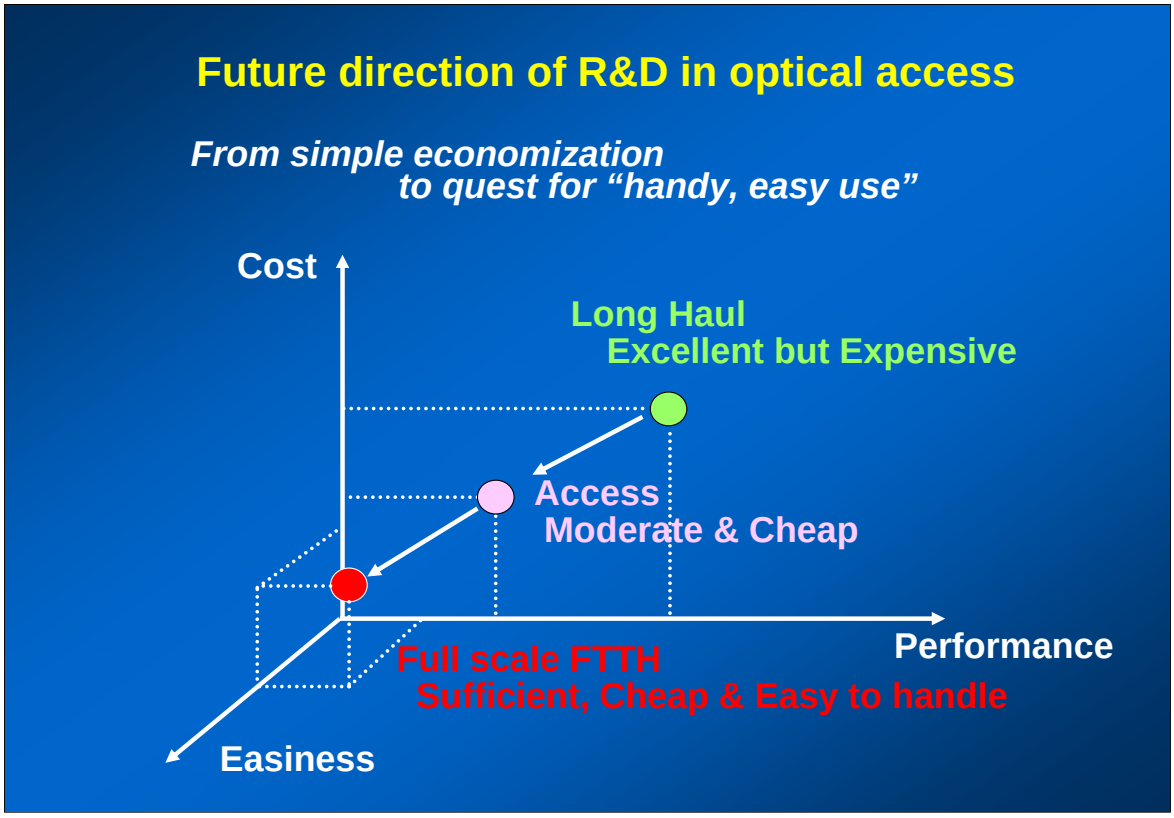
This slide shows an example of an optical fiber that can be bent at small radius. This is a hole-assisted fiber. The photo on the left shows the cross-section of the fiber. The core is surrounded by 6 air holes.

The preform of this fiber can be made by drilling to make holes in the preform of conventional single mode fiber (SMF). So the hole-assisted fiber can be produced economically.

The hole-assisted fiber is designed to lower the bending loss, and be able to be connected with the conventional splicing technologies. The graph on the right shows the bending characteristics. When the bending radius is 10 mm, this hole-assisted fiber shows a very little loss increase over a wide range of wavelengths. Also this hole-assisted fiber shows a very little increase in bending loss when the radius is 5 mm.

Furthermore, the Mode Field Diameter of this hole-assisted fiber is almost the same as that of conventional single mode fibers. So the connection loss is small when we connect it to single mode fibers.

As a result of appropriate design, the connection loss will not increase even when the holes are filled with high refractive index oil. I have a great hope in this fiber.



In conclusion, I will express my personal opinion on the future direction of R&D in the optical access network.

Almost all of the technologies presently applied for the optical access network are based on the technologies developed for the trunk network. We have achieved cost reduction by reducing the requirements on the performance, thereby achieving a first target for the prize of the product.

However, the total cost including construction fee has not been reduced fully yet. This is because the techniques of optical access are still immature on “handiness”.

We have to establish the techniques for “handy and easy use”, even though some compromises on the performance may occur. The hole-assisted fiber, I mentioned before, is one example for this.

Therefore, future R&D must shift from simple economization to the quest for “handy and easy use”. Thank you for your kind attention.