Appropriate Templates for Broadband Access in Non-developed and Developing Countries

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Abstract. Choosing the best access technology for delivering broadband services, is an important and complex step in moving toward NGN, specially in non-developed and developing countries. This paper, proposes a simple classification of users due to their communicational needs, and recommends the most appropriate access method for each class of users, considering network infrastructure in non-developed and developing countries, and capabilities and shortcomings of current technologies.

Keywords: Broadband access, DSL, NGN.

1 Introduction

Moving toward NGN is a "must", but "how to do it" is a "big question". However, development of broadband access is accepted as the first step in this way.

In non-developed and developing countries, with various economic problems and moderate communication needs, selecting an optimum solution for broadband access with lowest cost, is vitally important for operators.

By analyzing communicational infrastructure of these countries and knowing current access technologies and weighing their pros and cons, general templates can be proposed for different cases.

Here only two essential parameters have been used for proposing general templates for broadband access; "distance from CO" and "required bandwidth". In the final design steps, the influence of other parameters like "line quality", "crosstalk", "delay" and "jitter" on quality of services must be evaluated and initial proposed templates be modified if necessary.

2 User Classification

Classification is a common way for reducing the items and simplifying the problems.

In the communications world, users have different needs and access methods have different capabilities. On the other hand, users are located in different physical situations and also access methods have different weaknesses in reaching them.

C. Wang (Ed.): AccessNets, LNICST 6, pp. 333–340, 2009.

Network users have been classified according to different criteria, but bandwidth requirement is the most suitable criterion for choosing network access solutions.

Bandwidth requirement and its increase rate is mainly a function of interaction of technology, economy and social evolutions and may be different for various groups of users. To achieve a good estimation for required bandwidth in different user groups, a proper evaluation of technical, economical and social situation and current requests must be done and also global increase trend in user bandwidth requests be considered, otherwise the implemented network may have a short lifetime and investments in planning and implementation phases may not yield a handsome return.

As the main goal of this paper is simplifying the process of selecting the best access methods by recommending appropriate templates, user classification methods aren't treated deeply. All users are simply classified in four groups: A, B, C, and D. Typical services that each group needs have been determined and a suitable bandwidth has been assigned to it.

Although global request for bandwidth shows a tremendous growth (For some group of users a 50 fold growth has been estimated for a 5 to 10 year period [1]), in non-developed and developing countries, this request and its increase rate is much less than global index. So the recommended bandwidth for each group of users is less than global standards due to economic and cultural restrictions.

Class A- Include homes, shops, restaurants, small offices (with less than 10 employees), and so on, with capabilities like e-mail, file transfer, web surfing, games and low quality video communications.

We assume a maximum of 10Mb/s bandwidth for access to the network for this group of users.

Class B- Include schools, big shops and restaurants, hotels, banks, local offices, production centers, big professional centers (like legal offices) and small companies with 10 to 50 employees. These users, in addition to common services, need high-quality video communications, access to multimedia databases and reliable and high-speed data exchange.

A bandwidth of 10Mb/s to 50Mb/s is suitable for this group of users.

Class C- Include very big shops, big hotels, big governmental and industrial centers and enterprises with 50 to 250 employees which normally need high-speed private connections that a great many users share it. In addition to above-mentioned services, VLAN is one of the most important needs of this group.

A bandwidth of 50Mb/s to 200Mb/s has been assumed for this group of users.

Class D- Include universities, hospitals, big industrial centers and enterprises with more than 250 employees. This group needs a private network, due to its high communicational exchanges. This private network provides most of services and the major need is a reliable high-speed communication link.

A bandwidth of 200Mb/s to 1Gb/s is assumed for this group of users.

3 Recommended Access Methods

In many non-developed and developing countries in Africa, Asia-Pacific, South America, and Middle East, the copper twisted pair is still the dominant media for access to voice and data services.

Due to economical restrictions, considerable investments on this vast infrastructure couldn't be ignored in near future. On the other hand, wireless access solutions aren't well-known and cheap enough. So, xDSL or hybrid fiber-copper methods are the best and most cost-effective solutions for broadband access in these countries.

All-fiber method can be used for special user groups and as the final goal for NGN access in long-term plan.

Wireline can offer clearly higher data rates than wireless solutions. Fig.1 tracks the bit rate evolution. The wireline user data rate is some 30 times that of wireless, with both on a similar evolutionary trajectory. [2]

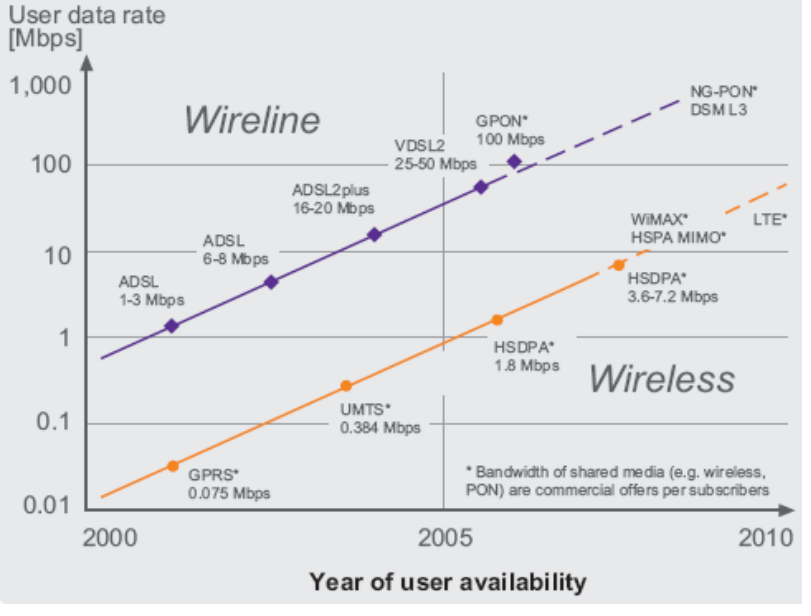

Fig. 1. The development of wireline and wireless user data rates [2]

Incumbent wireline operators leverage legacy copper assets to offer broadband services with DSL. In view of constantly growing end-user bandwidth demand, fiber must be brought closer to the subscriber. FTTC and FTTB are the fiber deployments of choice. The next step up is FTTH, where fiber runs right to the subscriber's home. Bandwidth-hungry applications like high-definition TV and corporate connectivity will drive the demand for wireline network deployments. [2]

CLASS "A"

FTTExch or FTTC with the aid of popular versions of ADSL can be used for this group of users, considering bandwidth requirements and distance from CO. Fig.2

shows the relationship between distance and bit rate in different versions of ADSL. As we see, the most improvements in new versions are made in short distances and performance in long distances is the same.

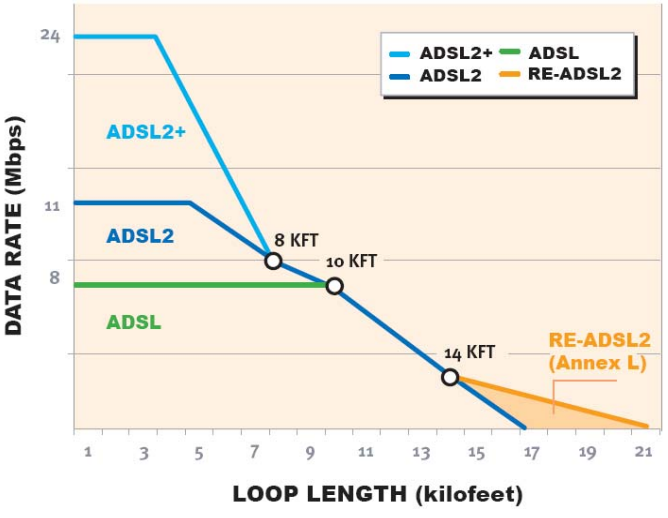

Fig. 2. Downstream capacity in different versions of ADSL [3]

In Fig.3, the local loop range that normally is less than 5km is divided to four intervals and the maximum ADSL bit rate for downstream and upstream has been determined for each one.

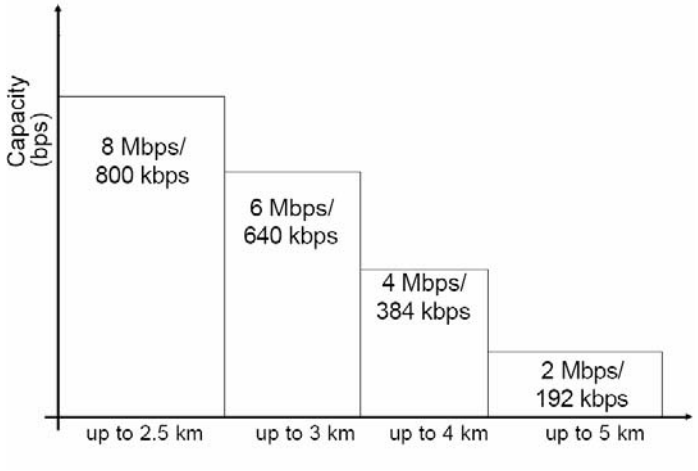

Fig. 3. ADSL capacity in different intervals [4]

With the aid of these figures, the criterion of choosing the appropriate method can be summarized as Fig.4, as a function of “distance from CO” and “requested bite rate”.

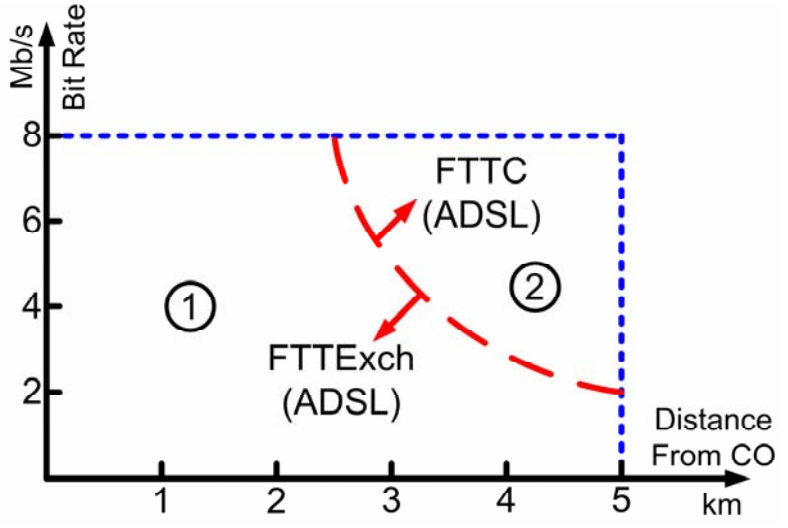

Fig. 4. Access methods for class "A" users

This diagram which only considers the users located in 5km radius is provided for this group of users, with emphasis on using cheap and common ADSL technology over available copper wires.

As we see, all users requesting less than 2Mb/s and a part of users requesting more than 2Mb/s in short distances can be served by FTTExch method and common ADSL technology (zone 1). Other users of this group in zone 2 need FTTC method.

For example for serving a user with 5km distance from CO and requesting 8Mb/s, the fiber must be neared at least 2.5km to user, in a FTTC architecture (Fig.5).

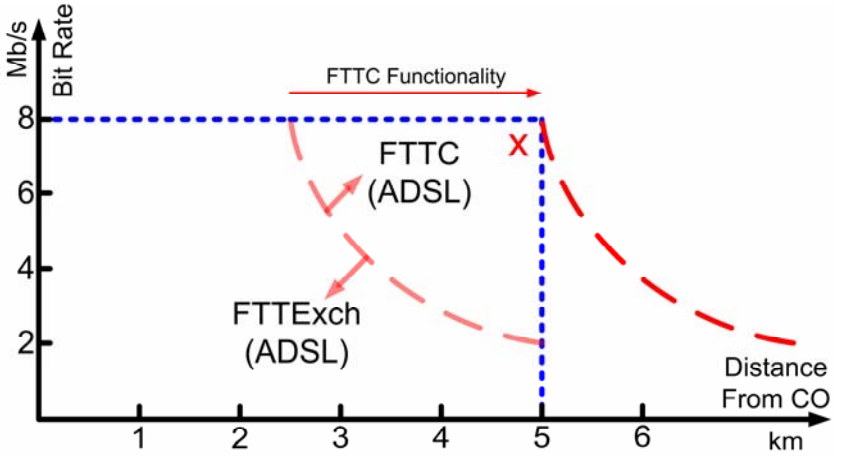

Fig. 5. FTTC Functionality

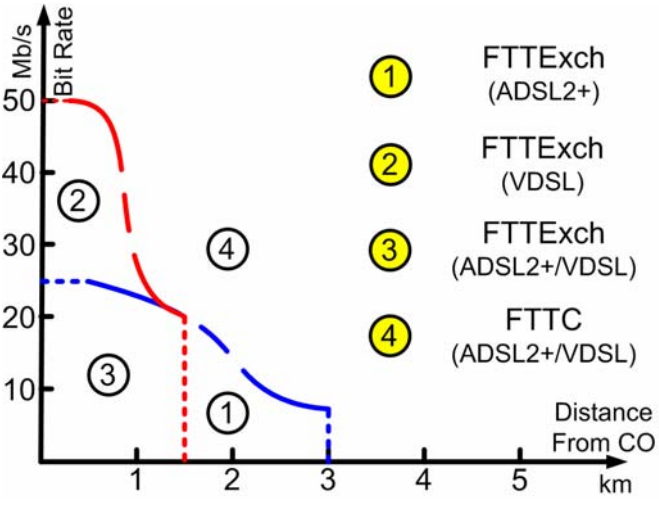

Fig. 6. Access methods for class "B" users

CLASS "B"

In this case, one of the FTTExch or FTTC methods with ADSL2+ or VDSL is recommended. Fig.6 shows the way of choosing the appropriate method, considering two parameters; "distance from CO" and "requested bite rate". The borders of zones are indeed the characteristic curves for ADSL2+ and VDSL technologies.

For users requesting symmetric bandwidth, SHDSL also is a possible choice.

As we see, all users located in zone 1 to 3 can be directly served from CO by copper wires, but zone 4 users need hybrid copper-fiber methods due to long distance or high bit rate request.

According to Fig.7, implementation cost for both copper and fiber networks is reducing, but the difference is reducing too, and it is anticipated that the costs will be the same in 2010 [3].

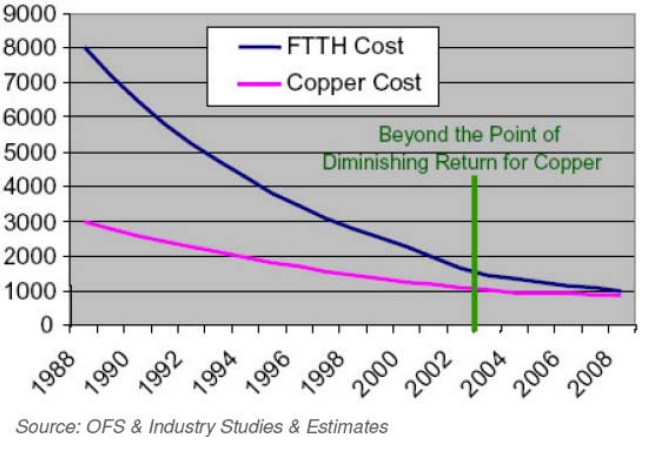

Fig. 7. Implementation cost for FTTH and copper [5]

In the other word in that time, implementing a new copper access network will not be cost-effective, considering its bandwidth limitations. So for green fields, different types of TDM-PON will be suitable choices.

CLASS "C"

Among different types of DSL, only VDSL can provide more than 50Mb/s bit rate (Fig.8).

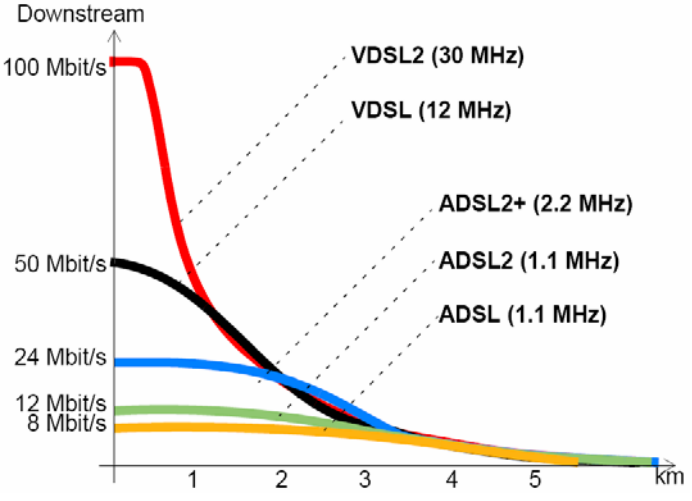

Fig. 8. The potency of VDSL in short distances

Fig.9 shows the way of choosing the appropriate method for this group of users. According to this diagram, VDSL versions can be used in FTTExch and FTTC configurations in zones 1 and 2.

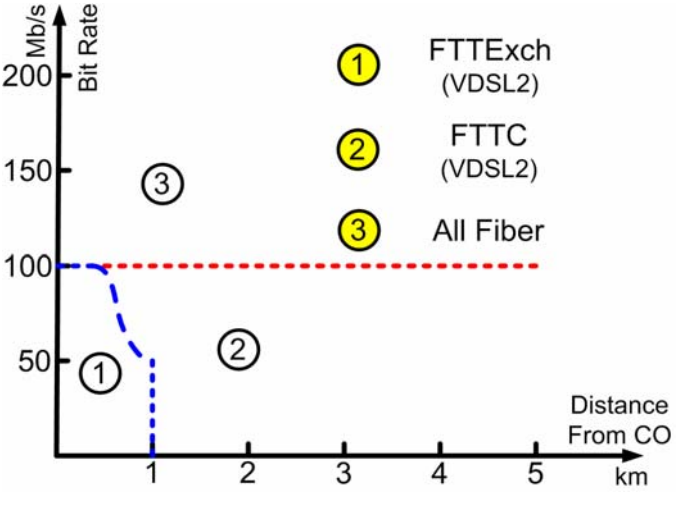

Fig. 9. Access methods for class "C" users

Users requesting more than 100Mb/s bandwidth exclusively need all-fiber solutions (zone 3). In all-fiber solutions, different types of TDM-PON technologies can be used which provide various bandwidths depending on number of splits. For more bandwidth requests, using active optical networks (and WDM-PON in near future) is inevitable.

CLASS "D"
This group needs all-fiber access and until WDM-PON technology generalization, only active fiber networks or direct fiber can answer bandwidth requirements of this group of users. As the total number of this group is few and the users in each center are voluminous, the cost of fiber cabling is tolerable for operators.

4 Conclusion

Broadband access generalization is the first step in moving toward NGN. Proposed templates in this paper can be used as a base for a general recommendation about implementation of novel broadband access technologies in most non-developed and developing countries.

In order to finalize these proposals, the influence of other parameters on real deliverable bandwidth like loop quality, crosstalk and user concentration must be considered.

On the other hand, service requirements in each group must be fully determined and quality characteristics of these services like delay, jitter and PLR must be noticed in final proposed architectures.

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