Life Cycle Assessment of Internet Connection Services

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Abstract

We are investigating life cycle assessment (LCA) as a means of quantifying how information technology can reduce society's impact on the environment. Taking Internet connection services as an example, we show how to apply LCA to information and communication services and present some calculations.

1. LCA for information and communication services

Life cycle assessment (LCA) is a well established technique that was developed primarily as a method for quantitatively evaluating the impact of industrial products on the environment over the course of the entire lifetime of a product, from manufacture through use to disposal. NTT Information Sharing Laboratory Group is developing an LCA-based method of evaluating the effects of information and communication services on the environment. This requires performing an LCA of the communication network providing the service. Since it is not feasible to perform LCA for the entire communication network, which is an aggregate of an immense number of transmission lines and facilities installed throughout the country, we created an evaluation model that narrows the scope of LCA to particular facilities and performed LCA on actual telecommunication facilities in the Tokyo metropolitan area and a few regional cities on that basis.

Another problem with applying LCA to information and communication services is how to allocate the results. Communication facilities are generally shared by many customers and a variety of services. How should we allocate LCA results to the communication facilities when considering the services being assessed? Wired networks comprise an access network, which connects customer homes with the telephone office, and the trunk network, which interconnects telephone offices. The access network is dedicated to the exclusive use of a particular customer, regardless of whether he/she is actually using it; however, the trunk network is shared by many customers. Therefore, for the access network, we divided the LCA result for the entire area of study by the number of subscribers in that area to obtain a value per subscriber. For the trunk network, we first divided the LCA result for each facility by the number of lines that can be accommodated and then divided this value by the mean amount of use (i.e., the mean call time or the mean amount of data transmitted) per user and took this to be the value per subscriber.

2. LCA of Internet connection services

As an example of LCA of information and communication services, we present some evaluation results for Internet connection services via three popular access methods in Japan (**Fig. 1**). FLET'S ISDN (integrated services digital network) uses a digital metallic ISDN line (64 kbit/s). FLET'S ADSL (asymmetric digital subscriber line) uses an analog metallic telephone line (1.5 to 47 Mbit/s). B FLET'S offers broadband Internet connections via optical fiber to offices and homes (up to 100 Mbit/s) [1].

As the evaluation conditions, we considered a user using a personal computer (as the terminal) for one hour per day via an always-on connection. As the evaluation criterion, we chose the amount of CO_2 emitted in each stage of the lifecycle of each facility—construction (manufacture and installation), use, disposal, and recycling—and assessed the entire life-

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cycle for one year (**Fig. 2**).

Although FLET'S ADSL and B FLET'S (enterprise service) both have higher emissions than FLET'S ISDN, the higher transfer speeds they offer makes them better on balance. Furthermore, the B FLET'S family and condominium types have lower

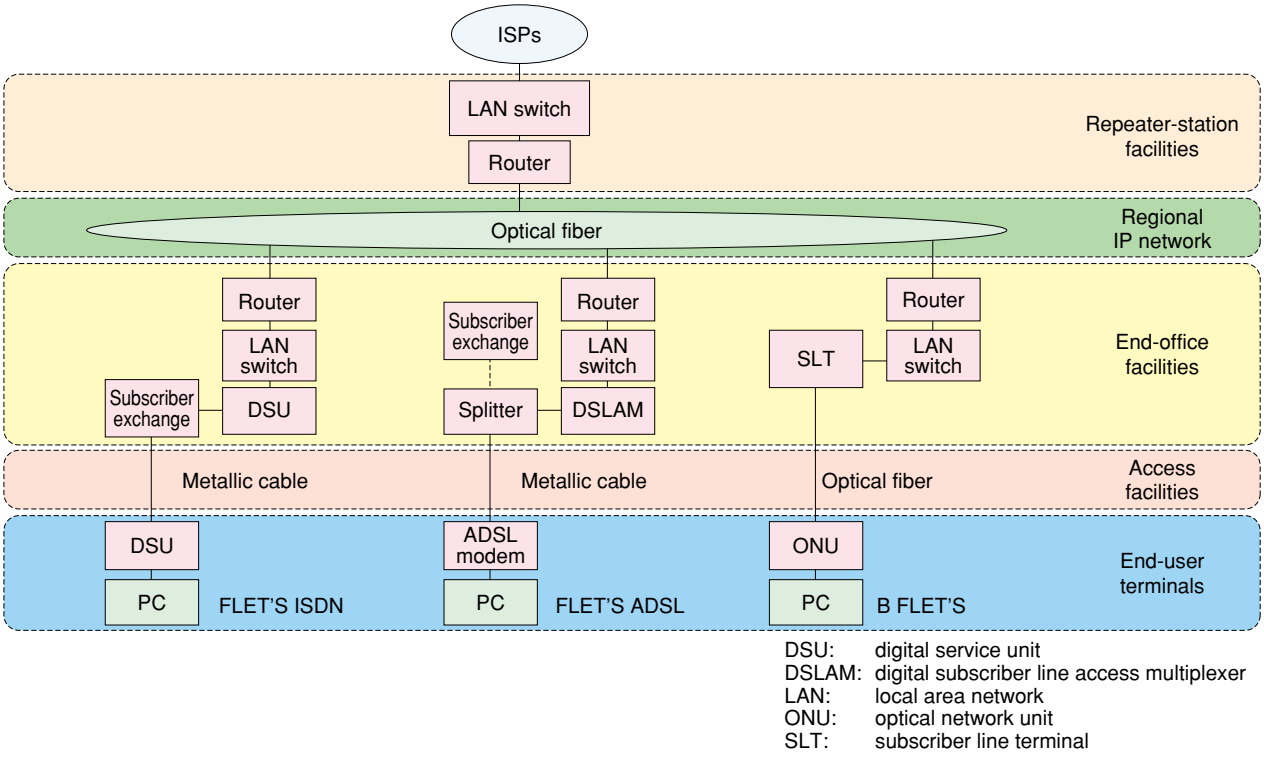
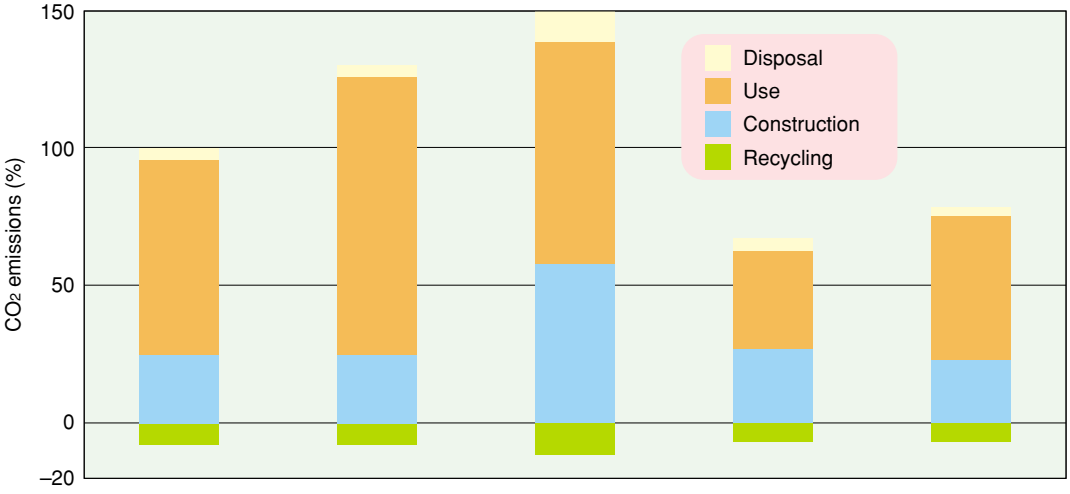


Fig. 1. Evaluation model for Internet connection service LCA.



Service name	FLET'S ISDN	FLET'S ADSL	B FLET'S (enterprise)	B FLET'S (family)	B FLET'S (condominium)
Transfer speed (bit/s)	64 k	1.5–47 M	100 M	25–100 M	12.5–100 M

* Values normalized by FLET'S ISDN emissions = 100%

Fig. 2. LCA results for Internet connection services.

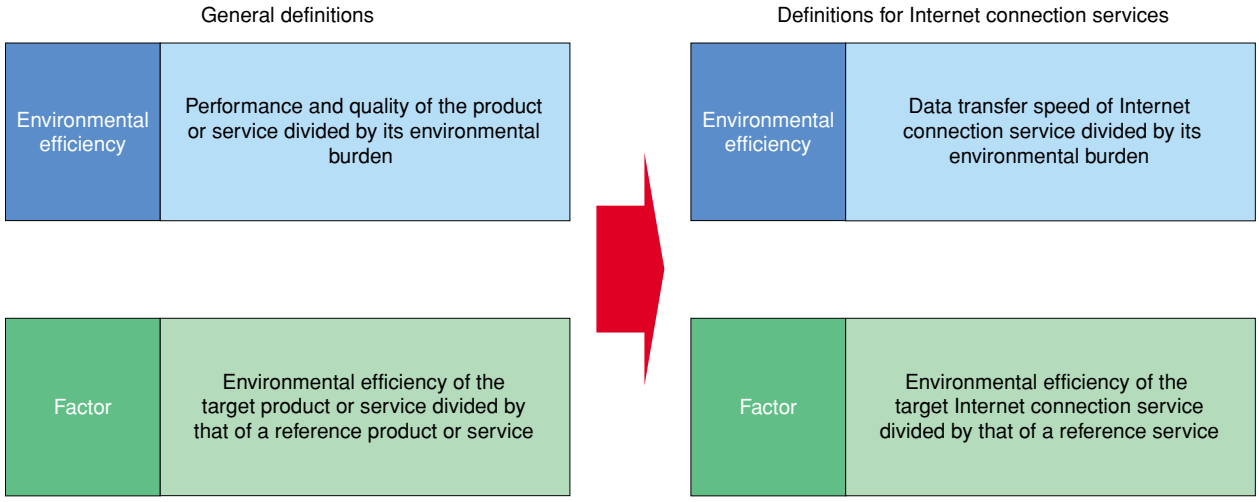


Fig. 3. Environmental efficiency and factor.

emissions than FLET'S ISDN because the broadband passive optical network (B-PON) system that they use allows multiple users to share a single optical fiber, so they have less impact on the environment than other FLET'S services.

3. Environmental efficiency and factor

Two indices have been proposed to show the reduction in environmental impact due to a product or service: the environmental efficiency and a factor that expresses the environmental efficiency relative to a reference (**Fig. 3**) [2], [3]. The application of these concepts, primarily to home appliances, is becoming widespread in Japan.

At NTT Information Sharing Laboratory Group, we are studying the application of these indices to information and communication services based on the results of LCA of environmental impact. According to the definition of environmental efficiency, it is necessary to reduce the lifecycle environmental burden while improving performance and quality to raise the environmental efficiency of a product or service. We calculated the factors for Internet connection services as an example. Compared with FLET'S ISDN service, FLET'S ADSL (12 Mbit/s) offers an improvement factor of 140 while B FLET'S (enterprise type) offers a factor of 1000, by providing much higher data transfer rates (corresponding to service performance) for roughly the same environmental burden.

4. Future plans

LCA is a powerful method for quantitatively evaluating the effect of information and communication services on the environment, but it takes a lot of time and effort. We will store the LCA results for Internet connection services that we have obtained so far in a database and develop a system that can perform LCA of various information and communication services through simple procedures.

References

[1] http://www.ntt-east.co.jp/product_e/05/index.html
[2] L. D. DeSimone and F. Popoff with the World Business Council for Sustainable Development (WBCSD), "Eco-Efficiency," The MIT Press, 1997.
[3] E. U. von Weizsäcker, L. H. Lovins, and A. B. Lovins, "Faktor vier," Droemer Knaur, Munich, 1997 (in German).

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