# Application of Eco-Efficiency to ICT Services

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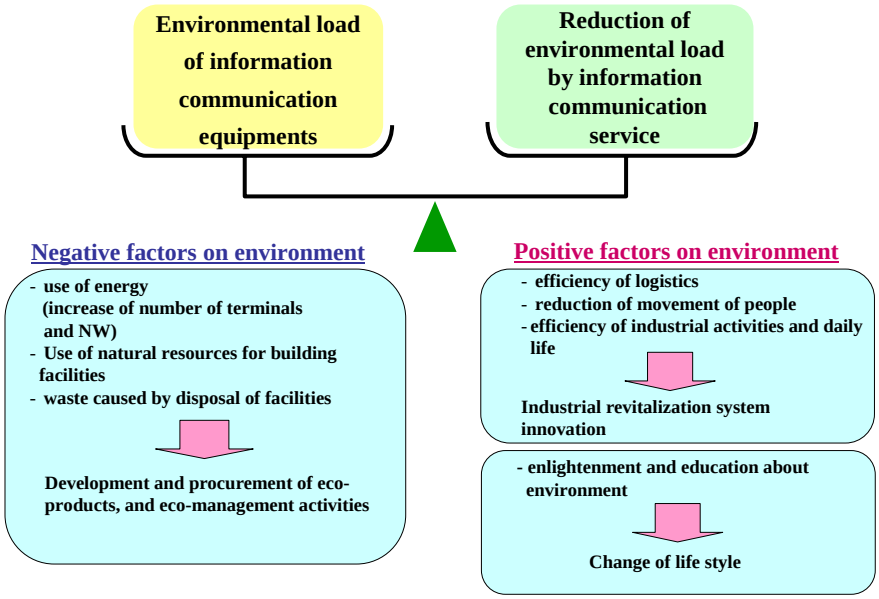
## Impact of ICT on the Environment



# Eco-efficiency and Factor of ICT Service

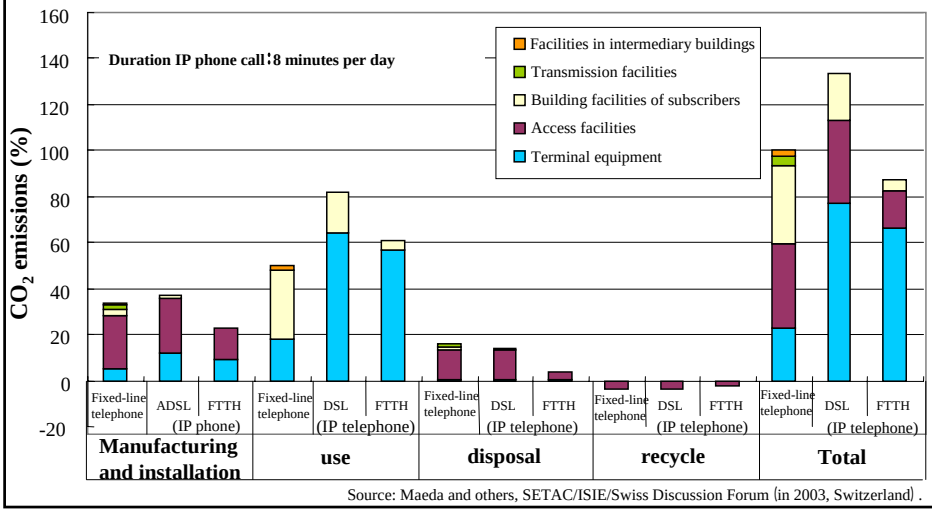
**Calculation of eco-efficiency and factor to estimate a qualitative effect of ICT system on reduction of environmental load**

$$\text{Eco-efficiency} = \frac{\text{Service provided by product system over its life-cycle}}{\text{Environmental load induced over the life-cycle of product system}}$$

$$\text{Factor} = \frac{\text{Eco-efficiency of service in question}}{\text{Eco-efficiency of standard service}}$$

## LCA and Eco-efficiency of telephone service

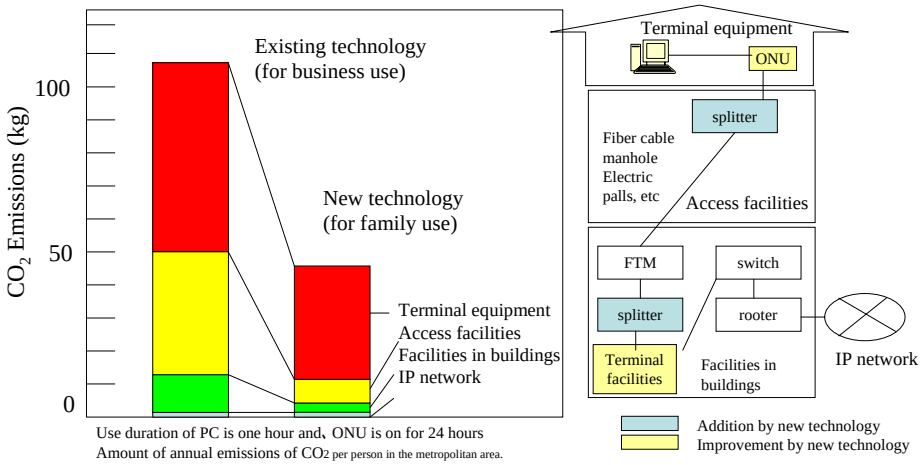
Environmental load of access facilities of FTTH access service and facilities in buildings of subscribers is smaller than that of other access (fixed-line telephone and ADSL) .
$CO_2$ emissions from transmission facilities and facilities in intermediary buildings are smaller than that of fixed-line telephone (7%), IP telephone (less than 0.1%). Energy consumption of terminal equipments of IP telephone has a large amount of electric consumption during standby time. In terms of eco-efficiency, the IP telephone (DSL) is greater than fixed-line telephone, and ***which is smaller than IP telephone (FTTH).***




Source: Maeda and others, SETAC/ISIE/Swiss Discussion Forum (in 2003, Switzerland) .

## Improvement of eco-efficiency by technical development of optical connection service

Sharing optical fiber cable and multiplexing of signals, $CO_2$ emissions reduced and eco-efficiency improved, and factor will be 2.3.




## Eco-efficiency of Flet's Connection Services (1)

Conditions evaluated
Transmission speed: ISDN (64kbps), ADSL (downlink: 12Mbps, uplink: 1Mbps), B-Flet's (Business-use type: 100Mbps)
Conditions used: DSU and modem are connected for 24 hours a day, and PC is used for an hour a day.

$$\text{Eco-efficiency} = \frac{\text{Transmission capacity}}{CO_2 \text{ emissions}}$$

| Service | Eco-efficiency (kbps/kg$CO_2$) |
|---|---|
| Flet's ISDN | 0.88 |
| Flet's ADSL (downlink)<br>(evaluated in uplink) | 125<br>10 |
| B-Flet's | 931 |

## Eco-efficiency of Flet's Connection Services (2)

The calculation of eco-efficiency depends on how ADSL is used.
・In case the main uses are WEB searching, mail reception, file downloading, and music reception, downlink transmission capacity is used for the evaluation.
・In case distribution of music and/or images is dealt with, uplink transmission capacity is used for the evaluation.
・In case animation for TV conferences and/or files are sent and received, uplink and downlink transmission capacities are used for the evaluation.

$$\text{Eco-efficiency} = \frac{\text{Transmission capacity}}{CO_2 \text{ emissions}}$$

| Service | Eco-efficiency (kbps/kg$CO_2$) |
|---|---|
| Flet's ADSL (downlink) | 125 |
| Flet's ADSL (downlink) | 10 |
| Flet's ADSL (arithmetic mean) | 68 |
| Flet's ADSL (geometric mean) | 36 |

## Factor of Flet's Connection Service

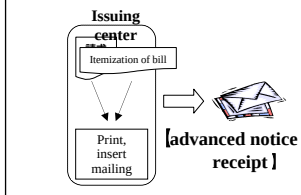
$$\text{Factor} = \frac{\text{Eco-efficiency of the service to be evaluated}}{\text{Eco-efficiency of Flet's ISDN}}$$

Flet's ISDN is regarded as the base service.
Additive average is used for ADSL.
Time for modem/PC use varies.

| Used hours a day (h) | | Factor | |
|---|---|---|---|
| modem | PC | Flet's ADSL | B-Flet's |
| 24 | 1 | 77 | 1052 |
| 1 | 1 | 96 | 876 |
| 24 | 3 | 81 | 1139 |
| 24 | 8 | 88 | 1265 |
| 24 | 24 | 95 | 1410 |

## Eco-efficiency and factor of billing service

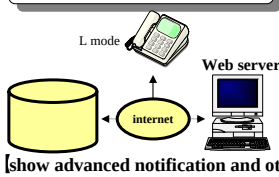
**Usual way**




【advanced notice and receipt】

Contractors of automated transfer for payment will receive mail to notify previous month's settlement and this month's charge by "advanced notice and receipt.

**Billing service**




【show advanced notification and others】

1. Account contractors will provide, by the Web, information about charges of this month and previous months and itemization of use per day at request.
2. It is possible to make reference to charge amount and itemization of daily use through L mode terminator.
3. Mail is sent automatically to notify the determined amount of charge.

$$\text{Factor} = \frac{\text{Billing service}}{\text{Usual service}}$$

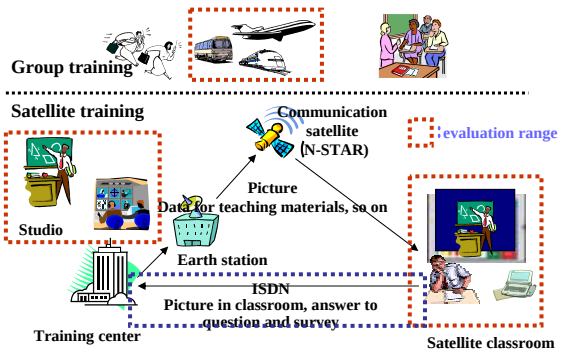
***If Paper resource is counted as environmental load*** ***factor 24***

***If $CO_2$ emissions are counted as environmental load*** ***factor 3***

## Eco-efficiency of Satellite Training and Factor

【object of evaluation】
<satellite training>
STARTs started from FY2000 (participants:13,932, total of training days: 91)
<group training>
Training which is supposed to be done as group training via satellite in the Training Center in Chofu city.

【range of evaluation】(product, use and disposal)
<satellite training>
conference hall, facilities of classroom for satellite, communication facilities (including estimate of circuit of ISDN)
※satellite communication (including earth station) is excluded from evaluation.
<group training>
training room, public transportation (the shortest cut is used)




$$\text{Eco-efficiency of satellite training} = \frac{\text{Educational effect of trainees by satellite training}}{\text{Environmental load from satellite training}}$$

$$\text{Eco-efficiency of off-classroom training} = \frac{\text{Educational effect of trainees by off-classroom training}}{\text{Environmental load when public transportation is used}}$$

$$\text{Factor} = \frac{\text{Eco-efficiency of satellite training}}{\text{Eco-efficiency of off-classroom training}}$$

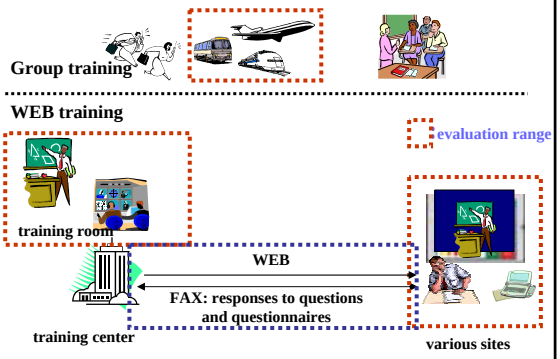
In case that educational effects are same

**Factor 6**

## Eco-efficiency and Factor of Real-time WEB Training (1)

【Object of evaluation】
<WEB training>
Training is held in various places through WEB
( 2 hours ✕ 4 sessions)
<groop training>
Training is held in Tokyo. (One-day session)
The instructors use PC

【Evaluation scopes】(product, use and disposal)
<WEB training>
PC (1 machine per trainee)
Facsimile (1 machine per site of the meeting)
Server in the training center
<groop training>
Public transportation (supposing used for the shortest time)




$$\text{Eco-efficiency of WEB training} = \frac{\text{Educational effects that trainees received from WEB training}}{\text{Environmental load from WEB training}}$$

$$\text{Eco-efficiency of off-classroom training} = \frac{\text{Educational effects that trainees received from gathering training}}{\text{Environmental load when public transportation is used}}$$

$$\text{Factor} = \frac{\text{Eco-efficiency of WEB training}}{\text{Eco-efficiency of off-classroom training}}$$

**Supposing the educational effects from both types of training are exactly same.**

Yuito et al, Eco Design Japan Symposium 2004

## Factor of Real-time WEB Training (2)

The more frequently WEB training is held the more factor increases.
Factor becomes bigger in the case the participants are spread throughout the country.

Suppose that 47 trainees participate in each type of training:

| Frequency \ Participants | 7 each in various site in the Kanto area* | 8 each in various major cities** | 1 each in every administrative division |
|---|---|---|---|
| once a month | 0.67 | 11 | 9.2 |
| once a week | 1.2 | 29 | 25 |
| twice a week | 1.5 | 38 | 37 |

* 7 participants from each: Utsunomiya, Mito, Maebashi, Saitama, Chiba and Yokohama, and 5 from Tokyo.
** 8 participants from each: Sapporo, Sendai, Tokyo, Nagoya, Osaka and Fukuoka, and 7 from Tokyo.

## Eco-efficiency and Factor of TV Conference (1)

$$\text{Eco-efficiency of TV conference} = \frac{\text{Communication of TV conference}}{\text{CO}_2 \text{ emissions by TV conference system and communication network}}$$

$$\text{Eco-efficiency of off-site conference} = \frac{\text{Face-to-face communication on off-site conference}}{\text{CO}_2 \text{ Emission by use of public transportation}}$$

$$\text{Factor} = \frac{\text{Eco-efficiency of TV conference}}{\text{Eco-efficiency of off-site conference}}$$

On the assumption that the value of communication of TV conference services and the value of face-to-face communication on off-site conferences are the same.

## Eco-efficiency and Factor of TV Conference (2)

Basic evaluation model

| | |
|---|---|
| Place: | Tokyo - Nagoya |
| Time: | one hour |
| Frequency of conference: | once a week |
| Participant: | one for each conference |
| TV conference system: | Phoenix F, 25-inch monitor |
| Communication circuit: | B-Flet's (for business use) |
| Transportation: | airplane, bus and train |

Eco-efficiency and factor for each conference

| | | |
|---|---|---|
| Eco-efficiency of TV conference: | 240 | (communication of TV conference/ton-$CO_2$) |
| Eco-efficiency of off-site conference: | 35 | (communication of off-site conference/ton-$CO_2$) |
| Factor: | 6.7 | |

## Eco-efficiency and Factor of TV Conference (3)

・Factor of TV conference between Tokyo to Nagoya is evaluated by changing parameters.
・While the factor of the base model is 6.7, it widely changes from 1.9 to 33 by changing a parameter. Conditions used influence the eco-efficiency and factor of TV conference.

| | Base model | Change in service using conditions | | |
|---|---|---|---|---|
| Time: | 1 hour | 30 minutes | | 2 hours |
| Factor | 6.7 | 7.4 | | 5.1 |
| Frequency | once a week | once a month | twice a week | 5 times a week |
| Factor | 6.7 | 1.9 | 11 | 16 |
| No. of persons on business trips | 1 | 2 | | 5 |
| Factor | 6.7 | 13 | | 33 |

## Eco-efficiency and Factor of TV Conference (4)

**The eco-efficiency greatly depends on the distance to travel.**

Evaluation model

| | |
|---|---|
| Place: | Tokyo – Nagoya → various sites |
| Time: | 1 hour |
| Frequency of conference: | once a week |
| Participant: | 1 from each site |
| Transportation: | airplane, bus and train |

Factor

| | |
|---|---|
| Yokohama (33km): | 0.74 |
| Shizuoka (193km): | 4.0 |
| Nagoya (378km): | 6.7 |
| Osaka (568km): | 67 |
| Hiroshima (856km): | 100 |
| Naha (172km): | 210 |

Factors of Osaka and other sites more distant from Tokyo are much bigger, because of the necessity of air transportation.
The factor of the conference involving a trip between Tokyo to Yokohama increases to 1.3 by supposing it is held twice a week.

# Conclusions

- The eco-efficiency and factor are applicable to various ICT systems and services, including telecommunication services, internet connection, TV conferences and WEB training.
- ICT services are more effective than the ones replaced for improvement toward the global environment
- The eco-efficiency of ICT service depends on the behaviors of service receivers.
- There are some issues about the evaluation ranges and methods.