Impact of Progress of Information Society on Energy Consumption (Vol. 3): Current Status and Future Forecast of Network-Related Energy Consumption and Technical Issues

Summary

The power consumption of the network was estimated in relation to the progress of information society on the assumption such as a core, metro, and access network structure, and the issues were examined. Assuming both an annual increase of 27% in traffic and a fixed state-of-the-art technology level, the problem to be considered is the increase of the power consumption of access systems that account for 80% of the total, especially wireless access systems in them. The paper also compared the future increase in power consumption of telecommunications networks with that of data centers, which also constitute a key part of ICT infrastructure. The finding is that they are almost on the same level.

Proposals for Policy Development

- As far as the telecommunication network sector is concerned, a sharp rise in power consumption is expected for access networks, especially wireless access systems. The equipment in question will be wireless base stations and routers. Research to reduce such power consumption is particularly important. The reduction target should be set at a half or one third of the current levels in 2030 and further one hundredth or less in 2050.
- In telecommunication networks it is important to consider not only hardware but also communication systems and architectures, in order to reduce power consumption in facilities with low traffic volume while coping with peak traffic.
- The types of hardware such as transmission amplifiers at base stations, routing-related processors, and switches are listed as devices of high-power consumption. It is important to save energy in these devices.

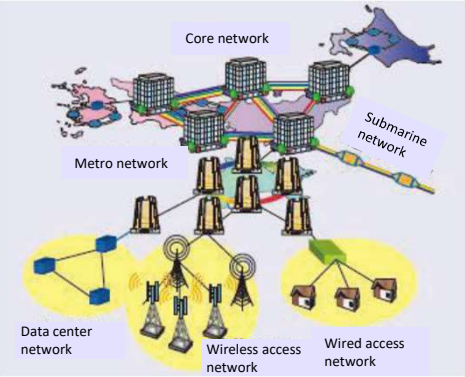

Figure 1: Network Structure[2]

1. Network Structure

The telecommunication network is classified into the core, metro, and (wired and wireless) access networks (Figure 1). The main equipment and facilities are routers in the core and metro networks, and base stations in the access networks.

2. Calculation of Network Power Consumption

The power consumption of the entire network was estimated to be 23 TWh in Japan and 490 TWh worldwide in 2018.

Assuming both an annual increase of 27% in traffic and a fixed state-of-the-art technology level, traffic volume for 2030 and 2050 was estimated. The estimated power consumption of the main equipment of each network was added up, and current and future total power consumption for Japan (the bottom row of Table 1) and worldwide (the bottom row of Table 2)was estimated.

Japan: 93 TWh in 2030; 9,000 TWh in 2050

Worldwide: 2,400 TWh in 2030; 260,000 TWh in 2050

Access networks account for 80% of the total and are expected to increase further with the expansion of applications.

3. Challenges in Reducing Power Consumption

The types of equipment that use the largest amount of energy are wireless base stations, followed by routers. The challenge for saving energy consumption lies in improving the efficiency of power amplifiers for wireless base stations and processors for routers.

4. Comparison in Power Consumption between Data Centers and Networks

Comparing the power consumption of the data center [1] and the network, which are the main ICT infrastructures, it was found that both were almost at the same levels (Tables 1 and 2).

Table 1: Current Power Consumption of ICT Infrastructure in Japan and Future Projections

Domestic		2018	2030	2050
Datacenter		TWh/Y	TWh/Y	TWh/Y
	server	7	62	9,600
	storage	2	29	3,700
	switch	0.1	1	70
	power supply	5	13	2,000
	Total	14	90	12,000
Network				
	Core	1	2	231
	Metro	4	13	1,510
	Access	18	78	7,000
	Total	23	93	9,000

Table 2: Current Power Consumption of ICT Infrastructure Worldwide and Future Projections

Global		2018	2030	2050
Datacenter		TWh/Y	TWh/Y	TWh/Y
	server	113	2,190	384,000
	storage	27	430	51,000
	switch	2	20	3,400
	power supply	43	400	66,000
	Total	190	3,000	500,000
Network				
	Core	25	42	4,900
	Metro	90	260	31,400
	Access	370	2,100	220,000
	Total	490	2,400	260,000

[1] LCS, "Impact of Progress of Information Society on Energy Consumption (Vol. 2): Current Status and Future Forecast of Data Center Energy Consumption and Technical Issues", Proposal Paper for Policy Making and Governmental Action toward Low Carbon Societies, February 2021.

[2] Miyamoto, Yutaka, et al. "Ultrahigh-speed Transmission Technology for Future High-capacity Transport Networks," *NTT Technical Review*. Vol. 17, No. 5. May 2019.