

Country Name	<b>The Project for the Construction of Disaster-Resilient Emergency Mobile Network</b>
Kingdom of Bhutan	

**I. Project Outline**

Background	In Bhutan, mobile phone penetration was 84.3% (as of 2014), much higher than the 3.4% for fixed-line phones, making it a major means of communications for citizens. However, redundancy of the mobile communication network, which is critical for disaster management, was still in progress, and there was only one existing mobile core system installed in Thimphu, the capital city of Bhutan. Therefore, when the Great Nepal Earthquake hit in April 2015, network congestion occurred in Bhutan and mobile phone calls were cut off, which drew attention to the vulnerability of the mobile phone communication system to disasters. Under these circumstances, the Government of Bhutan requested the Government of Japan to implement this project to establish a new core system in Jakar (about 110 km east of Thimphu) for mutual backup with the existing core system and to make the mobile communication network redundant.					
Objectives of the Project	To secure a stable communication network throughout Bhutan by developing a core system for a redundant mobile communication network in Jakar in Bumthang District, thereby contributing to alleviating vulnerability to natural environment deterioration through measures against natural disasters caused by climate change and enhancement of disaster management capacities.					
Contents of the Project	<ol style="list-style-type: none"> <li>Project Site: Jakar in Bumthang District</li> <li>Japanese side: <ol style="list-style-type: none"> <li>Equipment procurement: mobile switching center, media gateways, subscriber database system, serving general packet radio service support node, gateway general packet radio service support node, firewall, operation support system.</li> <li>Consulting services: detailed design, bidding assistance, procurement monitoring.</li> </ol> </li> <li>Bhutan side: power supply augmentation, transmission upgrade, civil work, interconnection work.</li> </ol>					
Project Period	E/N Date	December 19, 2017	Completion Date (ex-ante)	May 2019	Completion Date (actual)	June 29, 2019 (Completion of equipment handover)
	G/A Date	December 20, 2017				
Project Cost	E/N Grant Limit / G/A Grant Limit: 979 million yen, Actual Grant Amount: 979 million yen					
Executing Agency	Bhutan Telecom Limited (BTL)					
Contracted Agencies	Main Consultant: Kokusai Kogyo Co., Ltd. Equipment Procurement Agent: Toyota Tsusho Corporation					

**II. Result of the Evaluation**

<b>I Relevance/Coherence</b>
<p>[Relevance]</p> <p>&lt;Consistency with the Development Policy of Bhutan at the Time of Ex-Ante Evaluation&gt;</p> <p>The project was consistent with the development policy of Bhutan at the time of ex-ante evaluation. The Government of Bhutan prioritized the development of communications infrastructure in the “11th Five-Year Plan (2013-2018)” and formulated the “E-Government Master Plan” (2014) in response to the 11th Plan for the establishment of a robust communications system as a disaster prevention measure.</p> <p>&lt;Consistency with the Development Needs of Bhutan at the Time of Ex-Ante Evaluation&gt;</p> <p>The project was consistent with the development needs of Bhutan at the time of ex-ante evaluation, including the need for mutual backup with the existing core system to make the mobile communication network redundant.</p> <p>&lt;Appropriateness of Project Design/Approach&gt;</p> <p>The project design/approach was appropriate. No problem attributed to the project design/approach was confirmed.</p> <p>&lt;Evaluation Result&gt;</p> <p>In light of the above, the relevance of the project is ③<sup>1</sup>.</p>
<p>[Coherence]</p> <p>&lt;Consistency with Japan’s ODA Policy at the Time of Ex-Ante Evaluation&gt;</p> <p>The project was consistent with the Japan’s ODA policy at the time of ex-ante evaluation. Japan’s development assistance policy for Bhutan in 2015<sup>2</sup> positioned “Reduction of vulnerability” as one of the priority areas, and stated assistance in addressing environmental issues and climate change through urban environmental improvement, climate change countermeasures, and disaster prevention.</p> <p>&lt;Collaboration/Coordination with JICA’s other interventions&gt;</p> <p>The collaboration/coordination between the project and the “Project for Development of Business Continuity Plan (BCP) for Disaster Control in Bhutan” (2018-2021), JICA’s technical cooperation project, was expected during the project period and the positive effects were confirmed at the time of ex-post evaluation. The soft aspect (the technical cooperation project) supported the development of operational systems and human resources of BTL, and the hard aspect (this project) provided infrastructure</p>

<sup>1</sup> ④ : very high, ③ : high, ② : moderately low, ① : low

<sup>2</sup> Resource: Japans’s ODA Data by Country (2015)

development for stable telecommunications services. Through the collaboration of soft and hard aspects, BTL has not only ensured the resiliency of its communications network in both peacetime and disaster situations, but also strengthened the disaster preparedness.

<Cooperation with other institutions/ Coordination with international framework>

Any cooperation/coordination with other donors was not clearly planned at the time of ex-ante evaluation.

<Evaluation Result>

In light of the above, the coherence of the project is ③.

[Evaluation Result of Relevance/Coherence]

In light of the above, the relevance/coherence of the project is ③.

## 2 Effectiveness/Impact

<Effectiveness>

The project objectives were achieved beyond the plan. The core system in Jakar has not experienced any major outages/disruptions since its commissioning in June 2019. While the duration of interrupted mobile core systems, which was set as an indicator, was targeted to be 0.25 hours/year or less by 2022, the actual duration of interruption in 2022 was zero. Similarly, the mobile core system in Thimphu has remained stable without significant disruptions. This indicates that the two core systems are operating on a pooled/load-sharing basis, preventing major congestion at the core level. This was particularly notable during the Covid-19 outbreak when there was a substantial increase in mobile network traffic. Therefore, it can be said the Jakar core system has reduced mobile network congestion and ensured a stable communication network.

<Impact>

Since Bhutan has not experienced any major natural disasters by the time of the ex-post evaluation, there are no available data indicating the specific contribution to the measures against disasters caused by climate change. However, in July 2023, when a flash flood claimed 23 lives occurred in Unger village in Lhuentse, there was no congestion in communication. The communication usage (during a span of 12 hours) on the day of the disaster was 20.79 Erlangs<sup>3</sup> for 2G Voice and 80.99 Erlangs for 3G Voice. This was about three times higher than the communication usage (during a span of 12 hours) of 7.41 Erlangs for 2G Voice and 24.58 Erlangs for 3G Voice one week before the disaster. This means that the availability of a stable telecommunication network in the country has made BTL's mobile network more resilient and enhanced its disaster management capabilities.

As mentioned above, the project successfully established redundancy within the core level of the mobile network, ensuring that even if one of the cores in Thimphu or Jakar fails due to a major natural disaster, the core in the other location can remain operational. However, the issue remained that in the event of a failure in Thimphu's core system, cell sites and base stations connected to Thimphu's core system would also cease operation. The same situation would apply in the event of a failure in the Jakar core system, but measures to address this was out of the scope of the project. After the project completion, BTL invested in the Radio Access Network (RAN) segment to address this issue, and interconnected all cell sites and base stations to both core systems. This ensures that even if one core system experiences a failure, all cell sites and base stations within the network can remain operational. This further enhancement has significantly bolstered the redundancy of the mobile communication network.

<Evaluation Result>

In light of the above, the effectiveness/impact of the project is ④.

### Quantitative Effects

Indicators	Baseline 2016 Baseline Year	Target 2022 3 Years after Completion	Actual 2020 1 Year after Completion	Actual 2021 2 Year after Completion	Actual 2022 3 Years after Completion	Source
Duration of interrupted mobile core systems (hours/year) (Interruption time regardless of disaster)	10 hours or more per year	0.25 hours or less per year	5.3 hours /year *	0 hour /year	0 hour /year	BTL

\* The interruption only occurred at the Jakar core system due to initial errors, which were subsequently rectified. As the traffic was delivered through the Thimphu core system, there was no impact on overall mobile connectivity.

## 3 Efficiency

The project cost was as planned (the ratio against the plan: 100%) and the project period slightly exceeded the plan (the ratio against the plan: 112%). The extension of the project period occurred due to damage to the bridges along the road near the border, which forced the second shipment of equipment procured in the project (out of a total of three shipments) to take a detour. This resulted in delays in the delivery of the equipment and the subsequent installation, testing, and commissioning processes.

	Project Cost (Japanese side only, yen)	Project Period (months)
Plan (ex-ante)	979 million yen	17 months
Actual	979 million yen	19 months
Ratio (%)	100%	112 %

Outputs were produced as planned.

In light of the above, the efficiency of the project is ③.

## 4 Sustainability

<sup>3</sup> Unit for call volume per hour

<Institutional/Organizational Aspect>

The operation and maintenance (O&M) of the nationwide network managed by BTL is conducted across four regions: Western Region, Southwestern Region, Central Region, and Eastern Region. In the central region, the daily O&M of the core system is handled by the Profit Center in Jakar. The Jakar Profit Center is headed by a manager and staffed by 22 individuals. Eight of them are responsible for daily O&M of Jakar core system. In cases of major failures that are unable to be handled by Jakar's O&M team, remote support is provided by mobile core engineers in Thimphu. If even Thimphu's engineers are unable to repair the malfunction, the matter is escalated to experts from Ericsson, the equipment vendor under an annual maintenance contract (AMC). According to BTL, the number of staff for daily O&M is adequate, and the O&M system in case of major failures is well established. Moreover, BTL has a plan to construct a new Network Operations Center at Jakar to expand their O&M and provide better services.

<Technical Aspect>

According to BTL, the O&M staff refer to the manuals and no technical problems have been observed. Since the core systems in Jakar and Thimphu are fundamental to the mobile communications network, BTL recognizes the significance of ongoing human resource development for the O&M of core systems. Technical training on both core systems and RAN networks has been conducted based on annual human resource development plan of BTL. Technical training is also conducted in third countries, such as India and Singapore, to improve the skills of the staff. Besides the continued development of internal capabilities for daily O&M of the core systems, BTL also has a plan to continue AMC with the equipment vendor to strengthen large-scale O&M. Furthermore, BTL and Nippon Telegraph and Telephone East Corporation (NTT East) have signed a Memorandum of Understanding, aiming to enhance human resource capacity development by sending BTL engineers to Japan and also hosting the NTT East engineers to Bhutan.

<Financial Aspect>

BTL formulates the required O&M budget in accordance with its annual activity plan, and the budget is subject to review and approval by the BTL Board. The approved O&M budget is covered through the revenue generated from providing services to customers. Given that mobile services are the primary revenue source, BTL intends to ensure the allocation of a substantial budget for the O&M of the mobile network components, including the core system equipment. The mobile business has been and will remain the cornerstone of BTL, ensuring its financial sustainability for core system O&M in the future.

<Environmental and Social Aspect>

No issue on environmental and social aspects has been observed, and it has not been necessary to take any countermeasures.

<Current Status of Operation and Maintenance>

All equipment installed under the project is operating without issues, and relevant maintenance is conducted on a regular basis without any problems. Upgrades of software for various components of the core system equipment are performed annually or whenever an upgrade becomes available. Spare parts of all critical components of the core system equipment are being assessed, procured, and maintained in stock.

<Evaluation Result>

In light of the above, no problem has been observed in terms of the institutional/organizational, technical, financial, environmental and social aspects and the current status of operation and maintenance. Therefore, the sustainability of the project effects is ④.

5 Summary of the Evaluation

The project successfully achieved its objective beyond the plan, with the core system installed in Jakar under the project ensuring a stable communication network throughout Bhutan, developing redundancy of mobile communication network. In terms of coherence, through collaboration with JICA's technical cooperation project, BTL has not only ensured the resiliency of its communications network in both peacetime and disaster situations, but also strengthened the disaster preparedness. The sustainability has been maintained and secured across institutional and organizational, technical, and financial aspects.

Considering all of the above points, this project is evaluated to be highly satisfactory.

### III. Recommendations & Lessons Learned

Lessons Learned for JICA:

The technical cooperation project, aimed at the development of the business continuity plan of BTL, was implemented to complement this grant aid project. The implementation of the technical cooperation project provided technical transfer, including the BTL's operational structure development and human resource development. As a result, the sustainability of the project (grant aid project) was ensured and a synergistic effect was generated in terms of strengthening the resilience of the telecommunications network in both peacetime and disaster situations and disaster preparedness. Furthermore, the Royal Government of Bhutan is considering the inclusion of development of contingency plans for relevant agencies under the next five-year plan, drawing upon the experiences gained from those two projects. Therefore, combining the implementation of the grant aid project (hard component) and the technical cooperation project (soft component) has generated synergies, as well as enabled appropriate operation, management, and maintenance of the facilities developed under the grant aid project, thus ensuring the sustainability of the project.



Left: Inspection of the Mobile Network Core System Equipment at Jakar.

Right: Engineer of the Jakar Profit Center conducts a regular maintenance of the mobile core system.