Chapter 6
TELECOMMUNICATION SYSTEMS

From the beginning of this century, the telecommunication system in Indonesia has been undergoing fast-paced changes. Multiple service providers were allowed to compete in this market resulting in multiple services offerings at lower costs.

Although Telkom is still Indonesia's largest service provider, its market share is slowly being eroded by new competitors entering the market. The competitors are Indosat, Bakrie Telecom (Esia), Batam Bintan Telekomuniasi, Mobile-8 Telecom, Ceria, Smart, and XL Axiata, to name a few. Only four of these provide fixed-line (landline) phone services—Telkom, Indosat, Bakrie Telecom, and Batam Bintan Telekomunikasi. These four also provide all other telecommunication services including data, Internet, fixed wireless, and cellular phone service (commonly called mobile phone service in Indonesia). The remaining companies provide mobile phone and Internet services.

All Indonesian islands are interconnected via submarine cables and microwave. Recently, satellite connections have also come into use.

Cellular phone service is the fastest expanding market in Indonesia. The penetration rate is very high. Due to geographical nature of the country and dispersed population, fixed wireless is also quite popular. Therefore, there is a buildup of base transceiver stations (BTS)/cell sites around the country, especially on the biggest island, Java.

6.1 Description of System

The network configuration of the telecommunication system in Indonesia is basically the same as found elsewhere in the world. Most of the telecommunication equipment is imported from Europe, the United States, Japan, and recently from China. The basic elements of network components can be found in all BTSs and central offices (COs), which are also called strategic technology offices (STOs) in Indonesia.

Fiber optic cables are widely implemented to meet the demand for speed and bandwidth for Internet services. Optical fiber cable ring configuration is also deployed to provide a more efficient and reliable operation. Most hotels have Wi-Fi capability to meet the Internet services need of travelers.

The major service providers, such as Telkom and Indosat, have established different brand names for their various services. For example, Telkomsel is the brand name for Telkom's mobile phone service, and Telkom Flexi is the brand name for its fixed wireless service.

Colocating of service providers at point of presence (POP) is enforced by law, similar to North America.

In major cities such as Jakarta, BTSs mobile phone sites are sometimes installed on roofs of tall buildings to gain coverage. Similar to those in North America, the battery power reserve for these sites are usually low; that is, they have a short duration power supply after a power outage. In most cases, the battery backup is about 3 hours for BTS and about 6 hours for STO. Backup power generators are also installed in STOs to provide power to the equipment during a long duration power outage. Most STOs have BTSs colocated at the same site and share the building housing mobile phone equipment.

Standalone steel lattice towers are common for BTSs in rural areas.

6.2 Overview of System Performance

Fixed-line phone systems (including fixed wireless phone systems) and mobile phone systems did not perform well. Despite the widespread damage to the telecommunication networks, the recovery was reasonably fast due to the quick action and long hours of hard work of the service crews. In addition, external support from Jakarta to bring in the needed resources helped to speed up the process. Most services recovered within 3 days of the earthquake. The interruption of telecommunication service in the first two days after the earthquake created undue chaos within the emergency response services.

Telkom's offices and three STOs experienced severe damage. Many wiring circuits inside the STOs were damaged causing longer process to activate the generators to power the equipment. Most of the main switching centers (MSCs) were in good condition one day after the earthquake. Due to structural damage to the administrative offices in Padang, temporary offices were set up in an indoor tennis hall.

Many temporary BTSs were set up within Padang to provide mobile phone service when damaged BTSs could not be repaired. This type of unit is called cell on wheels (COW). It is the fastest means of replacing a heavily damaged BTS to restore service. However, the capacity of a COW is low, so call congestions and dropped calls occurred often in the areas covered by COWs.

Failure modes observed in STOs are

- damaged batteries,
- damaged building, and
- power outage.

While the failure modes of the mobile phone system are

- collapsed building with BTS installed,
- power outage,
- damaged power equipment, and
- generator problem.

The distribution system failure due to collapsed buildings on aerial cabling was quite significant.

One mobile phone service provider had 10 BTS antennas on rooftops of collapsed buildings damaged, and 28 BTSs had various power related problems. While another mobile phone service provider had so much damage to the mobile network that it required 2 days to restore service to normal.

The day after the earthquake, 42 out of 90 BTSs in one service provider's fixed wireless system in West Sumatera were out of service due to a prolonged power outage. In Padang, 47 of the 90 BTSs were not functional due to various problems. Most of the affected BTSs were back to normal 2 days after the earthquake.

6.3 Wireless System

In addition to observations by the ASCE/TCLEE team, this section includes information supplied by the fire department and a cellular service provider in Padang.

Cellular Base Stations (BTS)

Many BTSs have power supply units installed outside their buildings, which are air conditioned for the radio and controller units. A few BTSs were deployed with a self-contained, environmentally controlled unit within. Figure 6.1 shows one of these installations. Note the cabinet wall thickness; it is designed to reduce heat loss or gain. The cover protects service staff from the elements. Although these cabinets are designed with locks, a base perimeter wall provides added security. The majority of the BTSs are unmanned; that is, there is no attendant at the base. Monitoring is remotely done via data connection to a central control center within a region.

In addition to electric power outages, toppled equipment caused BTSs to go out of service. When equipment is not anchored or is inadequately anchored to resist seismic load, toppling is most common failure mode. The equipment is also installed on a structural platform about 0.7 m above ground, which amplifies the seismic load on the equipment. The platform is designed to provide vertical load capacity; there is no bracing to provide rigidity to resist lateral load (Fig. 6.4). The platform is a raised floor providing cable access to the bottom of the cabinets (Fig. 6.6). It was noted that heavy power cabinets with moveable components inside toppled. Figure 6.2 shows the failure of two unanchored power cabinets. Figure 6.3 shows the unsecured batteries inside, which might have caused the cabinet to tip over. A power cabinet anchored on a concrete pad in a BTS site had about 8 to 9 cm uplift but did not topple (Fig. 6.5). It appears that the anchor was inadequate to resist uplifting.

As Indonesia is frequented by monsoons with high wind speed, the towers are all designed to withstand a big wind load. Therefore, no standalone towers collapsed; however, BTSs on commercial buildings did.

Figure 6.1. BTS with a self-contained unit, no building is required. The base is still enclosed with a wall for security. (Courtesy of Thomas Heriyanto)

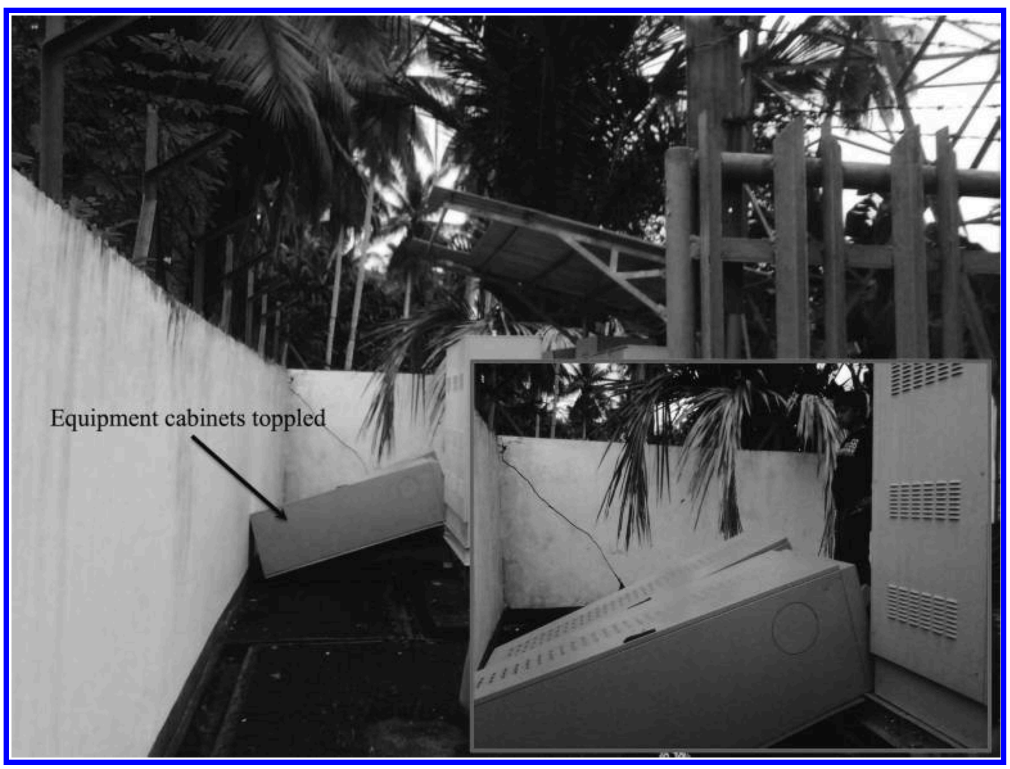

Figure 6.2. Toppled power cabinets at a BTS site outside of Padang. (Courtesy of Thomas Heriyanto)

Figure 6.3. Damage to the batteries in the cabinet close to the cracked wall in Fig. 6.2. (Courtesy of Thomas Heriyanto)

Figure 6.4. One of the two cabinets toppled at this BTS (Courtesy of Thomas Heriyanto)

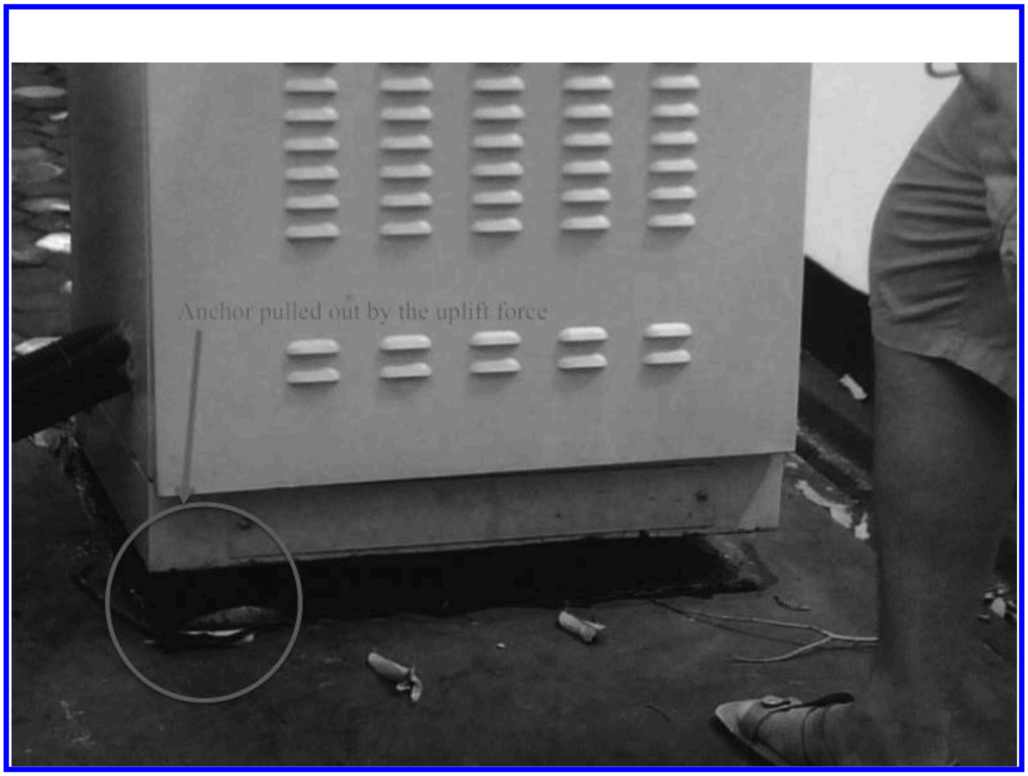

Figure 6.5. The power cabinet at this BTS site is anchored on a concrete pad. (Courtesy of Thomas Heriyanto)

Figure 6.6. This toppled cabinet was saved by the wall. Note that there is no anchor for the equipment cabinet. (Courtesy of Thomas Heriyanto)

Antenna Towers

It was observed that the steel lattice style standalone towers performed well (Fig. 6.7). Wind load is the primary design factor. However, towers on roofs of commercial buildings shared the fates of the buildings. In most cases due to spectral amplification, the antennas mounting structures were damaged.

Figure 6.7. Typical standalone steel lattice tower shows good performance

Figure 6.8. Roof-top mounted BTS antenna poles failed when the building failed. There were three service providers located on the roof of this 5-star hotel in Padang.

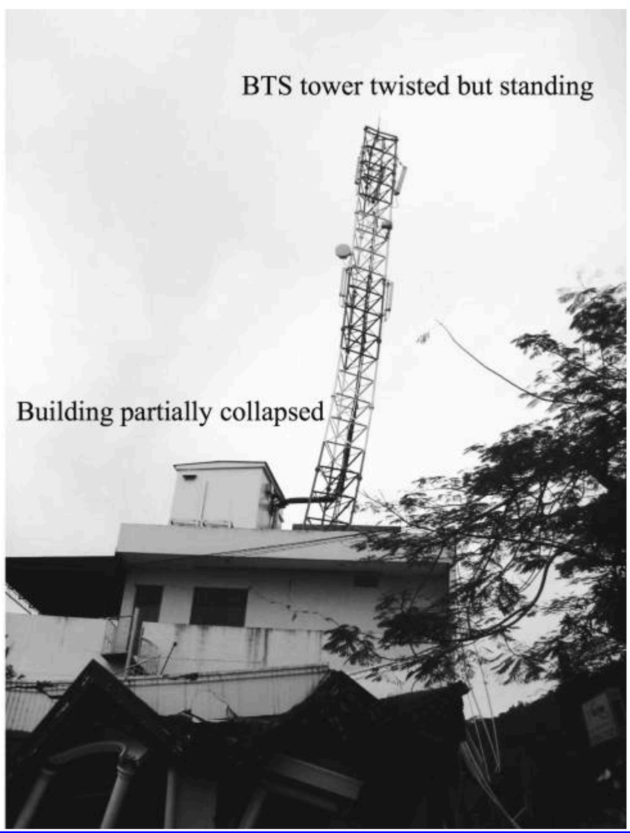

Figure 6.9. When the second story of this building collapsed, the tower was damage and power was cut off from this site. (Courtesy of Thomas Heriyanto)

Figure 6.10. The BTS tower on the roof (left side) of this building that collapsed (Courtesy of Thomas Heriyanto)

Figure 6.11. Detail view of the collapsed tower and antennas (Courtesy of Thomas Heriyanto)

Figure 6.12. The tower and the equipment housing do not look damaged, but power was cut off when the building collapsed. (Courtesy of Thomas Heriyanto)

Figure 6.13. This BTS tower collapsed when the buildings around it collapsed in the earthquake. (Courtesy of Fire Department, Padang)