

IPSTAR White Paper

Cellular Backhaul over IPSTAR

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1. Mobile Service Trends and New Frontiers

There has been an exponential increase in mobile services in recent years. In the Asia Pacific region the mobile penetration rate is expected to hit 106 percent, and the number of subscribers is expected to reach 4 billion by 2016. In parallel with the increase in mobile voice service, data services have also increased exponentially in recent years, mainly thanks to the popularity of social networks. The overall data traffic usage is expected to grow to more than 4 exabytes per month in the next five years in the Asia Pacific region alone. This kind of demand puts tremendous strain on the existing mobile networks and technologies. At the same time competition among mobile network operators is increasing in markets which are seeing ever shrinking ARPU (Average Revenue per User). Mobile operators need to expand their coverage and target new subscribers, while keeping their CAPEX and OPEX within profitable limits.

The urban and suburban mobile markets are now saturated, however many rural and remote areas are still lacking service coverage. The focus of the mobile industry is now shifting to these less developed areas. Mobile handset vendors are continuously developing low cost phones specifically targeting the low-income rural areas. Semi-smart phones with built-in social networking applications are being manufactured by vendors to target these developing markets. Even though such low cost handsets are now widely available, the fact still remains that it is not cost-effective for operators to extend their reach into remote areas using terrestrial based fiber and microwave networks.

Operators in Asia-Pacific's low ARPU markets have mostly depended on funding and subsidies from governments, for example USO (Universal Service Obligation) funds to provide services in remote areas. While in the past the objective of these funds was to provide basic telecommunication services, the intent has now widened to include the uplifting of quality of life of rural citizens. The focus now is on providing broadband to the remote areas, where access to broadband services will play a key role in bridging the Digital Divide through health services, rural schools, distance education programs, SME's and agriculture, and other community services. This vision of broadband services in rural areas can be realistically implemented using existing broadband satellite backhaul technology.

2. Satellite Backhaul for Mobile Operators

A broadband satellite like IPSTAR can provide diverse solutions for mobile operators for backhauling from their remote nodes to their core network. IPSTAR supports various cellular technologies such as GSM, CDMA, and 3G. Depending on the type of backhaul link in deployment, either E1 or IP and the total backhaul bandwidth required, different end modem solutions can be used.

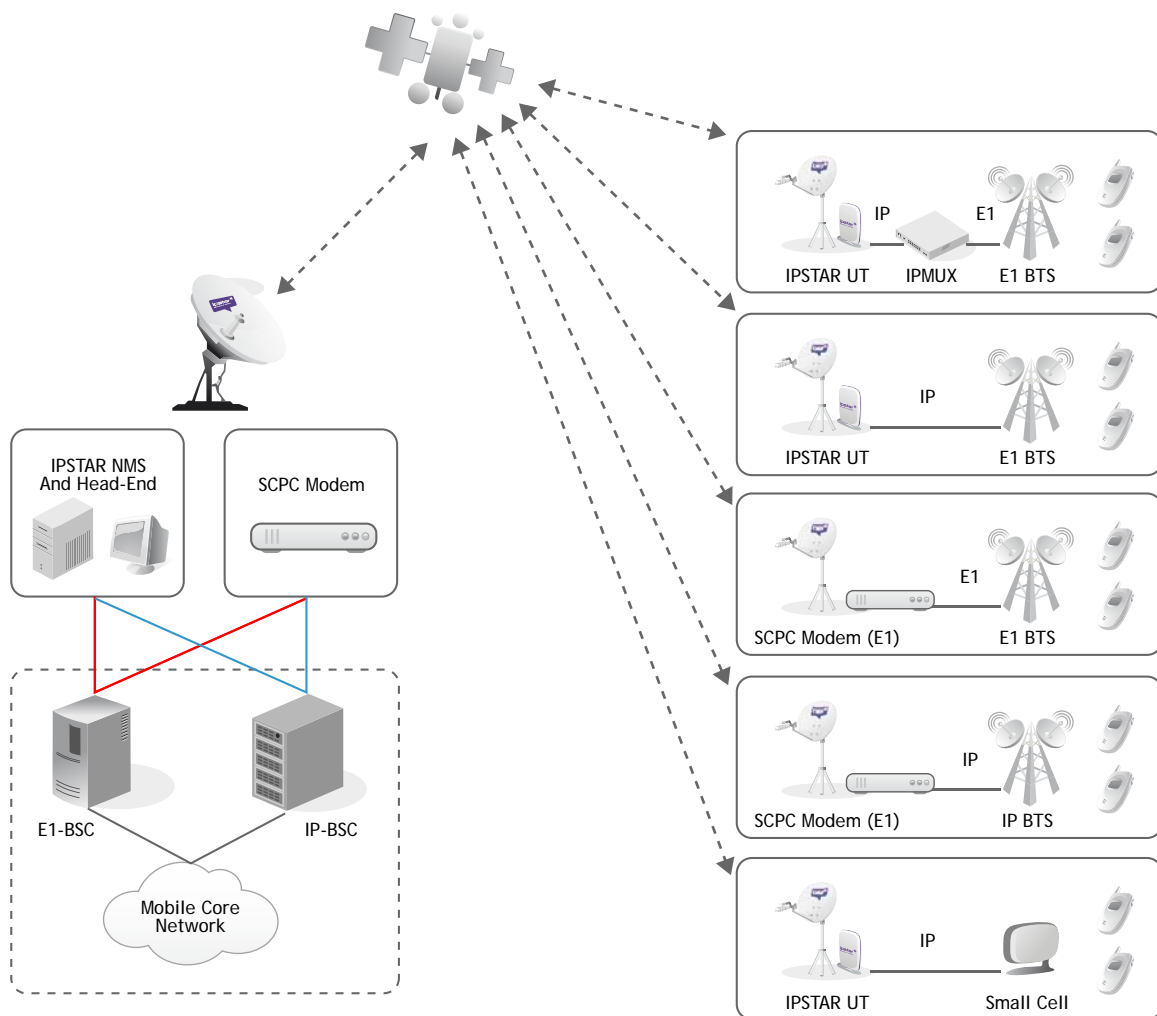


Figure 1: IPSTAR Backhaul for E1 or IP based base stations

IP based remote base stations can be directly connected to the IPSTAR UT, or SCPC modems. For E1 based base stations, an IP-MUX (IP-Multiplexer) can be used for E1 to IP conversion. The mobile operators' core network needs to be connected to IPSTAR Gateway through leased lines.

3. TCO Comparison with Other Media

On a TCO (Total Cost of Ownership) comparison based on a 1 Mbps link, there is no doubt that fiber is the best medium for distances less than 15 Km from the base stations. For backhaul nodes located within 15-40 Km, microwave backhaul would be the preferred solution. However, microwave has limitations due to strict LoS (Line-of-Sight) requirements, limited availability of spectrum, and possibility of interference. For base stations located at distances further than 40 Km, a broadband satellite like IPSTAR is the optimum solution.

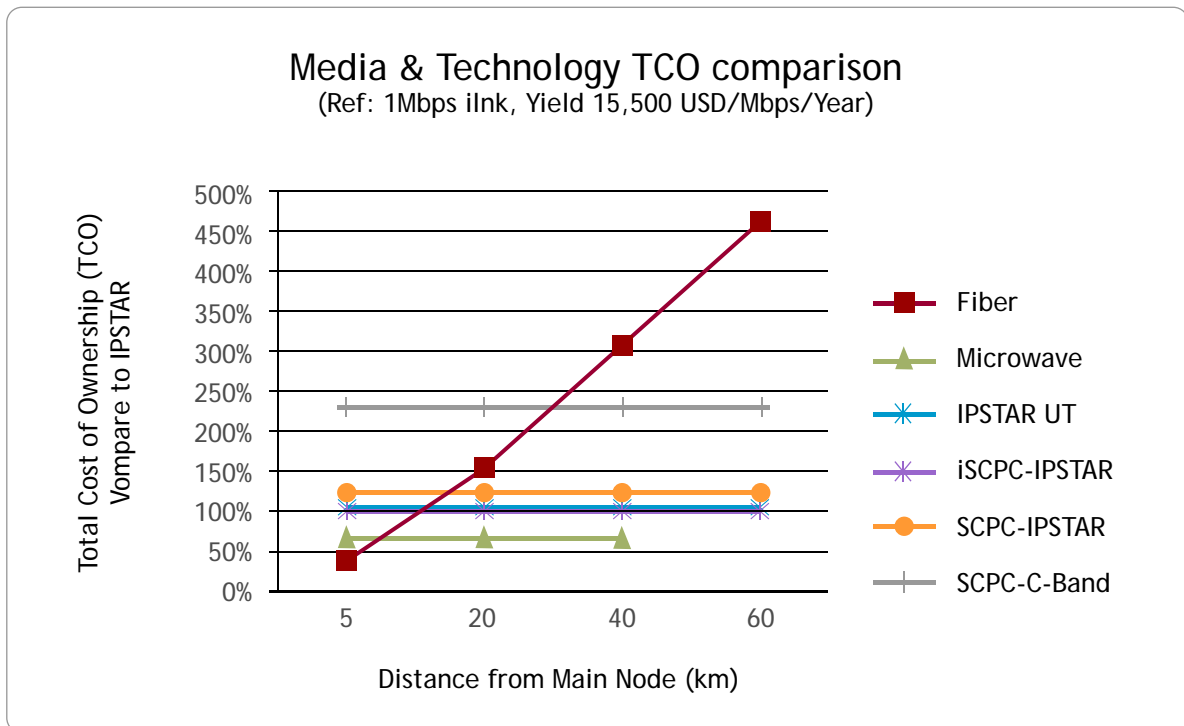


Figure 2: TCO comparison of IPSTAR with other backhaul media

4. Small Cells – Solution for Rural Areas

A new technology in the field of mobile communications - Small Cells, is ideal for penetrating rural areas and providing cellular voice as well as broadband Internet services. A Small Cell is a cellular base station originally designed to be used in residential or small business environments, where the mobile network's coverage is weak or non-existent. It was designed to connect to the mobile network using broadband ADSL or any other type of IP-based Internet connection as shown in figure 3. A small cell typically supports 8 or 16 concurrent voice calls, as well as access to data service. Small Cells from different telecom vendors are currently available for 2G, CDMA and 3G technologies—service providers can easily integrate them into their existing networks. When a 3G small cell is chosen for deployment, it can easily provide the broadband speeds required for today's needs and applications.

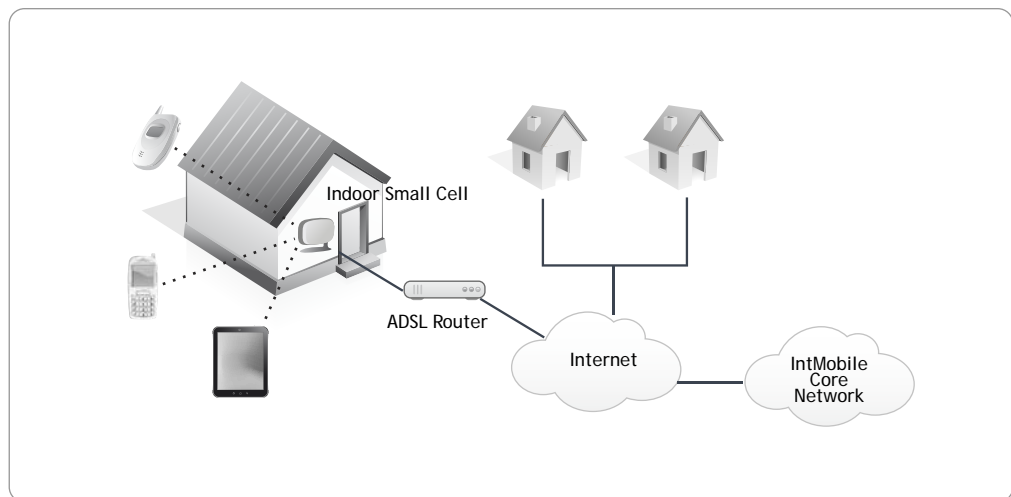


Figure 3: Small Cell (Femtocell) generally backhauls over Internet to connect to the core network.

Although originally intended for indoor use with a small coverage of around 10 or 20 meters, Small Cells are increasingly being adapted for use outdoors with an extended range of up to 1 or 2 kilometers. Small Cells are plug-and-play devices with Ethernet interfaces and work immediately after connecting to a broadband Internet connection, without the need for any configuration.

5. Small Cells and IPSTAR Backhaul – Perfect Combination for Rural Communication

A Small Cell base station backhauled over IPSTAR enables rapid installation and deployment by mobile operators. The remote Small Cells base station can be setup within a few hours using a standard electric pole. The Small Cell AP (Access Point), a signal booster, and satellite modem can be installed inside a small weatherproof box. A standard Ku-band satellite antenna can be strapped to the pole and the omni-directional cellular 3G antenna placed on top of the pole, providing circular coverage of up to 1 or 2 kilometers. Due to the low power requirements of Small Cells, these remote sites can be powered using solar panels and other alternative energy sources, if grid electricity is not available. The network configuration of Small Cell backhaul over IPSTAR service is shown in figure 4.

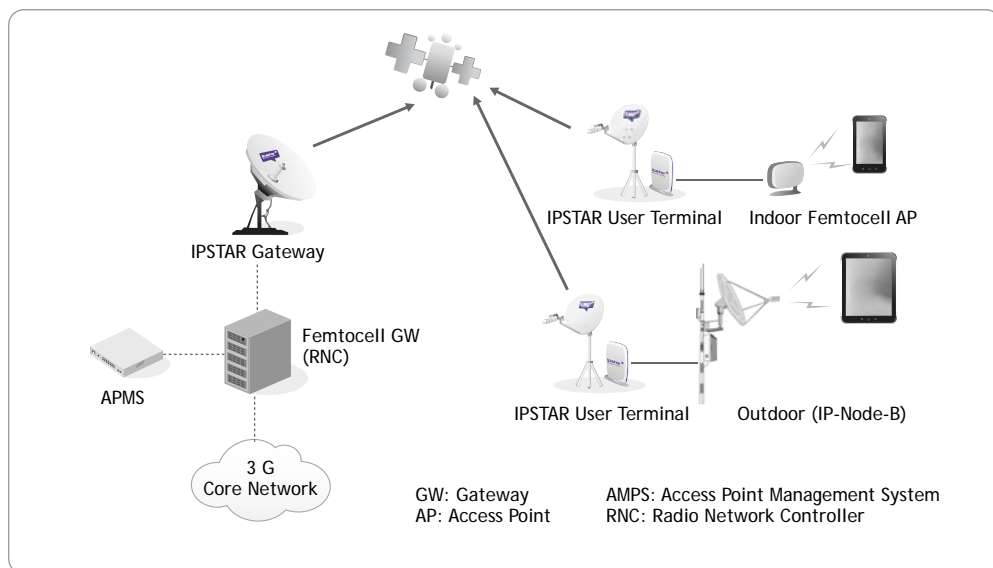


Figure 4: Small Cell service over broadband satellite backhaul

The inexpensive cost of Small Cell equipments and accessories enables deployment of this service using lower CAPEX as compared to traditional base stations. Also, the lower bandwidth costs of IPSTAR as compared to a conventional satellite allow for the feasible operation of Small Cell service with reduced OPEX. For remote areas beyond the reach of terrestrial access networks, Small Cells and IPSTAR backhaul are the perfect combination for a profitable business model.

6. Applications of IPSTAR Backhauled Cellular Service

Mobile Operators these days have a wide range of choice regarding base stations that be deployed - from macro BTS, and micro BTS, to pico BTS and Small Cells. This provides them with service diversity which they can deploy according to requirements – thus targeting services based on population density, coverage area required, and ARPU of the region. IPSTAR has already tested different end modems and ground systems which can be selected according to bandwidth capacity required by the Telco. There are three broad categories of applications for which cellular backhaul over IPSTAR can be used:

A. Rural voice and broadband service (USO)

IPSTAR is an ideal satellite platform to provide voice and broadband solutions in rural areas away from the reach of terrestrial backhaul networks. IPSTAR has been effectively used in microcell and macrocell backhaul in various countries using IPSTAR UT, SCPC modems, or other ground systems. Teams from IPSTAR work with mobile operators, and mobile equipment vendors to fine tune the system and reduce jitter so that the service performs within adequate levels of voice quality. The advent of Small Cell technology in recent years has greatly bolstered the deployment capability of mobile operators, with base stations on a single pole that can be deployed within a couple of hours.

B. Interim Solutions (Temporary Coverage)

The advantages of IPSTAR backhauled cellular service can also be leveraged as an interim solution for temporary coverage. Mobile operators generally have deployment plans spread over a long period of time. To reach some of the outlying areas, deployment of fiber may take a year or more; deployment of microwave also requires several months, requires strict line of sight, and possibly repeaters where distances to be covered are large. However, using a broadband satellite like IPSTAR, remote base station deployments can be done immediately. This enables the mobile operator to start generating revenues right away instead of waiting for several months or even years. Once the designated area has been covered by fiber, the IPSTAR satellite unit can then be moved to a more remote location.

C. Emergency Communications and Network Coverage Recovery during Disasters

Cellular backhaul over broadband satellite proved to be highly useful in the aftermath of the Great East Japan Earthquake and Tsunami of 2011. In addition to the tremendous loss of lives, the disaster caused extensive and crippling structural damages, including to that of communication networks. All the 4 major mobile operators of Japan had their infrastructure destroyed—with NTT Docomo, KDDI, Softbank Mobile (SBM) and Emobile losing 6720, 3680, 3800 and 878 base stations, respectively, in 11 prefectures. In the immediate aftermath of the disaster, the mobile operators also used instant IPSTAR backhaul to provide mobile phone and Internet services in emergency shelters, schools, and community centers. SBM and KDDI used Small Cells to provide mobile coverage in designated locations. Coupled with IPSTAR User Terminals, Small Cells became the ideal platform to provide instantaneous cellular service in disaster and emergency situations. Additionally, the mobile operators also used IPSTAR for its instant backhaul capability to bring back their service into operation. Base stations of various capabilities such as Pico BTS, Micro BTS, and even full capacity Macro BTS made use of IPSTAR backhaul to connect to their core network. This backhaul over IPSTAR was continued until the service providers recovered their capability and reconnected their lost terrestrial networks. Up to 500 base stations were backhauled via IPSTAR, with most of the deployments in the hardest hit Iwate and Miyagi prefectures.



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