# Satellite Communications

The availability and access to satellite communications has been steadily growing for the past few decades, and while the number of providers and wide scale availability of land based or localised internet and voice providers has dramatically increased in the past decades, humanitarian agencies are still heavily reliant on satellite communications in a variety of contexts.

# Technical Considerations with Satellite Communications

## National Regulations

Even though satellite signals can theoretically be received in any location under the satellite's coverage area, there are still national rules and regulations governing the use satellite communications in different countries. Some countries may require special licenses and registrations for the use of satellite equipment, while other countries may ban them outright. Many governments have close ties with local telecommunications providers which enables them to monitor and control voice and internet traffic – satellite communications devices can and do circumvent many of these controls. Some states allow for the use of some satellite communications equipment, but require additional hardware be installed at a user's location to properly monitor activities.

Prior to buying, importing, using or selling any satellite communications equipment, humanitarian agencies should research and understand what the local regulations are. Failure to comply with regulations may result in severe penalties.

## Latency

The delay in time between when a signal or packet of information is sent and when it is received is known as "latency" in ICT terms. Latency is something that impacts all forms of electronic communication, however users of satellite communications are especially impacted by this. The inherent distances involved with satellite communication and the types of communications infrastructure in place to support satellite communications can lead to fairly high levels of latency between users. This is especially noticeable when communicating by voice over a satellite phone or VIOP connection – users will likely encounter some form of delayed feedback and must moderate their communication styles accordingly.

## Antenna Focus

Satellite communications devices can use both what are called "omnidirectional" and "unidirectional" antennas.

- **Omnidirectional** – Antenna does not have to be specifically pointed, and can send/receive signals from any orientation.
- **Unidirectional** – Antenna can only send and receive signals in one direction, and has to be pointed directly at the satellite. Unidirectional antennas tend to be used for stronger signals.

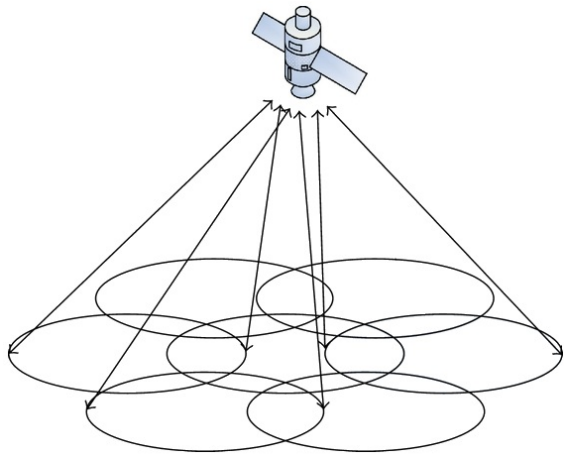
The antenna used by each device depends on the nature of the device, and it's relationship to the satellite.

## Spot Beams

In the process of delivering communications to the ground, satellites use a variety of antennas to transmit and receive frequencies. In order to better control specific areas served by the satellites, or to compensate for potential equipment failures, many communications satellites utilise what are called “spot beams”.

When a spot beam set up is used, the satellite will break the signal up into many smaller geographic coverage areas. Often times, these spot beams directly correspond to physical hardware components, such as processors, individual antenna components or other stand alone features. In most cases, while special spot beams enable satellite communications providers to turn up or turn down the bandwidth available in specific spot beams, they also limit the maximum throughput per spot beam. In other words, the maximum data output capable of the entire satellite cannot necessarily be used in just one location.

**Example: Spot Beams** **Real World Spotbeam Coverage - Inmars**



Understanding spotbeam coverage is important for humanitarian organisations utilising satellite communications. Often times, in post disasters or in complex emergency settings, many humanitarian agencies are co-located in the same clusters of towns and compounds. In situations where most or all actors are trying to access the same satellite communications service at the same time, they can overload the capacity of that specific spot beam. This is why even if only one or a few persons are using voice or data within your compound the system may still run slow – all of your neighbours may be doing the same thing at the same time.

## Contention Ratio

Contention ratio in normal networking terms refers to the ratio of the potential bandwidth capacity of a network compared to its actual network usage. In the world of satellite communications, contention ratio takes an entirely new context however. The contention ratio of a refers to the number of individual base stations that are using the same connection and the same channel at the same time. A ratio of 8:1 would indicate that eight total base stations are connecting to the satellite at once, and any organisation using a contract with a built on 8:1 ratio must be prepared to share bandwidth with seven other organisations at any given time.

In humanitarian response settings, the contention ratio of users can cause problems quickly. As many organisations pour into a disaster setting, often without any other functioning communications infrastructure, the number of concurrent organisations utilising a satellite communications network can add up quickly, especially for internet services. Many satellite communications providers can offer tailor made packages that guarantee lower contention ratios, however such packages tend to be more expensive. When planning to use a satellite communications device, plan ahead and know what it’s intended use will be. Will this device be

used for casual usage in areas where regular phone or internet coverage is spotty? Or will this device be used as the primary access point for multiple business essential users? If a data device is meant to be heavily used in emergency settings, perhaps a lower contention ratio package should be considered.

## Network Operation Centre (NOC)

In satellite communications, the term “Network Operation Centre” (NOC) is colloquially used to refer to any location where a satellite routes terrestrial traffic through. When using a satellite phone or satellite internet, though the handset or base station may be speaking to the satellite directly, the satellite itself must still eventually route its traffic through another form of connectivity to complete the communication.  Very few satellites offer direct communication point-to-point, while the vast majority of the time the other receiving end, either a computer, mobile phone hosted service is on a different network entirely.

| | |
|---|---|
| 1 | External ISP |
| 2 | NOC |
| 3 | Satellite |
| 4 | Base Station |
| 5 | Satellite Modem |

NOCs are the gateway rest of the world, and can route communications appropriately. NOCs are specially operated, and may be owned or sub-contracted by the satellite provider. In large satellite communications networks, a complex series of NOCs can be utilised to cover different geographic regions and special purposes. NOCs are also one many pieces of infrastructure required to enable satellite communications, but can also be another point along the communications chain that can slow down connections, and unfortunately service users have virtually no control over issues caused by NOCs.

## Bands of Transmission

Communications satellites operate using various form of radio and microwave transmission, both of which found on the spectrum of electromagnetic wavelengths. Communicating with satellites from the earth and vice versa  requires wavelengths that can penetrate the atmosphere and deal with a wide range ambient interference. Additionally, satellite communications providers have settled on certain standards that comply with state and international regulations. When speaking about satellite communications, the most common bands of transmission are:

| | |
|---|---|
| **L** | 1.0 - 2.0 gigahertz (GHz), radio range |
| **C** | 4.0 - 8.0 gigahertz (GHz), microwave range |
| **Ku** | 12.0 - 18.0 gigahertz (GHz), microwave range |
| **Ka** | 26.5 - 40.0 gigahertz (GHz), microwave range |