

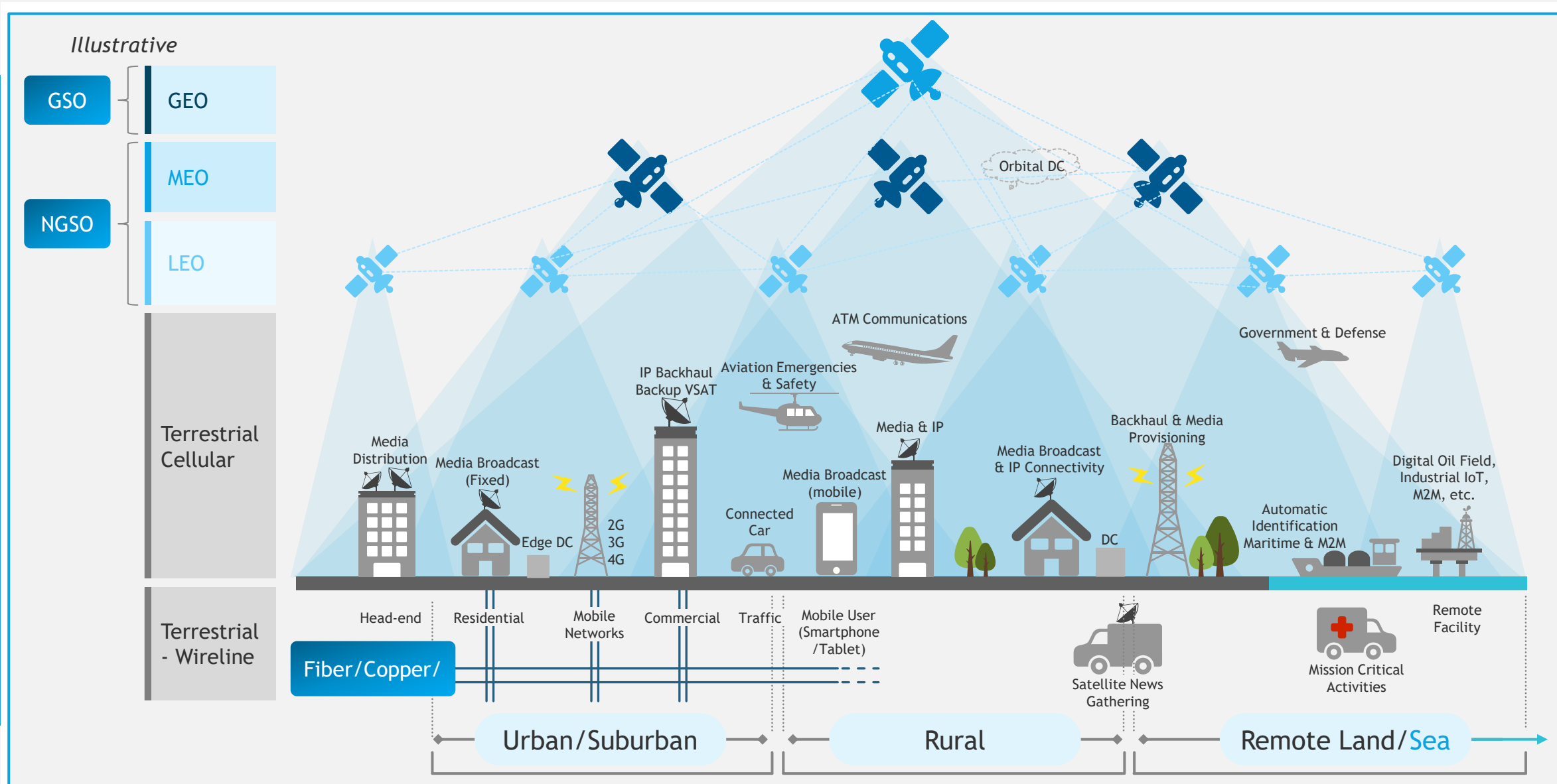


Satellite technology in disaster management

VIVEK BANZAL

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Satellite communications play a vital role in the overall global telecommunications market



It is not new , not even in India



Initial Sat Com deployments

Project Specific - Coal mines in WCL and SECL

Inaccessible area- DHQs - J&K , NE , HP , Hills

DoT deployed satellite base station across India to have some connectivity to DHQs ,
Pulwama was the last DHQ of india connected on satellite in 1994-95



Upgradation of Sat Com

The mere connectivity - couple of circuits , was upgraded during 1990-2000 by 8 Mbps for bigger places

Drive was also taken to connect important places below DHQ with multichannel

The use of smaller antenna VSAT , VSAT for leased ckt revolutionized the satellite connectivity



Emergency situation

India established exclusive network from all land border state to Delhi on satellite links - PB, GJ , RJ , J&K , AS, MZ ,WB

These links , were vital for any break in communication channel to ensure that the state is not isolated

7 MTr dish antenna were deployed serving as Hub for the state satellite , as well as link to Delhi



Iridium - Global

1998- constellation of 90 satellite was put in space

It gave global coverage , with small brief cases terminals (Bond movies) ,even hand held mobile like sets (though bigger bulkier)

It was ahead of the time , technology's commercial adoption some time does not work , if it is ahead of time

IRIDIUM struggle in last 27 + years

Planned 77 satellite to cover globe , Started operation in 1998.

Launched 95 satellites , 66 were sufficient to cover the globe , rest used as spares in orbit.

Rs 100/- min tariff

Went into Chapter 11 bankruptcy in 1999

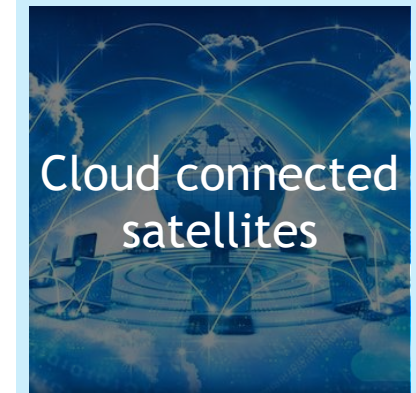
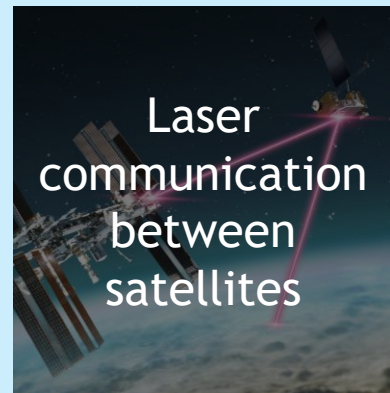
\$4 B write

Started again in 2001 . Met 33 satellite Collision in 2008 .

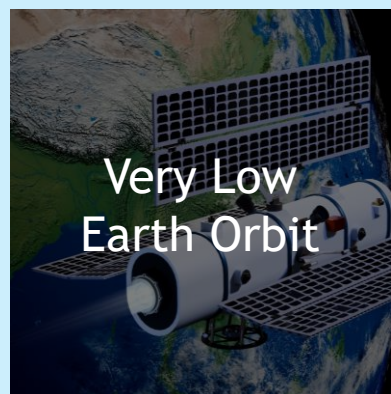
Currently on Project Stardust, a 3GPP standard-based satellite-to-cellphone service scheduled to launch in 2026

Ten trends are changing the satellite industry in 2025

Core Enabling Technologies



Emerging Deployment Shifts



Terrestrial Networks have limitations in disaster management response



Coverage Gaps

Rural, mountainous, forested, or island regions **lack sufficient tower infrastructure**



During the Uttarakhand floods (2013), entire valleys were out of network coverage



Infrastructure Vulnerability

Cell towers, fiber cables, and power lines are highly **prone to damage**



Cyclone Fani (2019) knocked out over 5,000 cell towers in Odisha within hours



Network Congestion

Massive **surge in traffic** during emergencies overwhelms the limited capacity of local networks



In Turkey's 2023 earthquake, mobile traffic spike + tower failures led to total blackout in many cities



Slow Recovery

Rebuilding ground infrastructure **takes several days**, especially in hostile terrain or during blockages



Nepal earthquake (2015), it took 3-7 days for basic cell coverage to return in remote hill towns

However, satellite capabilities can support in essential ways during all phases of the disaster management



Mitigation

Hazard mapping

Land **movement tracking** using InSAR and EO satellites



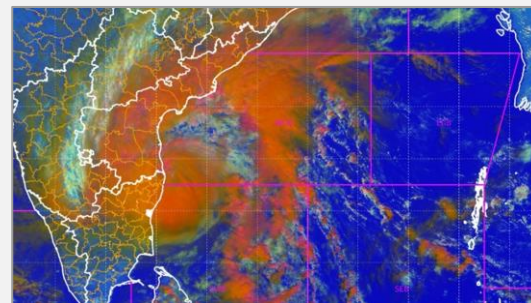
Blatten, Switzerland (2024): Sentinel-1 and TerraSAR-X tracked slow ground deformation enabling evacuation before the landslide.



Preparedness

Weather alerts & flood forecasting

Simulation modelling with EO & meteorological satellites



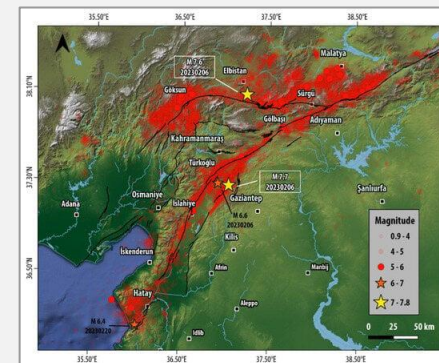
Cyclone Michaung (India, 2023): INSAT & Himawari satellites monitored storm intensity & issued early warnings



Response

Emergency **communications** via VSATs, satphones

Real-time **rescue coordination** using GNSS and EO



Turkey-Syria Earthquake (2023): EO data guided search and rescue by mapping collapsed zones.



Recovery

Damage assessment with post-event EO imagery

Infrastructure planning via 3D mapping



La Palma Volcanic Eruption
Recovery: EO satellites provided lava flow maps & elevation models for rebuilding roads & housing zones. 7

Blatten, Switzerland | Satellite monitoring turned a potential tragedy into a story of preparedness and precision

Tiny Swiss village engulfed by a mountain

Sudden glacial rockslide from Kleines Nesthorn in May 2025

- 90% of Blatten village buried in debris
- River Lonza Blocked
- 300+ residents at risk



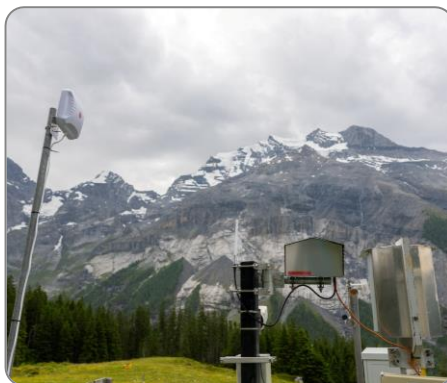
Satellite detected abnormalities aiding in evacuation days before tragedy

Sentinel-1 (InSAR) detected abnormal glacier deformation 10 days prior

Pleiades Neo visualised terrain shifts in high-res for rescue planning

LiDAR & AVIRIS-4 Spectrometry mapped landslide structure and instability zones

Optical & Radar Imagery identify river damming for evacuation of downstream



Early warning minimised casualties

- 300 residents evacuated 48 hours prior to landslide
- 190 sheep, 26 cows, and about 20 rabbits evacuated by air & land



Key satellite technologies deployed in disaster management



Communication Satellites

- VSAT terminals
- Satphones:
- Direct-to-Device (D2D):



Earth Observation satellite

- High-resolution imaging & mapping
- Radar and multispectral data



Navigation Systems

- GPS/GNSS (NavIC)



IOT via Satellite

- Remote sensors
- Real-time alerts

With significant advantages over terrestrial networks

Resilient Connectivity

Supports PPDR, NDRF, and DMOC operations when power lines fiber or cell towers are down

Wide-Area Coverage

Reaches rural, coastal, and hilly terrains—no reliance on ground infra

Faster Decision-Making

Mapping damage enables prioritization of relief and evacuation

Early Warning & Monitoring

Predict risks, improve readiness and preventive evacuation

Seamless Inter-Agency Coordination

Enables unified command across DMOCs, responders, and ministries

Chamoli, Uttarakhand | Satellite technology in Chamoli made rescue efforts precise & timely

Glacier triggered deluge in Uttarakhand

Flash flood & mudslide in Tapovan-Rishi Ganga project area in Feb 2021

- ~83 fatalities, ~121 missing
- Dozens **trapped in hydropower tunnels** & submerged villages



Stranded victims, rescue zones identification, communication enabled through tech

VSAT Quick Deploy Antennae provide live visuals & coordination support in accessible locations

Drones (UAVs) located stranded victims in high terrains

DRDO sourced radars detected air pockets beneath sludge in tunnels, identifying rescue entry zone

Sonar Rescue Radars assisted mapping of sludge depth & flood-affected structures



Tech-intensive rescue ensure precise efforts

- **Over 170 missing** traced & ~32 bodies recovered
- Technology synergy enabled more **precise, safer** and **faster** rescue ops



Telcos around the world are focusing on emergency preparedness & disaster resilience; satellite communication is a recent focus globally



verizon

X



NTT docomo

Tomorrow, Together
KDDI

SoftBank

Project Kuiper partnership

Enables Verizon to **backhaul cellular traffic via satellite** to serve rural and disaster-prone areas where building fiber is impractical

SatCOLTs and Flying COW drones

Portable deployables often relying on satellite links to provide temporary coverage to first responders in wildfires or hurricane

Flying base stations in Tohoku Earthquake

29000 earthquake-disabled cell sites were replaced by **“flying base stations”** by multiple Japanese carriers

Hurricane Ian

Verizon deployed **satellite uplinks** to reconnect several cell sites disabled due to hurricane

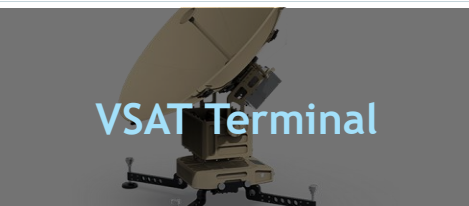
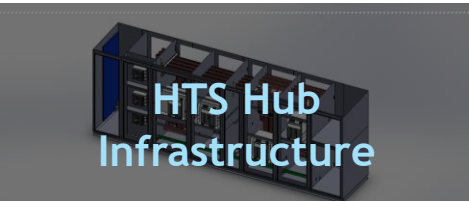
U.S. FirstNet first-responder network

As entity managing US-First Responder Network, tested **satellite connectivity** for public safety

High Altitude Platform Systems

Communication **drones/ balloons** - that stay aloft for long durations deployed by HAPS Mobile in the Kumamoto earthquake

BSNL provides crucial satellite communication technology for disaster response to key disaster management authorities

Offering	Features & Use case	National & State level disaster management bodies
	- Up to 125 Mbps download / 16 Mbps upload - Deployed using Ka/Ku-band with DVB-S2X support - Fully IP-based: Dual Stack (IPv4/IPv6), BGP, VLAN Tagging - Operates in spot beam HTS networks	   
	- Located in Mumbai & Delhi 24x7 operations with scalable gateways - HTS-ready	
	1m Ku-band manpack terminal, IP67 rated - Under 20 kg, <15 min setup time - Flyaway antennas, modems, Wi-Fi-enabled outdoor terminals	
	- Man-portable systems for on-the-go deployments - Voice, video, data services supported	

BSNL fixed VSAT technology has enabled setting up of Emergency Operation Centres with NDMA & SDMA



Fixed VSAT for NDMA EOCs

- ◇ Pilot led by BSNL to set up satcom for Emergency Operations Centre (EOCs)
- ◇ Installed 120 fixed VSAT terminals supplemented by satphones and HF radio
- ◇ Covering NDMA, NDRF HQ, all State/UT HQs, and select high-risk districts—between 2016-2019

Impact

Fail-safe voice, data, email, video conferencing, and GIS feeds across multi-level command centers
Successfully used in real disaster events (e.g. cyclones, floods)



Fixed VSAT in vulnerable districts

- ◇ BSNL provided VSATs to EOC's of selected vulnerable districts, in Himachal Pradesh and Meghalaya
- ◇ Enabled redundant satellite links and integrated data/voice/handicam video streams

District Disaster Management Authorities (DDMAs) gained **real-time situational awareness**, video feeds, and reliable **two-way communication with NDMA/State HQs**, significantly improving response and coordination



Thank You
