



Technologies to identify and/or mitigate harmful interference

International Satellite communication workshop: "The ITU - challenges in the 21st century: Preventing harmful interference to satellite systems"

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The Problem

Radio frequency INTERFERENCE continues to plague the satellite communications industry

- Operators and Industry Groups (e.g. SIRG, GVF) report that **signal interference significantly impacts margins, QoS, and operational efficiency**
- Owners and operators see an **increase in** cross-polarization interference and other interference associated with equipment problems, and install / operator errors, BUT also **unauthorized carriers, including hostile denial of service**.
- The scope of the problem **continues to grow** in line with **demands for SATCOM bandwidth** and transmitting infrastructure
- **Military needs outstrips MILSATCOM capacity** ... and so we place military communications onto commercial payloads...

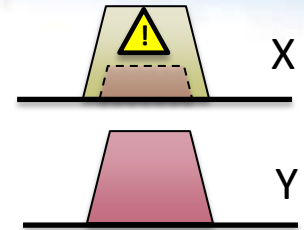
As interference events continue to grow in number, the resolution of issues which impact military communications transfer to the commercial battle-space.

Technologies to Mitigate or Identify harmful interference

Types of interference

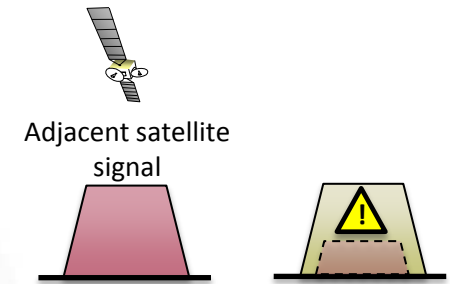
Cross-pol Interference – Accidental / very common

- **Generally caused by:** incompatible modulation types transmitted in the opposite polarization field to digital services on the cross-pol; poorly aligned antennas in bursting networks; and/or lack of [training/experience](#) of the uplink operators.
- **Becoming more prevalent** as installation margins are squeezed.
- **Mitigation:** [monitoring](#), [detection](#) and geolocation [tools](#), [carrierID](#), [training](#).



Adjacent Satellite Interference – Accidental / common

- **Generally caused by:** operator error, or poor inter-system coordination. Transmitting antenna is poorly pointed.
- **Becoming more prevalent** as two degree spacing between satellites in the geostationary arc becomes more common.
- **Mitigation:** monitoring, detection and geolocation [tools](#), [carrierID](#), [coordination](#) between satellite operators.



Adjacent Carrier Interference – Accidental / minimum occurrence

- **Generally caused by:** operator error, or equipment failure (unlocked equipment).
- Relatively infrequent
- **Mitigation:** [monitoring](#), [detection](#) and geolocation [tools](#), [carrierID](#).



Technologies to Mitigate or Identify harmful interference

Types of interference

Unauthorised Access – Accidental & Deliberate

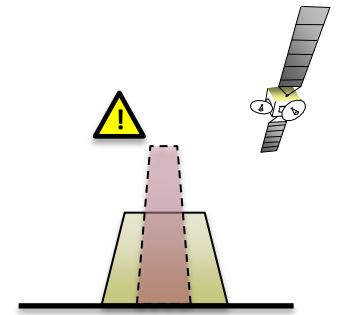
Term given to a signal which is not resident as cross-pol or adjacent satellite or carrier.

Accidental: very common

- **Generally caused by:** equipment failure, human error, improper commissioning, and terrestrial interference.
- **Becoming more prevalent** as two degree spacing between satellites in the geo-arc becomes more common, terrestrial microwave systems proliferate, and installation margins are squeezed.
- **Mitigation:** monitoring, detection and geolocation [tools](#), [carrierID](#), [training](#).
Unfortunately terrestrial systems often have priority and so becomes dead capacity.

Deliberate: relatively rare

- **Generally caused by:** unauthorised “borrowing” of bandwidth for test purposes (e.g. at commissioning), piracy, and hostile attempts to deny service.
- **Becoming more prevalent** though geopolitical motivation.
- **Mitigation:** [monitoring](#), [detection and geolocation tools](#). While hostile jamming is generally easy to locate, it is almost impossible to remove without political intervention, which can prove difficult.



ITU takes stand on satellite jamming

October 29, 2012 11:39 Europe/London By Robert Briel



The ITU has issued a statement on satellite jamming.

The organisation "is extremely concerned and alarmed to witness a continuing situation in which satellites operating in accordance with the Radio Regulations and duly recorded in the ITU Master International Frequency Register (MIFR) are the targets of harmful interference."

Recent satellite interference, believed to be caused by Iran and Syria, have caused problems for up to 25 broadcasters on the Eutelsat Hot Bird position, also affecting reception in Europe.

Med-TV jammed for 23 days – Sep 1997

The Times

July 17, 2003

Broadcasts to Iran, U.S. Says
several L.A.-based stations and
blocked.

BBC NEWS

Last Updated: Tuesday

HK probes Fa

BBC, Hong Kong

Hong Kong authorities investigating after programmes beam
China from the ter
satellite were allegedly
hacked into at the weekend.

Content promoting the spiritual
group Falun Gong, banned on the
the appeared on the
sat
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Intelsat Shuts Down Transponder Hijacked By Terrorists

April 26, 2007 | Satellite Today | JJ McCoy

Intelsat Ltd. has shut down a satellite transponder that was being used by Sri Lanka's
Tigers rebel group to make unauthorized TV and radio broadcasts in Europe and Asia
Sri Lankan Ministry of Defense announced.

The Falun Gong
in China

The Guardian | Wednesday, 29 September 2010

Al-Jazeera World Cup broadcasts were jammed

Exclusive: Guardian sees evidence interference came from
Middle East state, possibly due to deal with station going sour

BBC NEWS

TECHNOLOGY

News Sport Weather iPlayer TV Radio

Cyber-attack on BBC leads to suspicion of Iran's involvement

A "sophisticated cyber-attack" on the BBC
has been linked to Iran's efforts to disrupt
the BBC Persian Service.

In a speech Director General Mark Thompson
plans to say that the internet attack coincided
with efforts to jam two of the service's satellite
feeds into Iran.

He will say: "We regard the coincidence of these
different attacks as self-evidently suspicious."



The BBC is not providing detail of the timing or
nature of the cyber-attack

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Technologies to Mitigate or Identify harmful interference Hostile Jamming – Case Study

REGIONAL AFFAIRS



We're Jammin'

The inside story of how Al Jazeera Sports located the saboteurs of its World Cup coverage, and what the fallout from its findings could mean for the region

By Adam Grundey

TRIPS TO THE CINEMA IN DUBAI ARE always fraught with the threat of violence. Usually, it's restricted to fantasies of taking that gay's mobile phone and inserting it into his stupid yakking face. On June 11th, however, a mob of disgruntled customers reportedly trashed a cinema lobby when their demands for a refund weren't immediately satisfied.

The crowd had just exited the theater after viewing – or attempting to view – the opening game of this summer's FIFA World Cup in South Africa. The screening had been constantly plagued by technical glitches, with the picture disappearing for minutes on end and the commentary alternating between English, French and Arabic. The cinema-goers weren't to know that it wasn't an isolated incident, and not the cinema's fault. In bars, shisha cafes, hotels and homes across the Middle East and North Africa, transmission of the start of the

month-long competition (the world's most watched sporting event) had been spectacularly screwed up.

As the broadcast descended into chaos, the Doha headquarters of Al Jazeera Sport – which had splashed over \$1 billion to secure the exclusive rights to the tournament in the MENA region – were a whirlwind of activity. "We had people running in from all over," says an Al Jazeera official present at the time, who asks to remain anonymous. "Our director of technology was on the Saudi border when the broadcast went down. Within 20 minutes he was here. A lot of traffic lights were run that night."

The initial reaction at Al Jazeera was that something had gone very wrong with the uplink to Egyptian satellite provider NileSat. Crowded around a monitor in the control room, engineers and executives soon discovered, to their initial relief, that wasn't the case. The actual explanation, though, was more troubling.

"It took about half-an-hour for us to realize what was going on," says our source. "The monitor shows your signal as a wave. If you increase the power of your signal, the wave moves up. Decrease it, and it goes down. We're looking at the monitor, and there's a yellow line representing our signal. It looks normal. As far as the satellite is concerned, everything is normal too. The signal coming from South Africa is fine. The signal inside our IQ is fine. But, there's still disruption on the TV screen." NileSat reported to Al Jazeera that its monitors showed a normal wave. Its output was faulty, but there was no obvious sign of any problems with the signal.

"So we put out a stronger signal," he continues. "And as our line moves up, we see another line, exactly where ours was. Six seconds go by, then that wave starts to move up. And it stops exactly where ours is. So we decrease power. And the other line comes back down to where we are. We

check and doubt be no mistake.' There is another same time to the same strength." Al Jazeera broadcast was deliberately jammed by a third party. It wasn't a technical glitch. It was sabotage.

AL JAZEERA SPORTS, AS THE NAME suggests, is part of the Al Jazeera network, which enjoyed a meteoric rise to international fame following the September 11th, 2001 attacks, and the subsequent war in Afghanistan. It was Osama bin Laden's channel of choice for his Tora Bora home movies, and the only news network to report live from the ground, ensuring the Al Jazeera logo became a familiar fixture on screens all over the world.

Al Jazeera's Arabic news channel was launched in 1996 amidst much fanfare with claims that it was the first truly independent Arabic-language media in the region. "The whole point of Jazeera was that finally the Arab world had this media outlet that could balance the Western portrayal of what was going on here," says Fena Hamza, co-editor in chief of Middle East studies at the American University in Dubai. "So we could finally show Palestinian suffering as it really is. And that drummed up a lot of support."

The injection of an outspoken, opinionated network, unsurprisingly, ruffled a few feathers, too. Jazeera was given a home – and a \$197 million start-up package – by Qatar's emir, Sheikh Hamad bin Khalifa Al Thani. And while the channel has, on occasion, been openly critical of Gulf leaders, it's been accused of being soft on Qatar. "The Qatari authorities" wanted this as a flagship brand, as an independent media outlet, but, at the same time, they didn't want to allow it to scrutinize or criticize the regime," says Hamza's colleague, assistant professor William Guénaïche.

This perceived double standard has led to angry reactions from Arab countries that the channel has criticized (although they'd likely have been equally upset even if Al Jazeera was seen as being completely balanced in its reporting). Tellingly, though, the Arabic news channel has come under fire from pretty much everyone. It's been accused, at various points, of being biased towards (and against, often for the same story) the Arab world, the Arabs, and the Israelis. Which, you could argue, suggests its balance is pretty well-judged. What this all means, though, is that while Al Jazeera has unquestionably been a positive development for Arab media, providing an outlook on the world that had previously been grossly skewed, it has some very powerful enemies along the way.

BACK AT AL JAZEERA SPORTS' HEADQUARTERS, the team was frantically fire fighting, adding alternative



was not to blame. Around six the next morning, they felt the worst was over. They were wrong.

There was uproar in the region's media. And while Jazeera's claims of sabotage were reported, it was often with an obvious air of skepticism. A bad day turned worse when two June 12th games were also disrupted. By the end of the Cup's first week, it was clear that Jazeera was the subject of a concerted campaign of "space terrorism," as our source describes it. Subscribers' anger

wasn't just to us, but to the two distributors in two different countries that had their shops broken into and vandalized by angry customers who thought there was a problem with their cards. In one shop, the owner was beaten up." Al Jazeera needed something more than conciliatory press releases. It needed to find out who was responsible.



FOUL PLAY in soccer's broadcast as if of the opening game was plagued by blackouts and errors in commentary language

was mounting, and it was clear that the network's PR campaign hadn't succeeded in deflecting it elsewhere. Inevitably, the blame games began.

First up was Israel. "I don't rule out Israeli involvement in the disruptions," the head of Al Jazeera's broadcasting department, Raed Abed, told the U.K.'s daily *Al-Nahar* *Alyoum*. This being Al Jazeera, though, Israel was not the only suspect.

Because Al Jazeera Sports urged its viewers to switch from NileSat's downlink to Arabsat's (as, at the time, NileSat appeared to be the saboteurs' preferred target) the media began to speculate that Egypt was behind the disruption – a theory based in part on Jazeera's awkward relationship with Egyptian authorities, soured particularly by criticism from the Arabic channel (or at least its talk-show guests) of president Hosni Mubarak's role in the Middle East peace process.

This resulted in a counter-accusation from Egyptian officials, suggesting that Jazeera had sabotaged the broadcast itself. Mahmoud Juma, the head of Egypt's radio and television, was quoted on Al-

"Everybody was annoyed at the fact that Jazeera was the sole provider," says AUD's Hamza. "My friends in London were watching it for free on terrestrial television. Why couldn't we? So there was already a lot of anger there."

"It was seen as being greedy – a very Western approach," Guénaïche agrees. "Commercial transactions can be frowned upon. If you're a good Muslim, [many believe] it's your duty to share with your brothers and sisters, whether it's a football match or whatever."

[<link to article>](#)

Technologies to Mitigate or Identify harmful interference
The Toolbox

DETECT.LOCATE.RESOLVE

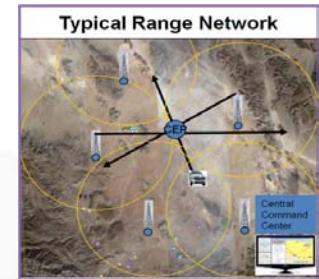
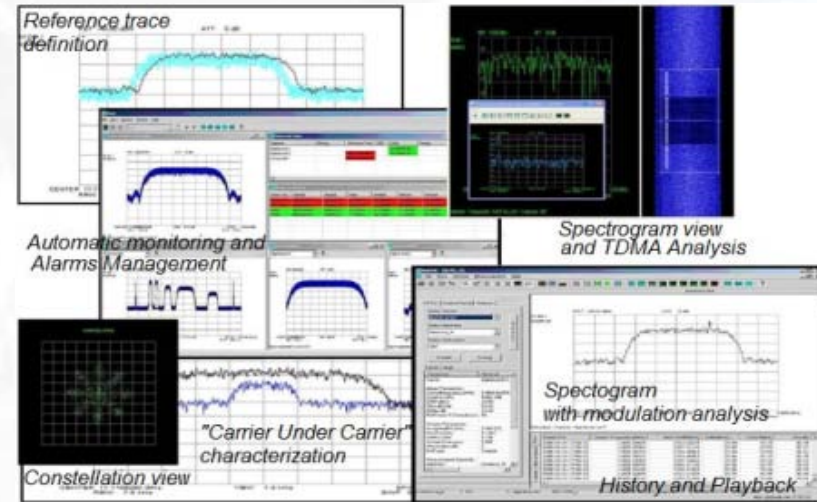
Technologies to Mitigate or Identify harmful interference

DETECT.LOCATE.RESOLVE

RF Monitoring and Interference Detection:

The first step towards mitigating against the disruptive effects of SATELLITE INTERFERENCE is rapid **DETECTION** and **CHARACTERISATION** through effective **MONITORING**.

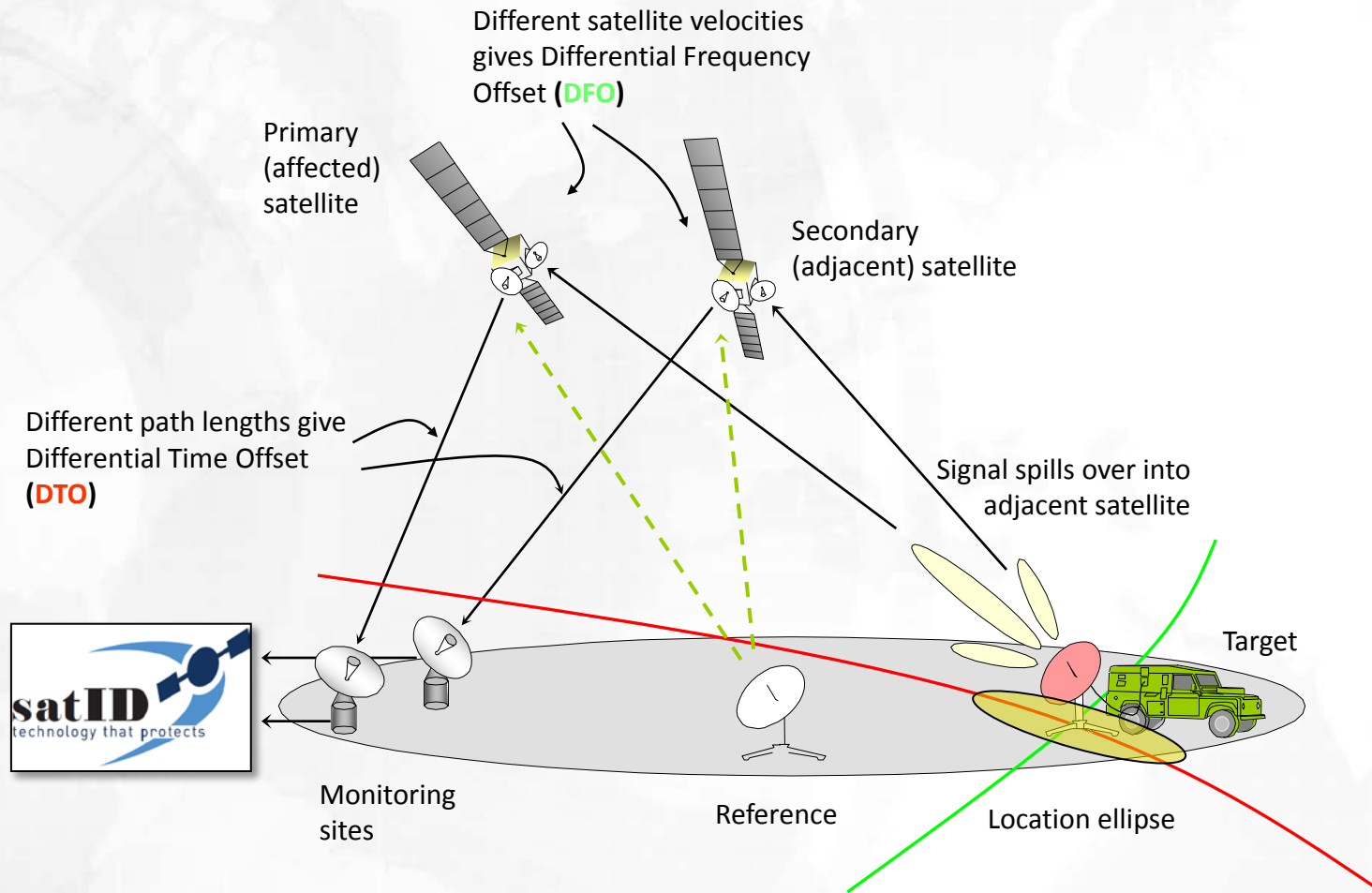
Includes extraction of the **Carrier ID** where available.



Technologies to Mitigate or Identify harmful interference

DETECT.LOCATE.RESOLVE

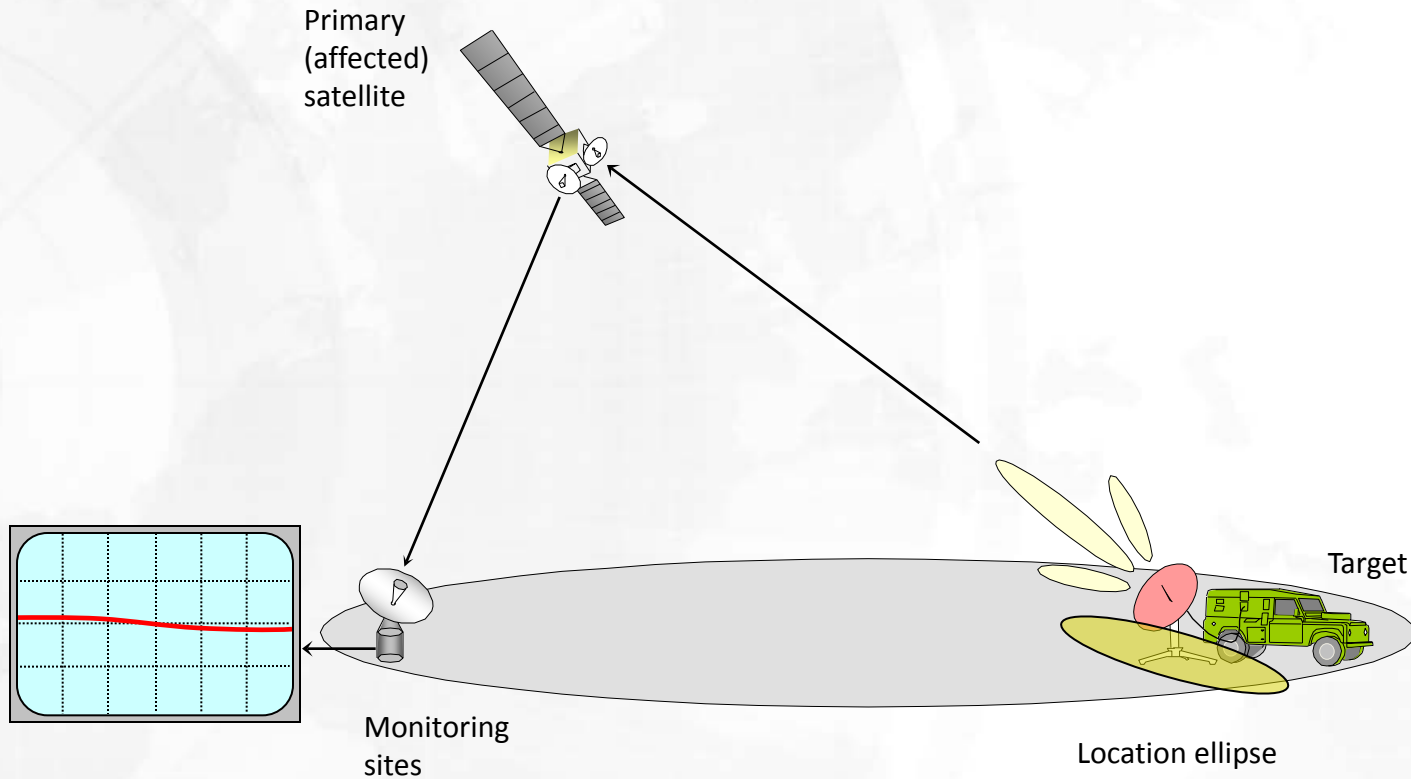
... and then **Geolocation** ... either two-sat



Technologies to Mitigate or Identify harmful interference

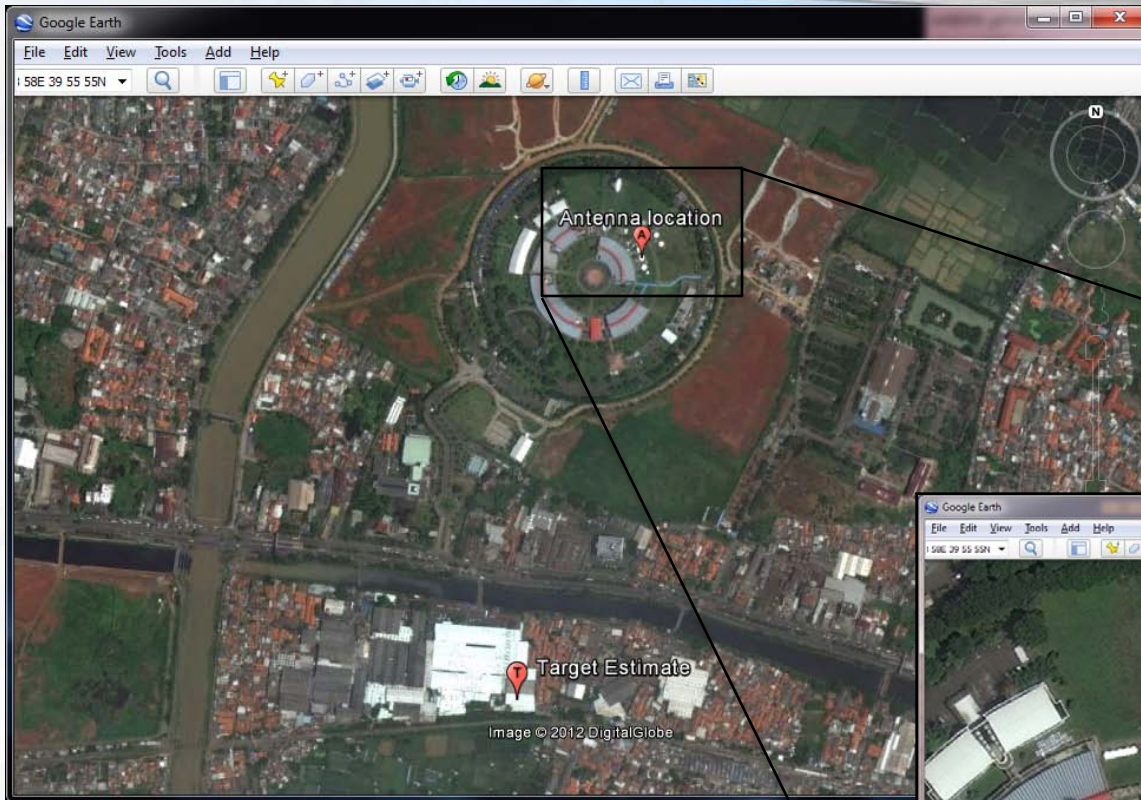
DETECT.LOCATE.RESOLVE

... or **single-sat...**



Technologies to Mitigate or Identify harmful interference

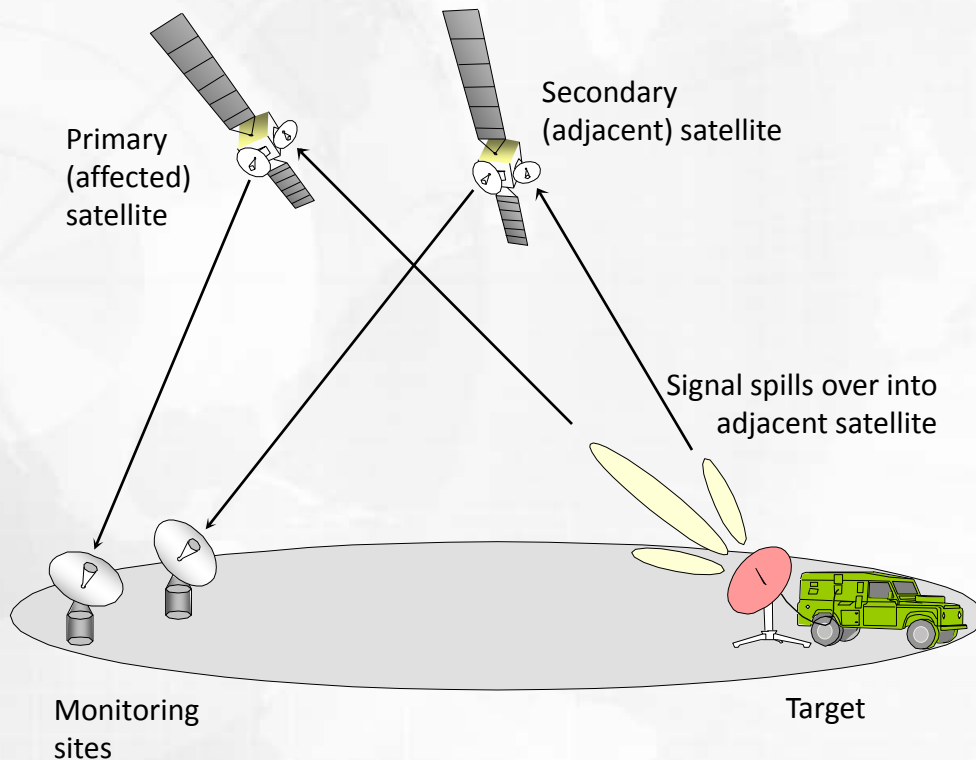
DETECT.LOCATE.RESOLVE



Technologies to Mitigate or Identify harmful interference

DETECT.LOCATE.RESOLVE

Two-satellite Geolocation: Constant development continues to push the boundaries

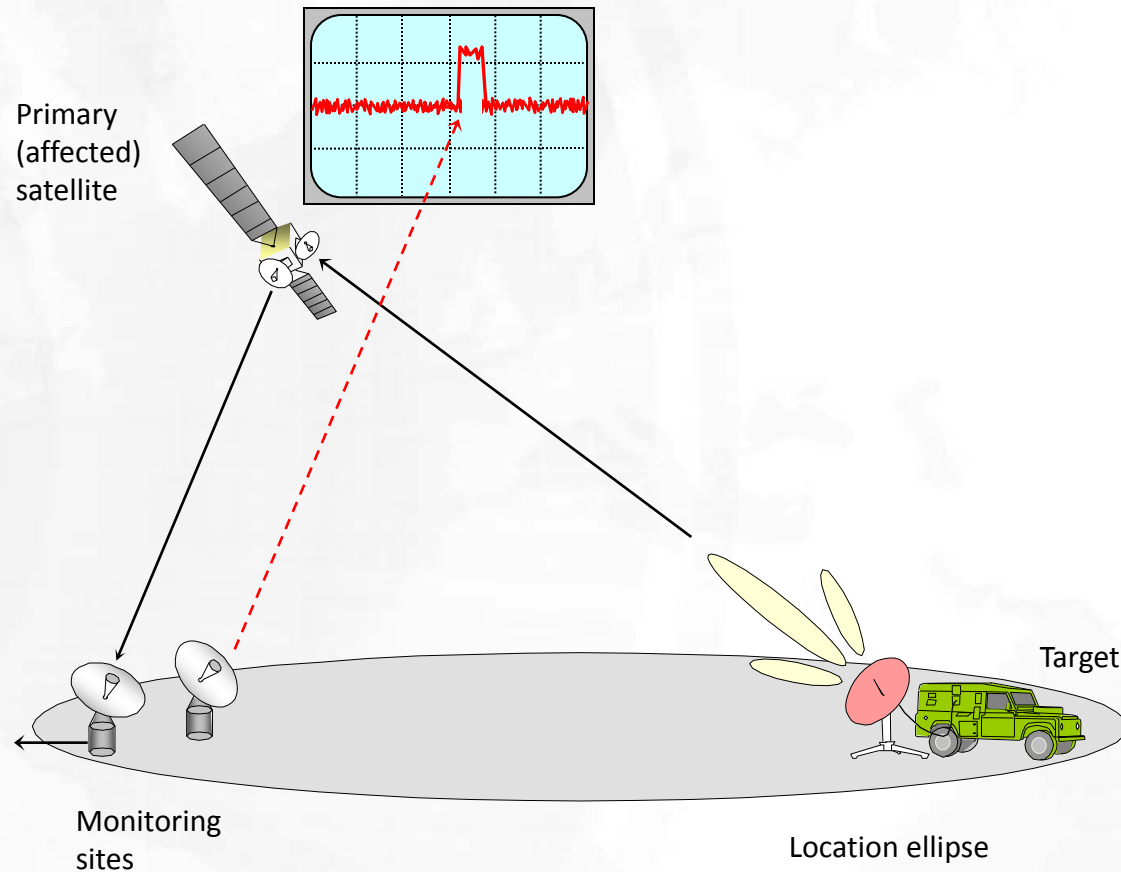


- Accuracy
 - Algorithm development and compensation techniques give < 5km today.
 - Future aims (< 3years) are for sub-km accuracy.
- Speed
 - High accuracy achieved in seconds
- Ease of Use
 - Map-centric software
 - Integrated monitoring, detection, characterisation and geolocation.
 - Managed services

Technologies to Mitigate or Identify harmful interference

DETECT.LOCATE.RESOLVE

Ground-based **interference suppression**... a band-aid



The tool-kit to mitigate harmful interference is extensive...

Training

Coordination

Monitoring

Detection and Characterisation

Carrier ID

Geolocation

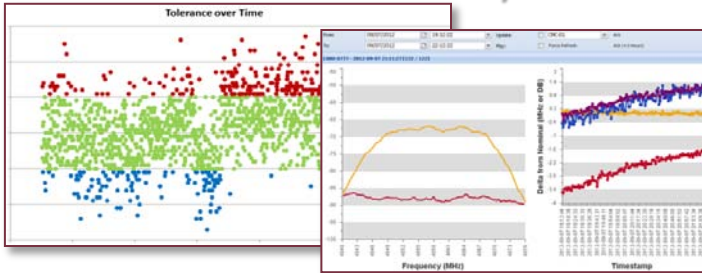
Suppression

- No one tool is 100% successful in isolation, but together they provide operators and regulators with the means to **RESOLVE** the vast majority of cases of harmful interference in-house...
- ... with the exception of hostile denial of service.

Technologies to Mitigate or Identify harmful interference

Verification Services

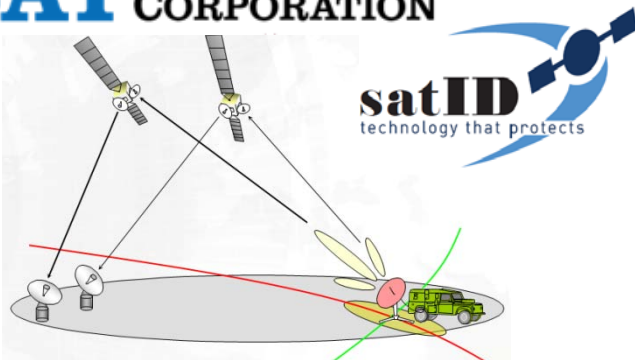
SAT CORPORATION SAT-DSA / Monics®



Monitoring of QoS 24/7

Detect and characterize issues before impact
Integrated Carrier ID recovery

SAT CORPORATION



Geolocate

Fast, accurate identification of ground source
using geolocation techniques and coordination

SAT CORPORATION/SERVICES

✓ Monitoring

- ... of RF Quality of Service Link Performance
- Power/bandwidth utilization
- Link quality (C/No, Eb/No & BER)

✓ Detection & Characterization

- FEC, modulation, & coding
- Detect and characterize RFI before the user sees a problem

✓ Coordination

- Extensive satellite operator network
- Can see adjacent satellites

✓ Carrier ID

- Extraction of carrier ID being integrated with CSM systems

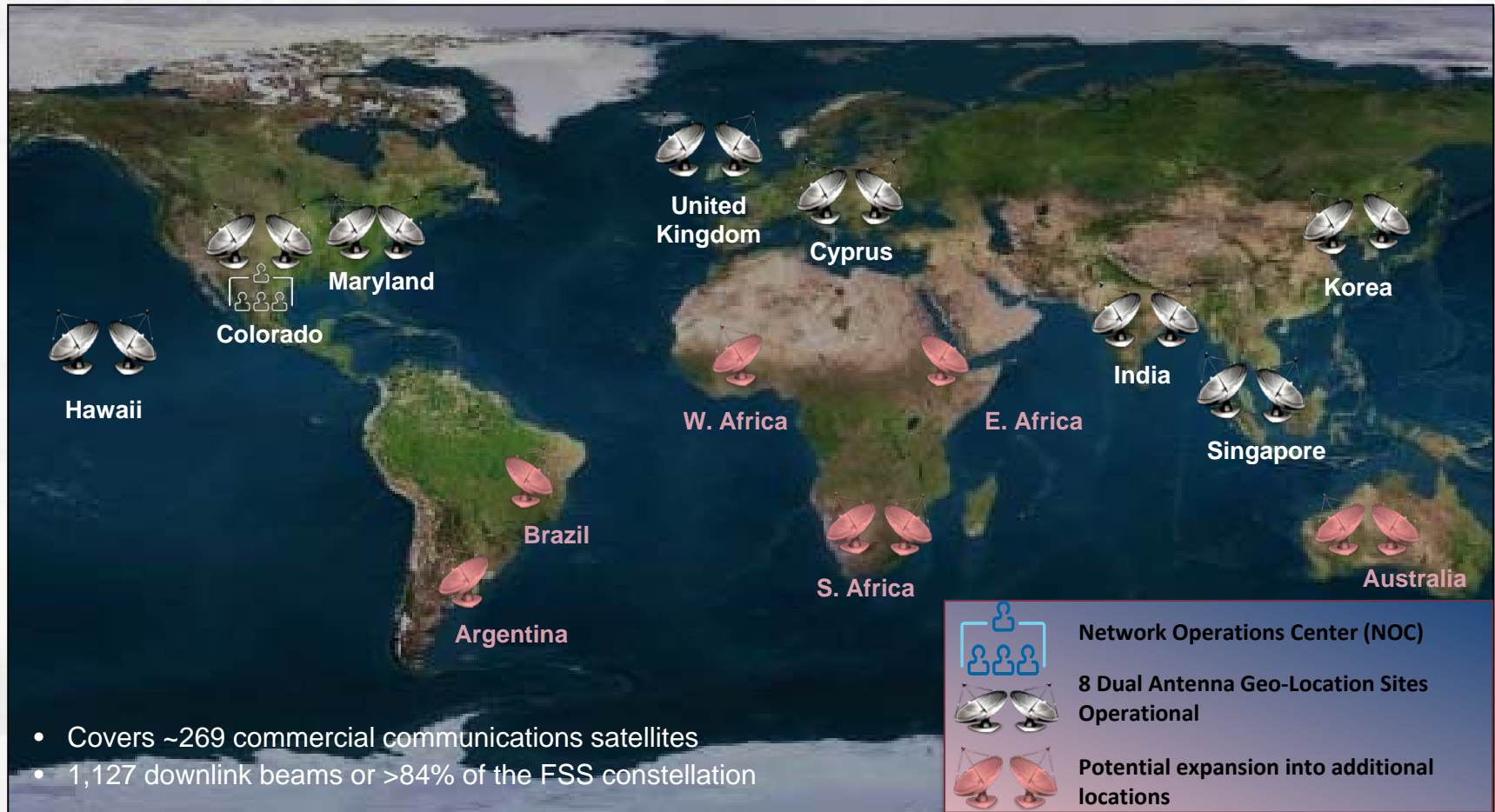
✓ Geolocation

- Pinpoint the uplink ground position


✓ Suppression

Technologies to Mitigate or Identify harmful interference

Verification Services



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