Background information

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Looking back at 10 years of the Disaster Monitoring Constellation

The Disaster Monitoring Constellation is a unique international partnership formed by national governments and organisations that recognised the need for coordinated satellite imaging campaigns to assess and mitigate natural disasters with more up to date and timely.

The Constellation was first proposed in 2000 following calls for improved response to man-made and natural disasters. The Vienna Declaration On Space And Human Development was adopted by the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE III) in 1999, calling specifically for the implementation of an integrated, global system to manage natural disaster mitigation, relief and prevention efforts through space activities.

By this time Surrey Satellite Technology Ltd (SSTL) had launched 19 satellites, testing lower cost technologies and demonstrating that smaller, more affordable satellites could be made highly capable by taking advantage of commercially available technologies such as solar cells, microprocessors and networking equipment. The Tsinghua-1 Earth observation satellite built and launched in 2000 for China's prestigious namesake, Tsinghua University, served as a pilot mission for low cost Earth observation further validating small satellite Earth observation advances from previous missions.

With support from the former British National Space Centre (BNSC) provided through its landmark MOSAIC small satellite initiative and partnership with Algeria's Centre National des Techniques Spatiales (CNTS), the Disaster Monitoring Constellation was born. The first satellite, AlSat-1, was launched in 2002 for Algeria. This first satellite was soon joined by the BNSC-supported UK-DMC-1 satellite, Nigeria's NigeriaSat-1 and Turkey's BILSAT-1 in 2003, forming the original four satellite constellation.

Unique capability

When the constellation first started providing images in 2003, the main source of satellite imagery was the American Landsat programme. Images from Landsat had become the staple for a growing user base of scientific researchers and governmental bodies throughout the World – and remains so to this day. However, data from Landsat had a fundamental limitation for disaster response because a single satellite is only able to image a given point on Earth every 16 days.

SSTL had proven with missions such as UoSAT-12 that stunning comparable resolution multi-spectral images could be produced for a fraction of the cost of Landsat TM data. This was only possible by building satellite using Commercial-off-the-shelf components whenever possible instead of space-qualified parts.

While the 100kg class Disaster Monitoring Constellation satellites are larger and more advanced than this early demonstration satellite, the approach remained the

same. The result is satellites that do more with less mass, for a low enough price tag that multiple assets can be built and flown in place of a single large satellite – and so the constellation was born.

From a technical point of view, coordinating multiple satellites in space made it possible to image any point in the world at least once a day compared to the 16 day Landsat revisit.

Each satellite orbits the Earth in synchronisation with the Sun. Because the satellites orbit the Earth in succession, if an area is obscured by smoke or cloud the following satellite can re-acquire an image of the missing area and fill any gaps with contiguous data.

Another factor crucial to the Constellation's success was its compatibility with Landsat data. The original Constellation satellites provide comparable 32m resolution images and optical spectra (Landsat 2,3,4 bands), enabling the extensive worldwide Landsat user base to make use of the new data.

Extremely wide images was another important feature of the new satellites. The 650km swath width of Disaster Monitoring Constellation satellites save users time and effort matching, processing individual scenes to compile a mosaic of images. The combination of multiple satellites and large images also made the Constellation very efficient at mapping large areas quickly at Landsat-comparable 32m resolution.

Because the Constellation satellites surround the Earth in a Low Earth Orbit they are able to provide timely global coverage.

Unique international cooperation

SSTL's cost effective approach to satellite design lowered the pricetag of Earth Observation to the point where governments and organisations throughout the world could own an independent satellite, providing cost effective sovereign remote sensing capability with shared ground segment, image processing and distribution – and an essential role in international disaster response.

Cost effective Disaster Monitoring Constellation satellites also provided a springboard for countries such as Nigeria to establish their national space programmes and harness Earth observation to map and monitor resources.

There are currently five consortium members (UK, Nigeria, Algeria, China and Spain) that each own an independent satellite, but pool their resources to gather and distribute up to date images of disaster stricken areas anywhere in the world.

Disaster relief

The SSTL subsidiary DMC International Imaging Ltd (DMCii) was set up to coordinate disaster response and to distribute images. In partnership with the former British National Space Centre (BNSC) and the Constellation members, DMCii uses the commercial exploitation of the satellite images to fund coordination of the Constellation for humanitarian use during natural disasters.

DMCii works with the United Nations (UN), European Space Agency (ESA) and the International Charter : Space and Major Disasters to provide multi-spectral optical imagery during natural disasters. The constellation responds to disasters frequently and has played an important role responding to disasters such as Hurricane Katrina

(2005), Asian Tsunami (2004), UK floods (2007), and the Sichuan Earthquake (2008).

In the event of a disaster, DMCii tasks whichever satellite in the Constellation is best placed to acquire imagery of the effected area. As new satellites have joined the Constellation, they have added new capabilities. For example, UK-DMC2 and Deimos-1 have an improved 22m resolution and can acquire both more data per orbit and larger individual images. When China's Beijing-1 satellite joined the Constellation in 2005 it provided high resolution (4m) panchromatic data that is ideal for "zooming in" to provide more detailed images in the event of a disaster.

When launched later this year, the NigeriaSat-2 satellite will provide still higher resolution 2.5m imaging and new highly flexible advanced imaging capabilities.

Don't forget the "day job"

When it is not responding to a disaster, the Constellation's satellites are utilised for national campaigns by its owned or for commercial imaging campaigns coordinated by DMCii.

An increasing number of users are switching to DMCii data from Landsat because of concerns about its current and future availability and because of its unique daily imaging capabilities. For example Brazil's National Institute for Space Research (INPE) has employed DMCii data for deforestation since 2005. Many precision agriculture companies in Europe and North America are increasingly relying on the daily imaging capability of DMCii for precision farming services that provide frequent updates on crop growth to guide fertiliser application and irrigation.

The Disaster Monitoring Constellation's low costs and sustainable business model represent an attraction in themselves to users, guaranteeing future data continuity with a steady stream of new launches – in marked contrast to the uncertain state of some government-sponsored systems.

Future developments

The Constellation will continue to adopt new capabilities as these become available. For example, data downlinks from satellites are now much faster. The original satellites could downlink images at 8MB/s. By comparison, UK-DMC2 that was launched in 2009 has and 80Mbps communications and downloads images up to 10 times faster than previous DMC spacecraft. Its storage capacity also increased from 1 - 1.5 Gb on the first generation of DMC spacecraft up to 12 Gb on UK-DMC2. These advances, in combination with improved power generation and storage systems, make UK-DMC2 very effective for rapidly mapping large areas.

Just two years later, SSTL mission planners have analysed their current storage, communications and imaging capabilities and concluded that it is possible to build a single satellite for equivalent cost that can image the landmass of the entire world every 5 days. A constellation of such satellites would once again change Earth observation forever – in the same way that the first generation of the Disaster Monitoring Constellation did in 2003 by providing daily images of the entire world.

Innovations in optics and changes to SSTL's heritage designs now also make it possible for small and cost effective satellite to provide very high resolution sub-1m images of the Earth. Synthetic Aperture Radar (SAR) payloads that can image through clouds or smoke and infra-red are also being considered for future Constellation satellites.

Important milestones

BNSC supports Constellation through MOSAIC	June 2000
TsingHua-1 pilot mission	June 2000
AlSat-1	November 2002
UK-DMC-1 launched (UK, SSTL) BilSat-1 launched (Turkey – mission completed) NigeriaSat-1 launched (Nigeria)	September 2003
Beijing-1 launched (China) - high resolution	October 2005
UK-DMC-2 (UK, SSTL) Deimos-1 (Spain, Deimos Imaging)	July 2009
Ten years of the Consortium NigeriaSat-X, NigeriaSat-2 (Nigeria) launches	2011

About SSTL
Surrey Satellite Technology Limited (SSTL) is the world's leading small satellite company, delivering operational space missions for a range of applications including Earth observation, science and communications. The Company designs, manufactures and operates high performance satellites and ground systems for a fraction of the price normally associated with space missions, with over 300 staff working on turnkey satellite platforms, space-proven satellite subsystems and optical instruments.

Since 1981 SSTL has built and launched 34 satellites – as well as providing training and development programmes, consultancy services, and mission studies for ESA, NASA , international governments and commercial customers, with its innovative approach that is changing the economics of space.

Based in Guildford, UK, SSTL is owned by EADS Astrium NV.
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