



ATC Global Market Intelligence Reports

The market for wide-angle/beyond airport surface ADS-B surveillance

The market for Advanced - Surface movement guidance and control systems (A-SMGCS)



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Foreword



Philip Butterworth-Hayes, ATC Global Editorial Director

Dear Reader,

The global air traffic management market is undergoing some fundamental changes. As radars, ground-based navigational aids, voice communications and paper-based flight briefing tools give way to more network-enabled software systems, the market for customers and suppliers alike is in flux. There are new companies entering the market and a consolidation process which is seeing aircraft manufacturers becoming ATM service suppliers and ANSPs selling more goods and services into the global market. To help understand the new concepts, the players, the global drivers and the values of the new technology sectors the ATC Global Insight team is developing a series of studies which will give the reader an overview of the scale and shape of each market sector. These reports will highlight regional trends, values and the contract successes of the major players. Over the coming months more communications, navigation and surveillance sectors will be analysed so the reader will be able to develop a real understanding of how industry trends are re-shaping the ATM market.

A handwritten signature in black ink, appearing to read 'Philip Butterworth-Hayes', with a stylized flourish at the end.

Philip Butterworth-Hayes, ATC Global Editorial Director

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The market for wide-angle/beyond-airport surface ADS-B surveillance

INTRODUCTION

ADS-B is a technology that broadcasts an aircraft's call sign, position, altitude, velocity and other data, twice a second. ICAO has identified ADS-B as a main component in future ATM surveillance and is actively supporting ADS-B implementation. ICAO has revised key documents such as PANS-ATM Doc 4444 to reflect the change from radar surveillance to also use ADS-B for 5 NM en route separation. ADS-B relies on aircraft broadcasting their identity, position and velocity, and this signal can be captured by receivers on the ground ("ADS-B out") or on board other aircraft ("ADS-B in"). ADS-B is recognised as an essential element in SESAR and in the FAA's NextGen programme.

The benefits of ADS-B over radar surveillance, according to Eurocontrol, are its low cost when compared to other surveillance alternatives (up to 1/10 of a radar system with system coverage), its high accuracy, and the support of airborne surveillance applications which will enable many future safety capabilities.

There are three main sub-markets for ADS-B suppliers:

- The wide-angle, beyond airport surface surveillance market, which encompasses national, or in the case of Australia and Indonesia, regional surveillance programmes.
- The AMSG airport surface surveillance market, which includes ADS-B services for airport vehicle and aircraft tracking. Typically these systems combine surface movement radar, multilateration and ADS-B.
- Airlines, airports and flight operations - for aircraft operator flight management services, such as Honeywell's "SmartTraffic" system which allows for better planning of oceanic flight level changes to reduce fuel burn.

This market study addresses the first of these three markets.

THE MARKET

There are 25 countries who are implementing nationwide ADS-B surveillance programmes, or at least, programmes where ADS-B will be used to provide coverage in no-radar covered areas. A further five countries have announced their intention to develop nationwide ADS-B coverage.

Both COCESNA and ASECNA have multi-national ADS-B programmes under way.

The market for wide-angle/beyond-airport surface ADS-B surveillance services in 2011 has been worth around \$300 million a year, though the market is dominated by a single contract: the August 2007 award by the FAA of a contract which could be worth up to \$1.8 billion to a team led by ITT Corp, for a nationwide deployment of systems (the ITT team comprises AT&T, Thales North America, WSI and PriceWaterhouseCoopers), between 2007 and 2025.

According to the FAA (2007): "The cost to equip a commercial aircraft with ADS-B "Out" capability ranges from \$32,000 to \$174,640, depending on the age of the aircraft and its existing avionics. Since much of this equipment is based on existing technology, the unit costs are not expected to decrease over time. The additional cost to equip with ADS-B "In," over and above ADSB "Out" with a Class III Electronic Flight Bag to support the initial advisory applications ranges from \$162,250 to \$217,000. ADS-B "In" incremental costs can range from \$210,750 to as much as \$670,000 to equip for future, more advanced aircraft applications.

¹ Australia, Morocco, Switzerland, Peru, Fiji, Congo, Ethiopia, Guinea, Sierra Leone, Liberia, Kuwait, Namibia, UAE, Afghanistan, Indonesia, Singapore, Taiwan, Tajikistan, Austria, Czech Republic, Slovakia, Sweden, Canada, USA, Iceland. ² Greece, Italy, Turkey, Netherlands, Portugal



"The cost to equip a general aviation aircraft ranges from \$7,644 to \$10,920 for ADS-B "Out" and from \$10,444 to \$29,770 for ADS-B "Out" and ADS-B "In" depending on aircraft type."

The FAA has set aside \$285 million in FY 2012 for ADS-B deployment.

This suggests that for a worldwide fleet of 8,000 airliners of 100 seats or more the ADS-B costs are likely to be between \$256 million and \$1.74 billion.

The cost of a single ground station is between \$100,000 and \$400,000 compared with \$1 million to \$4 million for an equivalent radar system.

It cost Avinor NOK 6.5 million (\$1.1 million) to build three ADS-B base stations on the mainland outside Stavanger and Florø and eight on the oil installations at Ekofisk, Sleipner and Heimdal.

While spending on ADS-B ground stations is currently peaking – with the world's largest ground-station programme in the USA currently accounting for over \$200 million a year – other major national programme awards such as China and Russia could boost this market in the near future.

GLOBAL DEPLOYMENT

The speed with which ADS-B is being deployed globally has been determined, since the completion of successful trials, to some large extent by the stick and carrot approach by regulators to airborne equipment as well as by the availability of ground stations. The FAA announced the performance requirements for aircraft tracking equipment that will be required under NextGen, at the end of May 2010. The final rule requires aircraft flying in certain airspace to broadcast their position via ADS-B by 2020, known as 'ADS-B out'. The rule mandates that the broadcast signal meet specific requirements in terms of accuracy, integrity, power and latency. By 2020, the FAA will require ADS-B equipment for aircraft flying in airspace including Classes A, B and C, around busy airports and above 10,000 feet. The final rule can be found on: http://www.federalregister.gov/OFRUupload/OFRData/2010-12645_PI.pdf

As well as developing a nationwide set of ground stations the FAA and NavCanada have also prioritised the equipment of aircraft with compliant avionics. For example, the FAA signed an agreement with JetBlue in early February 2011 that will allow the airline to fly more precise, satellite-based flights from Boston and New York to Florida and the Caribbean beginning in 2012. The FAA has agreed to pay USD4.2 million for the ADS-B avionics. JetBlue will provide flight operations, pilots, and aircraft maintenance and will pay for the cost of aircraft downtime while the ADS-B avionics are installed.

While most areas of the world are now fairly advanced in deploying ADS-B technology for oceanic services Latin America appears to be less advanced, even though its terrain of high mountains, vast, sparsely-populated areas and a high proportion of flights over water would suggest it should lend itself to this technology. The main cause appears to be a lack of aircraft equipment. As reported in table one, COCESNA has been carrying out trials with Indra systems to determine how many aircraft passing through the Monte Crudo radar area are equipped with the appropriate avionics and although the total percentage is not clear it appears the number does not suggest an accelerated uptake of ADS-B ground stations.

Although Brazil has undertaken a number of ADS-B trials it is unlikely that it will migrate from radar surveillance to this new technology in the near future for a nationwide application. Having invested heavily in radar in recent years – to cover its entire territory – the DECEA has no immediate plans in short terms to migrate to ADS-B or MLAT for En-route and TMA in continental areas.

"Nevertheless," said a DECEA representative at a recent ICAO regional meeting, "there is a specific operational need in the oil platforms area close to Rio de Janeiro (Bacia de Campos) that might be suitable for trials on those technologies, since it represents an homogeneous airspace (helicopters only) that has partial radar coverage."

³Source: http://www.aviationweek.com/aw/generic/story_generic.jsp?channel=comm&id=news/1TT08317.xml&headline=FAA%20Awards%20ITT%20Team%20ADS-B%20Contract

⁴Source: http://www.icao.int/icao/en/ro/apac/2005/ADSB_SITF4/sp01.pdf



In Chile the DGCA has received from Innovative Solutions International a report into the feasibility of implementing ADS-B services in Chile which suggests these technologies can be feasibly implemented at airports around the country, providing substantial benefits to airlines and users of the national aviation system. The CAA considered in the current Strategic Plan the first implementation of this system at Arturo Merino Benitez airport and then Tepual Puerto Montt, Carlos Ibanez del Campo de Punta South Carriel Arenas and Concepcion airports.

Peruvian ANSP CORPAC selected Indra for the provision of the New Lima Air Traffic Control center, an ADS-B Station installed in Pisco, providing Oceanic Enroute and Approach coverage in the area. Comsoft Quadrant ADS-B systems were installed in Peru in 2009.

North America is now well on the way to fully ADS-B equipage.

The US House Transportation and Infrastructure Subcommittee on Aviation introduced the FAA Reauthorization and Reform Act of 2011 (HR 658) in early February 2011. It included USD285 million for the ADS-B system and the installation of a network of over 800 ground transceiver stations nationwide by 2013.

Under a NextGen programme, the FAA reports the number of operational ADS-B radio stations rose to 329 in June 2011. Additionally, 20 new service volumes were added in advisory services. A service volume is a defined volume of airspace in the NAS within which a set of ADS-B services are provided and the required performance for the set of services is achieved.

In January 2012 the FAA has selected Saab Sensis Corporation for the Airport Surface Surveillance Capability (ASSC) programme. The FAA has incrementally funded USD5 million of the USD54 million five year contract. In addition, options for deliveries beyond the five year period are valued at USD65 million, for a total contract value of USD119 million. Each ASSC deployment includes Saab Sensis multilateration, safety logic conflict detection and alerting software, air traffic controller working positions, and recording/playback functionality. ASSC will process ADS-B data along with other sensor sources for a single, fused view of the airport runways and taxiways. In addition, future airport surface safety enhancements such as Runway Status Lights (RWSL), and airport surface movement data may be distributed to other approved systems and users.

The 2012 Implementation Plan continues to focus on ADS-B rollout, data communications and performance-based navigation to increase safety and capacity, and to reduce emissions. A final investment decision for the VHF network that will carry data-com messages is expected in 2012. The Plan responds to the comments made by the NextGen Advisory Committee in September 2011. Among action points, the Plan says the FAA will focus on business-case analysis and data sharing that will enable users to justify investments. This includes developing benefits estimates applying metrics that are useful to operators. The FAA is also working on several near-term proposals to incentivize operator equipage for PBN, ADS-B and datacomm.

Meanwhile in Canada the new Gander Automated Air Traffic System Plus (GAATS+) will allow future integration of ADS-B over southern Greenland, where previously only procedural control was possible.

In Europe, Eurocontrol's "Cascade" trials have led the way to proving the technology and now individual states, such as Austria, the Czech Republic and Sweden, have developed nationwide ADS-B deployment programmes. The purpose of Cascade was:

- to publish worldwide standards for ADS-B,
- to enable the development of certified ADS-B equipment, and
- to support the first ADS-B operational implementations.

Standards development take place in the Requirement Focus Group, a joint venture between EUROCONTROL, the FAA, EUROCAE and RTCA with participation of Airservices Australia, NavCanada, the Japanese Civil Aviation Board and many industrial partners.

Cascade ADS-B trial: areas of radar-like services in non-radar airspace

Site	Country	Implementer
Azores	Portugal	NAV Portugal
Dutch North Sea coast	The Netherlands	LVNL
Kiruna	Sweden	LFV
Pescara	Italy	ENAV
Trabzon	Turkey	DHMI

Site	Country	Implementer
Ajaccio	France	DSNA
Alghero	Italy	ENAV
Karphatos	Greece	HCAA
Larnaka/Pafos	Cyprus	DCA

Cascade also incorporated its ADS-B Pioneer Airlines Project is to obtain airworthiness approval for the use of ADS-B for enhanced Air Traffic Services in a non-radar environment (ADS-B-NRA). This certification will be based on the relevant EASA Acceptance Means of Compliance (AMC20-24) material, which in turn refers to the EUROCAE ED-126/ RTCA DO-303 document defining the ADS-B-NRA Safety, Performance and Interoperability Requirements.

No	Operator	Contracted a/c
1	CCM Airlines	10
2	SAS - Scandinavian Airlines	20
3	Cyprus Airways	4
4	TUfly (Hapagfly)	20
5	Airbus Transport International	5
6	NIKI	6
7	Ryanair	115
8	Air Europa	20
9	Aegean Air	11
10	British Airways	20

11	Lufthansa	20
12	Air France	22
13	Air Mediterranee/Airconseil	7
14	Air One	12
15	Volkswagen AG Air Services	2
16	United Airlines	10
17	Turkish Airlines	42
18	KLM	63
	Total O	409

EUROCAE Working Groups on ADS-B include WG51-SG4 for ED129 Standard (ADS-B NRA), WG70 for ED142 Standard (WAM TS). Industry involvement into this area includes Indra in the re activation of WG51-SG4 for ADS-B & WAM Composite Surveillance, contributing to the creation of the future standards defining the use of ADS-B and WAM in Europe.

In 2008 Europe's safety agency EASA granted three airlines (Air France, Air One and Volkswagen) airworthiness approval to use ADS-B in airspace not covered by radar. The approval covers Airbus, Boeing and Dassault airframes and allows ADS-B messages broadcast via 1090 MHz Extended Squitter to be used as the sole surveillance source for an air traffic control service. The EASA approval is also valid in the Hudson Bay area of Canada where the ADS-B operational service began in November 2008.

The CRISTAL MED Project (Co-operative Validation of Surveillance Techniques and Applications of Package 1 in the Mediterranean region) has been conducted in the CASCADE Program of EUROCONTROL, involving various service providers in Southern Europe. The purpose was to assess the operational benefits that could accrue from the use of the ADS-B 1090 ES (Automatic Dependent Surveillance - Broadcast 1090 MHz Extended Squitter) in selected operational scenarios, and to verify the technical and economic feasibility of developing an ADS-B 1090ES infrastructure.

Cascade is not the only European regional ADS-B programme. The North European ADS-B Network (NEAN) project, an infrastructure developed with Northern Europe and the Nordic countries; and FARAWAY (Fusion of Radar and ADS through a two-way datalink) has trialled combined ADS-B technology with ground radar in order to demonstrate that it is possible to give pilots an element of free flight supported by ground controllers.

Portugal, the Netherlands, Greece, Italy and Turkey are committed to implementing ADS-B in those parts of their airspace not covered by radar. Elsewhere, Greece has included ADS-B in its PALLAS ATM upgrade strategy and Serbia has ADS-B as part of its Future Air traffic Management Modernization & Upgrade (FAMUS) programme.

The SESAR JU is also researching ADS-B. Work package 15, non-avionics CNS systems (leaders Thales and Selex) is tasked to:

"Proceed with enhancements to the ground Surveillance systems and introduction of new Surveillance systems (e.g. WAM). Considering these enhancements and new means, the surveillance infrastructure will be rationalised by considering decommissioning legacy technologies (e.g. SSR) thus decreasing operating costs while balancing the necessary non-cooperative requirements in TMA and for military purposes."

The sub-package 15.4 - Surveillance (led by Indra) includes two projects specifically designed to research ADS-B functionalities, defining new ADS-B application which will be used as baseline for new ADS-B developments. :



P 15.4.5a Surveillance ground system enhancements for ADS-B

P 15.4.5b Surveillance ground system enhancements for ADS-B (Prototype development)

The Far East remains the single largest potential market for this equipment.

Airservices Australia says the deadline for fitment of ADS-B technology in aircraft operating within Australian airspace at and above 29,000 feet (FL290) is now less than two years away. Australia's air traffic control surveillance future is tied to ADS-B. Due to come into effect on 12 December 2013, the mandate, introduced by the Civil Aviation Safety Authority in 2009, requires operators of aircraft flying at and above FL290 to have ADS-B equipment installed and operating correctly. Non-ADS-B equipped aircraft will be restricted to operate below FL290, resulting in less operational flexibility and the potential for delays due to the procedural separation standards will be applied outside radar airspace.

China will probably look to developing ADS-B surveillance operations for the less populated western and central areas, while developing navigation and precision approach techniques based on its indigenous satellite system. According to China Satellite Navigation Engineering Center, China plans to launch 10 Compass satellites to create a regional positioning system as a first step to building a global navigation capability. New Zealand and Australia will develop increasing ADS-B oceanic services. The November 2010 agreement between Airservices Australia and the Indonesian Directorate General of Civil Aviation (DGCA) to exchange enhanced flight data for aircraft travelling across the two countries' Flight Information Region boundaries, via a trans-national ADS-B infrastructure was an institutional landmark for the equipment as it started a truly regional approach to equipage, in line with ICAO global ATM roadmap concepts. Under the arrangement, data from four Australian ADS-B ground stations is transmitted to Makassar Air Traffic Services Centre in Sulawesi, Indonesia. Airservices Brisbane Air Traffic Services Centre receives reciprocal data from four ADS-B ground stations in Indonesia. Indonesia has installed 27 ADS-B ground stations across its archipelago.

Elsewhere in Asia the Pakistan Civil Aviation Authority has included ADS-B as a priority technology in its future strategic plans. By 2014, Vietnam is projected to be the world's third fastest growing market for international passengers and freight, and the second fastest for domestic passengers; IATA has identified the implementation of ADS-B and Performance Based Navigation (PBN) a priority for the country.

Other near-term **Africa/Middle East** ADS-B surveillance programmes include Jordan, which plans to acquire ADS-B, MLAT, OLDE and CPDLC services and Tanzania which is also planning to adopt ADS-B in the short to medium term.

Operational benefits

- Once all aircraft using the Hudson Bay airspace are equipped with ADS-B, Nav Canada estimates savings of approximately 18 million liters of fuel per year and reduced CO₂ equivalent emissions of 50,000 tons per year.
- A cost-benefit study published by CANSO's Asia Pacific office has identified potential savings of over USD4 million and 10 million lbs of CO₂ a year following ADS-B implementation in the South China Sea. The savings were identified as a result of reduced separation on seven routes starting in 2013. The initial phase includes ADS-B stations in Indonesia, Vietnam and Singapore from 2010, supporting radar-like separation for suitably equipped aircraft. The results suggest a benefit/cost ratio of 2.7 net present value of USD46.4m and payback year of 2018.
- The Gander Automated Air Traffic System Plus (GAATS+) will allow future integration of ADS-B over southern Greenland, where previously only procedural control was possible. The additional surveillance capability will support a further reduction in separation required between aircraft from five minutes to five nautical miles in portions of the North Atlantic, leading to further fuel and green house gas emissions savings. The ENGAGE Corridor Project, an initiative of NATS, Nav Canada, and Air France co-sponsored by the SESAR Joint Undertaking (SJU), are aimed at improving the efficiency of the 350,000 flights per year that cross the North Atlantic. The ENGAGE trial flights will measure fuel and emissions savings through the use of two procedures: progressive or continuous altitude change; and a corresponding change in aircraft speed (Mach), within an approved airspace block. The project uses ADS-B to reduce aircraft separation, thereby increasing airspace capacity and allowing variable altitude and speed.

Table one: the global ADS-B wide-angle surveillance project map

AFRICA/MIDDLE EAST		
Country	Supplier	Project
ASECNA	Thales	The Agency for Air Navigation Security in Africa and Madagascar (ASECNA) selected Thales to modernise the air traffic control centres in six countries including Senegal, Congo, Niger, Ivory Coast, Chad and Madagascar. The modernised ATC systems will include a Multi Sensor Tracking System, integrating all surveillance means including radars, ADS-B, ADS-C, Multilateration and Wide Area Multilateration. Thales will also deliver a training and test platform for air traffic controllers. ASECNA is in charge of five flight information regions (FIRs), controlling the largest area in the region and covering a total of 16 million square kilometres across the African continent.
Congo	Thales	The Congolese Ministry of Transport has selected Thales to supply its Eurocat automation system and install ADS-B ground stations in Kinshasa, Lubumbashi, Buta, Mbandaka and Ilebo.
Ethiopia	Selex	The Ethiopian CAA awarded SELEX a USD8 million contract to supply the country with radar and ADS-B surveillance. Equipment includes several satellite-linked ASD-B ground stations to enhance nationwide surveillance
Guinea, Sierra Leone, Liberia	Intelcan	Intelcan has signed a contract with Roberts flight information regions to deliver communication and surveillance systems. The ADS-B portion of the contract consists of two phases to provide five ADS-B ground stations, including a new station in Liberia, and will be integrated into Intelcan's existing Skycontrol ATM system. Roberts FIR is a cooperative ANSP of air traffic management for three West African nations - Guinea, Sierra Leone and Liberia.
Kuwait	Selex	The Kuwait General Directorate of Civil Aviation has awarded SELEX a contract worth USD16 million to supply an ATR-33/S primary radar, a SIR-S secondary radar and ADS-B ground station ADS-B for en-route, terminal area and airport surveillance applications at Kuwait International Airport.
Morocco	Indra	Moroccan ANSP ONDA has selected Indra to provide SIX ADS-B Ground Stations, already installed and operational in the south of Morocco, in Non Radar Area, desert environment characterized by high temperature, dry conditions and sandy environment. The long range of the ground stations is particular suited for for costal surveillance.
Namibia	Era	In 2009 Era was selected by Thales to deploy a wide area multilateration system to provide nationwide coverage in Namibia down to FL 145. Era announced 8th March 2011 that its multilateration and ADS-B system for the Directorate of Civil Aviation in Namibia (NDCA) has successfully passed acceptance testing. Era's MSS ADS-B and multilateration system provides nationwide coverage for Namibia. The Era solution provides 36 strategically located MSS ground stations, offering optimum surveillance coverage of the entire country. Covering more than 82,500 square kilometers, the system is one of the world's largest wide area multilateration system.
Saudi Arabia	Saab Sensis	In 2009, the General Authority of Civil Aviation selected Saab Sensis to deploy Wide Area Multilateration coupled with Advanced-Surface Movement Guidance and Control Systems at King Abdul Aziz and King Fahad International Airports. The WAM systems will provide terminal area surveillance up to 50 nautical miles from each airport.



Country	Supplier	Project
South Africa	Era	In early 2009 South Africa certified its MSS ADS-B and multilateration systems for wide area and surface surveillance at Cape Town International Airport and in Johannesburg International Airport for surface surveillance by ATNS. ERA's wide area multilateration (WAM) system in Cape Town was the first certified WAM system in Africa for ATC-separation services in terminal area and en-route airspace. Era's WAM provides surveillance out to 60NM from the Cape Town International Airport, covering TMA and upper airspace. Data from the Era WAM-system is fused and tracked along with primary radar, traditional MSSR and ADS-B data in the Thales Eurocat X ATM-system.
United Arab Emirates	Comsoft	The General Civil Aviation Authority (GCAA) of the UAE has selected COMSOFT to provide three operational ADS-B ground stations. With Tarif, Sharjah and the new Sheikh Zayed Centre in Abu Dhabi serving as locations, ADS-B coverage of UAE's air space and adjacent areas is now available. The GCAA later announced it was extending its network of redundant Quadrant ground stations with eight additional ADS-B/WAM sensors plus active interrogation. The upgrade will see a total of 14 sensors and additional processing equipment, covering most of the airspace under control of the GCAA. Four additional locations will be added to the existing sites feeding accurate position reports into the main processing unit at Abu Dhabi's Sheikh Zayed Centre.

ASIA

Country	Supplier	Project
Afghanistan	Thales	The Afghan Ministry of Transport and Civil Aviation (MOTCA) has selected Thales to supply a wide area multilateration system (WAM) for Afghanistan. The system will provide surveillance in the vicinity of Kabul, Mazar-e-Sharif and Herat airports covering an area approximately 540 by 350 nm. The ground stations include ADS-B capability.
China	Saab Sensis Telephonics	In October 2007 the company installed two ground stations at Chengdu Shuangliu International and Jiuzhai Huanglong airports in partnership with Aviation Data Communication Corporation (ADCC) to support ADS-B trials. CAAC ATMB selected Telephonics AeroTrac ADS-B/radar data fusion system for Zhanjiang, Zhengzhou and Shantou, bringing to 14 the number of Aerotracs systems in China. Other sites are: Guangzhou, Wuhan, Changsha, Zhuhai, Sanya, Shenzhen, Jinan, Xian, Haikou, Nanning and Guilin.
India	Comsoft	Airports Authority of India (AAI) has launched a programme to establish a single continuum of upper air space, which will facilitate the uniform application of rules and procedures. AAI plans to amalgamate 11 area control centres initially into four and ultimately into two centres. Each flight information region will have only one upper area control centre with multiple sectors to be operated from four major cities. The four main en route centres will be at Delhi, Mumbai, Kolkata and Chennai. Information is now being integrated from seven existing radars as well as three additional radars and ADS-B sensors into the automation system and a radar picture of all the aircraft in the southern region is available at the Chennai ATC centre. At the start of 2012 AAI selected Comsoft to develop ADS-B installations across the country, the Bay of Bengal and the Arabian Sea. A network of 14 ground stations will deliver air surveillance in non-radar air space while 14 national and international will be equipped with two sensors each in dual-redundant

Country	Supplier	Project
Indonesia	Era and Thales	In 2006 Indonesia started trials of a nationwide ADS-B surveillance system and in November 2010 Airservices Australia and the Indonesian Directorate General of Civil Aviation (DGCA) reached a formal agreement to exchange enhanced flight data for aircraft travelling across the two countries' Flight Information Region boundaries. It will allowed controllers to precisely track aircraft up to 150 nautical miles inside the other country's airspace using ADS- B technology. Under the arrangement, data from four Australian ADS-B ground stations is transmitted to Makassar Air Traffic Services Centre in Sulawesi, Indonesia. Airservices Brisbane Air Traffic Services Centre receives reciprocal data from four ADS-B ground stations in Indonesia. Indonesia has installed 27 ADS-B ground stations across its archipelago, 18 of which display information to controllers in Makassar. The installation of 30 ADS-B ground stations is underway and the plan is to have them operational in 2012. The ATM system in Ujung Pandang has been updated to receive ADS-C/CPDLC (FANS-1/A protocols) messages, which became operational on 23 September 2010. Comsoft supplied Quadrant ADS-B units in 2009. In 2009 Era supplied MSS ADS-B surveillance sensors to DGCA of Indonesia for West Indonesia; three Thales ground stations were deployed in Indonesia during 2007 during a six month trial in partnership with DGAC, SITA and Airservices Australia.
Japan	Telephonics and NEC	Telephonics Corporation's AeroTrac ADS-B/radar fusion system has been deployed in Japan; NEC Corporation's (ADS) system is in service in Japan
Kazakhstan	Lockheed Martin	Kazaeronavigatsia announced a USD49.9 million contract award to Lockheed Martin at the ATCA 2010 meeting in Washington 24-27 October 2010. Lockheed Martin will deploy its Skyline automation system at the new Almaty area control centre and thirteen airfield towers. Lockheed Martin will also upgrade existing Skyline installations at Astana and Aktobe centres and provide maintenance and support for the nationwide system through 2025. The contract award includes ADS-B systems.
Korea	Telephonics	In 2004 South Korea selected Telephonic's AeroTrac for joint military civil sites to manage the main traffic corridor between northeastern China, Japan and Korea.
Kyrgyzstan	Saab Sensis	Under contract to Raytheon, Saab Sensis will be deploying a nation-wide WAM system in support of the modernization of the Kyrgyz Republic air traffic management system.
Myanmar		According to the government ADS with Controller Pilot Data Link Communication (CPDLC) has been in use since 1998.
New Caledonia		The implementation of ADS-B services, the establishment of GNSS procedures, changing over-water routes, creating itineraries VFR flight preparation are under way.
Philippines		The EADS Defence & Security (DS) Monopulse Secondary Surveillance Radar MSSR 2000 I installed in the Philippines in association with Integrated Energy Systems & Resources Inc (IESRI) combines active Mode S interrogations with the passive reception of ADS-B signals.
Singapore	Comsoft	In early 2009 the Civil Aviation Authority of Singapore (CAAS) has selected Comsoft to supply two ADS-B ground stations and data processing system to begin operations later this year. Comsoft is supplying two sensors and data fusion system to integrate with the existing ATM system. The ADS-B system features a 300nm range and low power consumption.

Country	Supplier	Project
Taiwan	Comsoft	The Air Navigation and Weather Services (ANWS) of the Civil Aeronautics Administration of the Republic of China has taken the ADS-B network supplied by Comsoft into operational service. The system includes six redundant Quadrant ADS-B ground stations and eight complimentary QCMS systems for monitoring and control of all sites.
Tajikistan	Era	Tajikaeronavigation, the Republic of Tajikistan's ANSP, has selected Era to provide a nationwide wide area multilateration (WAM) solution in the Republic of Tajikistan. Era is supplying its MSS multilateration and ADS-B surveillance system in place of costly surveillance radar across the country's mountainous terrain. The nationwide WAM solution will be deployed in three phases. The first phase includes WAM surveillance for the northern portion of the country and will provide air traffic controllers with complete situation awareness of en route traffic in the Khujand portion of the Dushanbe flight information region as well as the approach surveillance for the Khujand International Airport. The second and third phases will include surveillance for the south and central areas of the nation and surveillance for the eastern portion, respectively

EUROPE

Country	Supplier	Project
Armenia	Peleng	2007 saw completion of the Armenian ATS Provider (ARMATS) programme which began in 2006 and processes data from a wide range of surveillance systems, including ADS-B. Multilateration equipment was supplied by Era in 2006
Austria	Saab Sensis	Austro Control GmbH has selected Sensis Corporation to deploy a Wide Area Multilateration (WAM) system across the country. The system will provide terminal and en route surveillance of the entire country, including Austria's mountainous regions, encompassing more than 32,000 square miles. The system will provide surveillance of Mode S, Mode S Extended Squitter and Mode A/C equipped aircraft and ADS-B. Austro Control will use the WAM system to complement SSR infrastructure while adding surveillance of areas not previously covered by SSR due to the terrain.
Bulgaria	Comsoft	Comsoft ADS-B ground station was implemented at Sofia for trials by BULASTA in March 2008
Czech Republic	Era	The Czech air navigation service provider ANS CR took delivery of a third wide area multilateration and ADS-B system supplied by Era in early July 2010. Era has already supplied WAM systems to Prague and Ostrava, and all three are due to be connected to provide a countrywide WAM network. The Brno system provides coverage out to 80 nm, and is designed to replace the soon-to-be retired secondary radar in Feichtberg, Austria. The network is expected to provide the first nationwide deployment of multilateration and ADS-B in high-density European airspace.
Eurocontrol	Indra	Indra has been working for years with Eurocontrol on a number of different programmes, including CASCADE. The company has provided its ADS-B ground station to the Agency, currently installed in Bretigny (France) which will be used by Eurocontrol for ADS-B monitoring as part of the CASCADE programme.

Country	Supplier	Project
Finland	Comsoft	In April 2012 the Finish air navigation service provider and airport operator Finavia ordered a total of 39 of Comsoft's Quadrant ADS-B sensors and 12 transmitters to cover approximately a quarter of the territory of Finland. Each Quadrant sensor offers a range exceeding 300 n miles. Comsoft is also supplying an ARTAS tracker at Helsinki-Vantaa airport to fuse the disparate surveillance sources into one coherent air situation picture, as well as the delivery of a Radar Monitoring Display (RMD) as independent surveillance display, and the universal monitoring system Enhanced Supervision Management System (ESMS). Project completion is due by the end of 2012. In further steps the successive coverage of the entire country is envisaged by establishing three additional WAM system installations in central, Northern and Eastern Finland.
France	Thales	Thales ADS-B trial systems in place.
Germany	Raytheon	Raytheon ADS-B system is supporting Cascade trials
Greece	Comsoft	The Hellenic Civil Aviation Authority (HCAA) has selected Comsoft to upgrade the Radar Message Conversion and Distribution Equipment (RMCDE) at Athens to distribute radar and ADS-B data. The installation includes implementation of HCAA's specific tracker format in order to integrate the existing tracker with other surveillance systems. Comsoft initially delivered RMCDE as part of the CRISTAL trials for ADS-B evaluation in 2006.
Iceland	Comsoft	Icelandic service provider ISAVIA is installing a nationwide network of Quadrant ADS-B sensors. Installations are due to start in Spring 2012 followed by operational use before the summer season starts. The new sensor network is expected to provide surveillance across the Reykjavik FIR, with each station's range exceeding 300 NM. The project was initially launched as a joint procurement of ADS-B stations for installation in Iceland, Greenland and the Faroe Islands.
Norway	Saab Sensis	Avinor has selected Sensis to deploy ADS-B ground stations to strengthen monitoring of airspace extending to the Ekofisk, Sleipner and Heimdal oil fields. A total of three base stations are to be established on the mainland outside Stavanger and Florø - in addition to eight on the oil installations at Ekofisk, Sleipner and Heimdal. Every year there are 160,000 passenger trips between Ekofisk and the mainland alone. The new installations are to be approved in April 2013. The cost of the project is NOK 6.5 million.
Portugal	Era	Nav Portugal has selected Era WAM and ADS-B to provide surveillance for the Azores in 2009. Surveillance coverage includes the approach, departure and go-around zones of Portugal's Horta airport and will extend to over 100 nautical miles in most directions, with accuracy sufficient to enable both en-route and approach separation services.
Russia	NITA	NITA finished commissioning ground-based ADS-B mode 4 stations in Nadym and Salekhard ATC centers in September 2011. The work was carried out under Federal Task Program "Modernization of unified ATC system in Russian Federation till 2015" in respect of ADS-B technology implementation. The stations installed are a part of ground surveillance network designed for ATC in the lower airspace of the Yamal peninsula. A similar station has been installed in Bovanenkovo airport, which was commissioned in 2010. Early field trials are planned to cover the lower airspace with a network of ground-based stations for navigation and surveillance in remotes area with high-intensity air traffic, such as the Nadym-Bovanenkovo air route and within the area of the Bovanenkovo oil-gas fields.



Country	Supplier	Project
Russia	Era	MSS multilateration and ADS-B system have been certified for operational use by the Interstate Aviation Committee (MAK) for use in Russia following a seven-month process. Era also reports a second contract in Russia to supply its multilateration and ADS-B surveillance solution, after Domodedovo International.
Slovakia	Comsoft	Slovakian air navigation service provider LPS has selected the Comsoft ADS-B solution Quadrant. Four sensors and a control and monitoring system are due to be installed across the the country after completion of all tests. The new system will also operate with a new ARTAS surveillance data input source that LPS is due to install.
Sweden	Saab Sensis CNS Systems	Sweden's ANSP Luffartsverket (LFV) contracted Saab Sensis Corporation to provide wide area multilateration (WAM) for surveillance of Swedish airspace. The technology will be deployed across the country, complementing and replacing the existing Monopulse Secondary Surveillance Radar (MSSR) systems with a solution compatible with contemporary avionics. Saab Sensis WAM will support Mode A/C, Mode S and ADS-B 1090 ES, and systems will be deployed in the Stockholm terminal movement area (TMA) and in a large part of the north of Sweden. LFV's long-term WAM deployment goal is comprehensive coverage within the LFV area of responsibility. WAM will provide surveillance from low level in the Stockholm TMA up to 66,000 feet, depending on coverage requirements. CNS Systems implemented the first ADS-B network with 4DT capability for LFV Group, including 12 VDL Mode 4 systems completed in 2008. The ground stations are installed at the following airports: Malmö, Stockholm Arlanda, Luleå Kallax, Umeå, Norrköping, Stockholm Bromma and Gothenburg Landvetter, Kiruna, Östersund, Sundsvall, Vizby, and Karlstad. Besides ADS-B information, the systems form part of the airport A-SMGCS and enables time controlled ATM and 4DT applications for more efficient operations.
Switzerland	Indra	Since 2008 Indra has been collaborating with Ruag and has delivered ADS-B stations to Saentis and Dübendorf. Saentis ground station has been installed in an extreme environment and is able to monitor more than 300 targets. The ground station is located in the Alps at 2700m altitude and provides coverage over more than 315 nm in a very high traffic environment. Coverage includes traffic flying above France, Switzerland, Germany, the Czech republic, Austria and Italy and direct coverage of flights into and out of four airports.
Turkey		DHMI recently decided to involve in ADS-B trials in the context of CASCADE Cristal Med II Project to implement it in Trabzon Airport and SBAS based APV-I approach trials in the context of METIS Project in Esenboga Airport and started studies accordingly.

Country	Supplier	Project
UK	Thales	<p>Cascade</p> <p>NATS has awarded Thales a contract to supply a Wide Area Multilateration (WAM) system for trial purposes as part of the Eurocontrol CASCADE programme. NATS is participating in the CRISTAL UK 3 trials within CASCADE, and aims to validate the safety of ADS-B/WAM in meeting 3 nm separation standard in busy airspace. Thales is supplying its MAGS system, including six sensors located around London covering the airports of Heathrow, Gatwick, London City, Luton and Stansted. The data collected will be compared with radar surveillance data to validate WAM performance.</p>
	Sensis	<p>North Sea</p> <p>NATS and LVNL of the Netherlands have introduced wide area multilateration (WAM) services to monitor helicopter operations in the North Sea. NATS Services is using the Sensis WAM system to support more than 25,000 helicopter operations a year in the 25,000 square miles of the North Sea between Aberdeen airport and the oil and gas platforms.</p> <p>Edinburgh</p> <p>NATS selected Saab Sensis Wide Area Multilateration for flights in the vicinity of Edinburgh Airport. Saab Sensis WAM will provide surveillance of all flights operating within 60 nautical miles of the airport and will replace the existing Monopulse Secondary Surveillance Radar.</p>
Ukraine	Era	Era has supplied a wide area multilateration system (WAM) of 18 ADS-B sensors for Kiev airport.

LATIN AMERICA

Country	Supplier	Project
COCESNA	Indra	<p>According to the Second Meeting of the Surveillance Task Force of the CNS Committee (CNS/COMM) of the GREPECAS ATM/CNS Sub-Group (ATM/CNS/SG) ADS-B trials have been conducted to obtain statistical information on the equipage of aircrafts in the region. Phase one consisted of monitoring the aircraft that have this technology and that over fly the Central American airspace. The activities carried out were: acquisition of a receptor equipment Mode-S/ADS-B (SBS-1) for the management of aircraft signs. This equipment included a software application (base station) that shows the received information on a screen as a virtual radar allowing the presentation in real time of the aircrafts. In the application all equipped Mode-S/ADS-B aircraft, within the receptor's coverage, were shown. The real coverage of this receptor is approximately 250 NM. Since January 30, 2008, further tests have been carried out by a team based on COCESNA Headquarters in Tegucigalpa and in the Radar Site of Monte Crudo. Preliminary results indicate that several aircraft of the main airlines fleets that over fly the central area of Honduras and its proximities use ADS-B regularly. In total, 61 aircraft have been registered (in different days and with different assigned flights). The following fields of information has been identified among the ADS data that has been gathered of these flights: Track position (longitude and latitude), call sign, Mode-S Address, Ground speed, Altitude, Vertical Rate and status (on-ground or during flight). Indra has provided its ADS-B Ground Station co-mounted with Indra MSSR mode S and Tegucigalpa and seven MSSR mode S Radars.</p>

Country	Supplier	Project
Jamaica	Era	In early 2009 Era was selected to provide an ADS-B system to the Jamaica Civil Aviation Authority (JCAA). The system will be used by the JCAA for extensive operational testing, prior to an eventual nationwide wide area multilateration and ADS-B deployment.
Mexico	Indra	SENEAM is in the early stages of assessing the benefits of installing an ADS-B network over the Gulf region to enhance surveillance
Peru	Comsoft	Peruvian ANSP CORPAC selected Indra for the provision of the New Lima Air Traffic Control center, eight MSSRS mode S and one ADS-B Station installed in Pisco, providing Oceanic Enroute and Approach coverage in the area. Comsoft Quadrant ADS-B systems were installed in Peru in 2009.

NORTH AMERICA

Country	Supplier	Project
Canada	Saab Sensis	In March 2008 Saab Sensis began work ADS-B ground stations on Canada's East Coast to enhance surveillance of trans-Atlantic traffic. ADS-B operates over Hudson Bay. The first flight flew over Hudson Bay using ADS-B surveillance technology in mid-January 2009. Sensis Corporation installed the ADS-B ground stations, each consisting of an antenna, a receiver and a target processor, along the Hudson Bay shoreline. Nav Canada estimates customer savings of about 18 million litres of fuel per year and reduced CO2 equivalent emissions of 50,000 tonnes per year, once all aircraft using this airspace are equipped for ADS-B. The service provider plans to extend its ADS-B coverage over the eastern coast of Canada and parts of Greenland.
		Fort St. John, Vancouver Harbour & Whistler Saab Sensis has deployed wide area multilateration to Fort St John to provide low level surveillance of flights operating in the "oil sand" area and in Vancouver Harbor to provide surveillance of sea plane traffic that operates below traditional radar. In addition, Saab Sensis deployed a WAM system to support air travel in the "Sea to Sky" corridor between Vancouver and Whistler for the 2010 Winter Olympics.
USA	ITT	ADS-B is expected to be available nationwide by 2013. ADS-B services in the USA were pioneered by four programmes: Alaska, Houston and the Gulf of Mexico, Louisville, KY and Philadelphia. Since 2007, ITT has been under contract to the FAA to deploy the ADS-B ground infrastructure under the FAA's NextGen modernization programme. ITT is installing 794 ADS-B ground stations that will comprise the entire network. By 2020, aircraft flying in controlled airspace in the US must be equipped with ADS-B avionics that broadcast their position. The FAA is also using ADS-B technology to provide free weather and traffic information to operators who choose to equip their aircraft with avionics capable of receiving this data. This will allow pilots to view cockpit displays showing where they are in relation to other aircraft, bad weather and terrain. They will also receive flight information such as temporary flight restrictions to help them plan safe, more efficient routes.



Country	Supplier	Project
		<p>Gulf of Mexico</p> <p>Controllers are now able to safely reduce the separation between ADS-B equipped aircraft to five nautical miles, improving capacity and efficiency. The new technology allows the FAA to provide more direct routes over the Gulf of Mexico, improving the efficiency of aircraft operations while using less fuel. In particular, the technology increases capacity and efficiency for the 5,000 to 9,000 daily helicopter operations in the Gulf of Mexico. Aircraft equipped with ADS-B in the region also have access to weather information and receive flight information including Notice to Airmen and Temporary Flight Restrictions. The FAA installed ground stations on oil platforms as part of an agreement with the Helicopter Association International, oil and natural gas companies and helicopter operators.</p>
	Saab Sensis	<p>Alaska</p> <p>The FAA has approved Initial Operating Capability (IOC) of the Wide Area Multi-lateration (WAM) system at Juneau International Airport Alaska, supplied by Sensis Corporation. Controllers at Anchorage area centre now see aircraft on approach to Juneau and can provide radar-like separation where previously this was not possible in the mountainous terrain. The WAM system covers the airspace roughly 40 miles west, 10 miles south and 20 miles north of the airport from 200 ft to 20,000 ft. Due to the remote location of some sensors, communication between the sensors and the target processor is achieved using a variety of communications systems, including leased digital data system circuits, FAA-supplied microwave links and Juneau Police microwave links. Alaska was one of four key sites where the FAA is rolling out ADS-B services. The other sites include Houston and the Gulf of Mexico, Louisville, KY and Philadelphia. Alaska was the initial test site for ADS-B under a pilot project called Capstone from 1999-2006. Through the Capstone project, the FAA equipped hundreds of general aviation aircraft in Southeast Alaska with ADS-B avionics and installed ground-based infrastructure. Pilots were able to see on their displays where they were in relation to bad weather and terrain and the fatal accident rate was cut nearly in half for equipped aircraft. The success of the Capstone project led to the FAA's decision in 2005 to deploy ADS-B nationwide. Controllers at both the Anchorage Air Route Traffic Control Center and at the Juneau Air Traffic Control Tower are using ADS-B, which is critical in Juneau because, like in the Gulf of Mexico, there is no radar coverage. Radar transmissions cannot pass through the mountains in Juneau, making it one of the nation's most difficult airport approaches.</p>
		<p>Colorado</p> <p>In 2009, Saab Sensis wide area multilateration in the "ski country" of Colorado became the first FAA-certified WAM system for the separation of en route aircraft. The system provides FAA air traffic controllers at the Denver Air Route Traffic Control Center with surveillance to provide separation services of flights operating to and from Yampa Valley Regional, Garfield County Regional, Steamboat Springs and Craig-Moffat County Airports.</p>
		<p>Detroit Metropolitan Wayne County Airport</p> <p>Saab Sensis Wide Area Multilateration is the industry's first certified multilateration system for simultaneous approaches to closely spaced parallel runways. The system is providing the highly accurate, constant surveillance needed for PRM procedures.</p>

OCEANIA / AUSTRALASIA

Country	Supplier	Project
Australia	Sensis	In October 2007 Sensis provided a Wide Area Multilateration system for terminal airspace surveillance and precision approach monitoring at Sydney Airport within 60 n miles range.
	Thales	Nationwide system Australia's nationwide ADS-B network went into operation in late 2009, to provide surveillance above FL300 for the first time in non-radar areas. Users carrying certified equipment can take advantage of 5nm separation procedures, with mandated equipage due to see user-preferred routes become available from 2014. Airservices has deployed 57 ground stations supplied by Thales at 28 sites since launching the programme in 2004. The service is available to over 1,150 aircraft that have approved ADS-B avionics equipment, and the Australian Civil Aviation Safety Authority (CASA) has mandated the fitment of this equipment by all aircraft operating in the upper airspace by December 2013. ADS-B equipped aircraft are also given operational priority in the ATC system.
		Oceanic systems Airservices Australia has completed a major upgrade of air navigation systems based on Lord Howe Island. The service provider has commissioned a VHF radio and ADS-B services where previously only HF radio was available. The airspace around Lord Howe Island hosted numerous crossing points for Trans-Tasman flight routes between Australia and New Zealand and for international traffic from across the Pacific into Sydney. Controllers can positively identify, track and directly manage aircraft within a 250nm radius (around 460km) of Lord Howe.
	Saab Sensis	Sensis's Wide Area Multilateration (WAM) system over Tasmania, Australia is now operational. The system uses both multilateration and ADS-B to provide Airservices Australia with enhanced en route surveillance of air traffic across the island and down to the surface at Hobart and Launceston Airports. The WAM system provides seamless cooperative surveillance coverage between Launceston and Hobart Airports, with accurate coverage of 150 meters or better from the ground level at the airports to 18,000 ft. Surveillance data is sent to the Melbourne area center where it provides controllers with information to implement five nautical miles of separation in an environment that had largely been controlled with procedural separation measures.
New Zealand	Era	Wide Area Multilateration system at Queenstown International Airport.
Fiji	Era, Adacel	In 2009 Era was selected by Airports Fiji Ltd to provide a nationwide air traffic management replacement system for the Fiji flight information region (FIR). Era will deploy its MSS surveillance system to provide ADS-B and multilateration surveillance and Adacel is supplying its Aurora air traffic management system. Equipment has been installed in the area control center, and control towers at Nadi and Nausori International airports. The delivery includes FlightYield aviation charging system, technical and operational training. Aurora is currently installed in adjacent US and New Zealand airspace. The system is expected to make Fiji the first country in the world with a fully comprehensive, operational ADS-B solution with no reliance on radar.

Please note: this table is compiled from published data supplied by manufacturers. It was compiled at the start of 2012 and updated in April 2012. Further additions/ amendments are likely.

The market for Advanced – Surface movement guidance and control systems (A-SMGCS)

INTRODUCTION

Advanced – Surface movement guidance and control systems (A-SMGCS) is a “total system approach enhancing safe operations of ground movements, which becomes essential for maintaining capacity in low visibility conditions.”

The ICAO A-SMGCS Manual (Documents 9830) defines the systems principle functions as being:

- Surveillance, which provides controllers (eventually pilots and vehicle drivers) with situational awareness on the movement area (such as a surveillance display showing the position and identification of all aircraft and vehicles);
- Control, providing conflict detection and alerting on runways (and eventually the whole movement area);
- Routing, through which manually (eventually automatically) the most efficient route is designated for each aircraft or vehicle;
- Guidance, giving pilots and drivers indications enabling them to follow an assigned route.

EUROCONTROL has identified four implementation levels of the system:

- **Level one** provides surveillance, display systems and procedures to permit comprehensive ATCO situation awareness;
- **Level two** consists of Level one functions together with automated monitoring and alerting functions, initially including the prediction of conflicts on active runways or incursions into restricted areas;
- **Levels three and four** correspond to the introduction of routing, automatic guidance and planning functions, but have yet to be clearly defined.

According to ICAO: “An A-SMGCS differs from an SMGCS in that it may provide a full individual service over a much wider range of weather conditions, traffic density and aerodrome layouts. A-SMGCS are to use common modules in all circumstances.”

A-SMGCS integrates data from multiple sensors, including ADS-B and radar systems.

THE MARKET

The average one-off cost of a complete A-SMGCS based on a 2006 cost-benefit analysis by EUROCONTROL and the costs made public by contractor award information (see the global A-SMGCS project map below) is around €3.8 million (\$5 million).

Costs for A-SMGCS Level I	Stakeholder	One-off capital costs	One-off implementation costs	TOTAL one off costs	Operating costs per annum
Scenario A*	ANSPs	2.6M€	0.593M€	3.3M€	0.274M€
	Airports	0.150M€	0.019M€	0.169M€	0.019M€
Scenario B*	ANSPs	3.4M€	0.653M€	4.2M€	0.342M€
	Airports	0.3 M€	0.038 M€	0.338 M€	0.038 M€

*Scenario A – a medium sized airport
*Scenario B – a larger airport

¹Source: http://www.eurocontrol.int/airports/public/standard_page/APR2_Projects_ASMGCS_2.html

²See: http://www.icao.int/Meetings/anconf12/Documents/9830_cons_en%5B1%5D.pdf

This suggests that the market until now has a global value \$755 million, or \$125 million a year, since the first operational units were installed in 2004/2005.

Table two: global expenditure on A-SMGCS

	Africa/Middle East	Asia	Europe	Latin America	North America	Oceania
Units	16	31	59	1	40	4
Value (\$ million)	80	155	295	5	200	20

GLOBAL DEPLOYMENT

Much of the early research into deploying the technology was undertaken in Europe with the EMMA (European Airport Movement Management by A-SMGCS) programme, which involved, from 2004 to 2008, "maturing and validating the A-SMGCS concept as an integrated air-ground system, seamlessly embedded in the overall ATM system." Level 1 and 2 A-SMGCSs were implemented at three European airports (Prague Ruzyně, Milan Malpensa and Toulouse-Blagnac) as part of a €16 million research programme part funded by the European Commission.

Since then, the benefits and management of the system have been spread globally. An important global implementation co-ordinating body is the International Cooperation on Airport Surveillance (ICAS), a group of Airports, Air Navigation Service Providers (ANSPs) and Eurocontrol, supporting airports and ANSPs "in the implementation, integration and exploitation of Airport Surveillance Systems in an Airport environment, covering all phases of the ground movement" with a focus on all aspects of A-SMGCS and supporting systems.

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Currently representatives from 45 ANSPs, EUROCONTROL and Airport Authorities are ICAS members, covering 31 countries (see also, <http://www.icas-group.org/icasgroup/home/>)

The table below shows the global implementation status of systems identified by the report's author. It shows the continuing predominance of Europe as the largest region of systems' deployment with major potential scope for new deliveries to secondary and regional airports in the continent, where traffic is growing relatively quickly. China is also a major potential growth market, with 70 airports under construction or development, and China is developing its own domestic suppliers in this area. Sales to Latin America are, in contrast, relatively low.

Lower-cost surveillance systems are now entering the market, with the Searidge video airfield monitoring system sold to Canadian airports, for example, and the Airport Surface Surveillance Capability (ASSC) programme, an FAA-funded January 2012 project won by Saab Sensis to bring enhanced surface situational awareness and advanced warning of potential runway incursions to nine US airports. The FAA has indicated the following airports to receive ASSC: Ted Stevens Anchorage International Airport (Alaska), Andrews Air Force Base (Maryland), Cincinnati/Northern Kentucky International Airport (Kentucky), Cleveland Hopkins Airport (Ohio), Kansas City International Airport (Missouri), Louis Armstrong New Orleans International Airport (Louisiana), Pittsburgh International Airport (Pennsylvania), Portland International Airport (Oregon) and San Francisco International Airport (California).

³Source: <http://www.eurocontrol.int/airports/gallery/content/public/pdf/Final%20Report%20on%20the%20Generic%20Cost%20Benefit%20Analysis%20of%20ASMGCE2%80%A6.pdf>

Table three: The global A-SMGCS project map

AFRICA/MIDDLE EAST			
Country	Supplier	Airport	Project
Egypt	HITT, Era Terma	Cairo	The National Air Navigation Services Company (NANSC) in Egypt has also selected HITT to extend the existing air traffic control system for Cairo International Airport. Part of the contract, the multilateration system, will be delivered by ERA and will be operational within 18 months. NANSC selected Era to deploy a surface surveillance solution at the Cairo International Airport. Era has supplied its MSS multilateration system to integrate into the A-SMGCS system from HITT. In 2005, Era supplied NANSC with a vehicle tracking solution to monitor all vehicle ground movements on the airport's surface.
Israel	Saab Sensis	Tel Aviv/Ben Gurion	The Israel Airports Authority (IAA) has selected Saab Sensis Corporation's Level II A-SMGCS for Ben Gurion International Airport. The company is supplying its multilateration system, Surface Movement Radar (SMRi), and VeeLo NextGen vehicle locators to provide location and identification of all aircraft and vehicles on the airport's runways and taxiways. The surveillance data is integrated with Saab Sensis Safety Logic conflict detection and alerting algorithms to give controllers advanced visual and audible warning of potential runway incursion situations.
Oman	Indra, Northrop Grumman Park Air, Era	Muscat and Salalah	The contract was awarded by Indra Sistemas, selected by the Directorate General of Meteorology and Air Navigation Services to modernisation and upgrade Oman's ATC infrastructure. Project completion is due in April 2015. Park Air Systems is supplying its NOVA 9000 A-SMGCS, including multilateration systems being supplied by teammate Era. Indra Sistemas will supply the surface movement radars, which will be integrated into the NOVA 9000 A-SMGCS.
Qatar	Northrop Grumman Park Air	Doha	
Qatar	SELEX	Doha	SELEX Sistemi Integrati has signed a contract worth D2.6 million with the Civil Aviation Authority of Qatar for the supply of an A-SMGCS at Doha airport.
Saudi Arabia	Saab Sensis	Dammam/ King Fahad And Jeddah/King Abdulaziz	Saab Sensis has been selected to deploy A-SMGCS and WAM for King Fahad and King Abdulaziz International Airports in Saudi Arabia. Additionally, the airports will use Sensis VeeLo NextGen vehicle locator units for tracking and identification of vehicles on the airport surface.
Saudi Arabia	Saab Sensis	Dammam/ King Fahad And Jeddah/King Abdulaziz	Saab Sensis has been selected to deploy A-SMGCS and WAM for King Fahad and King Abdulaziz International Airports in Saudi Arabia. The airports will use Sensis VeeLo NextGen vehicle locator units for tracking and identification of vehicles on the airport surface.

Country	Supplier	Airport	Project
South Africa	Era Northrop Grumman Park Air Terma	Cape Town and Johannesburg	Era Systems Corporation reports its MSS ADS-B and multilateration systems have been commissioned for wide area and surface surveillance at Cape Town International Airport and in Johannesburg International Airport for surface surveillance by ATNS. Era's surface surveillance systems provides coverage of the Cape Town and Johannesburg surface and has been fully integrated with ParkAir Nova 9000 A-SMGCS systems.
United Arab Emirates	Saab Sensis, Terma	Dubai	Saab Sensis is deploying its surface multilateration at Dubai World Center Airport.
United Arab Emirates	Northrop Grumman Park Air, Terma	Dubai JXB	
United Arab Emirates	Thales, Terma	Abu Dhabi	Thales STREAMS equipment in place

ASIA

Country	Supplier	Airport	Project
Azerbaijan	Era, HITT, Terma	Baku	HITT has won an order worth EUR1.6 million to supply A-SMGCS systems to Baku International. The airport in Baku is currently undergoing a major overhaul which will be completed in 2013. Part of this will be a full HITT A-SMGCS, including a Terma surface movement radar and the integration with a new multilateration system from prime contractor Era under a contract award from Azerbaijan Airlines.
Azerbaijan	Era, HITT, Terma	Heydar Aliyev	The Azerbaijan Air Navigation Service (AZANS) is installing a complete A-SMGCS at Heydar Aliyev international airport. Prime contractor ERA will deliver an air traffic control system fed by surface movement radar and multistatic surveillance sensors. Team partners include HITT and Terma.
China	LES	Beijing Capital International Airport	Nanjing Large Scale Electronics Systems Engineering (LES) has supplied an A-SMGCS system to Beijing Capital International Airport. The system includes fused data from three surface movement radars, three local approach radars, the multilateration system, ADS-B and vehicle tracking data.
China	HITT, Terma	Chengdu Shuangliu	The Air Traffic Management Bureau of the Chinese Civil Aviation Administration (CAAC) has selected HITT to provide an A-SMGCS system to Chengdu Shuangliu. Terma Radar Systems have been awarded a contract for two Scantec 2001i Surface Movement Radars (SMR) to Chengdu Shuangliu, to form part of HITT's A-SMGCS system.
China	HITT, Terma	Shanghai Pudong, Shanghai Hongggiao, Xi'an	
China	HITT, Terma	Kunming	HITT was due to deliver its A-SMGCS system, including two high performance Terma radars by the end of 2011.

Country	Supplier	Airport	Project
China	Northrop Grumman Park Air, Terma	Beijing, Guangzhou, Macau, Shenzhen	Northrop Grumman Park Air Systems has delivered NOVA 9000 systems to Beijing, Guangzhou, Shenzhen and Macau airports.
China	Saab Sensis, HITT, Terma	Hong Kong	Saab Sensis A-SMGCS is in operation at Hong Kong with its Aerobahn system. In September 2008 Hong Kong CAD placed a EUR5 million order for an additional radar to integrate with the existing system supplied by HITT in 2003. Terma A/S's DCL/PDC is in service at Hong Kong International Airport
India	HITT, Terma	Mumbai, Chennai, Kolkata	Airports Authority of India (AAI) in April 2008 awarded HITT a contract worth Eur5 million to install A-SMGCS at the airports of Mumbai, Chennai, and Kolkata. HITT's A3000 equipment for each airport includes two surface movement radars, multilateration system and data fusion display. The system features an advanced video extractor and web based control and monitoring system that enables maintenance staff to manage the system from any connected location with a standard web browser.
India	Saab Sensis	New Delhi	Saab Sensis has upgraded its A-SMGCS and surface multilateration equipment at Indira Gandhi International Airport (New Delhi, India). The expanded A-SMGCS will provide surveillance coverage to address a terminal and runway expansion project. The expansion will include additional Multistatic Dependent Surveillance (MDS) multilateration sensors and a second Surface Movement Radar. The A-SMGCS installed at Delhi has upgraded operation to runway 28 from CAT-III A level to CAT-IIIB level. CAT-III A system permits landing of aircrafts up to visibility of 200m. However, CAT-IIIB will permit safe landing at the airports at a visibility below 200m but above 50m.
Kazakhstan	Thales	Astana, Almaty	Thales STREAMS equipment in place.
Korea	Thales	Jeju	Thales STREAMS equipment in place.
Korea	Thales	Seoul Incheon	Thales STREAMS equipment in place.
Korea	HITT, Terma	Seoul Incheon	Terma A/S DCL/PDC units are in service at Seoul-Incheon alongside a HITT A-SMGCS system.
Malaysia	Northrop Grumman Park Air	Kuala Lumpur	The NOVA 9000 has been installed at Kuala Lumpur International Airport and has been upgraded to provide an integrated tower system including approach control and A-SMGCS.
Singapore	HITT, Era	Singapore	HITT has supplied an A-SMGCS to Singapore Changi, interfacing with existing approach and ground radar systems, and new multilateration system (completed in 2008). CAAS has also selected Era's MSS multilateration, ADS-B sensors, and Squid systems.
Taiwan	HITT	Taipei	In 2004 HITT supplied an A-SMGCS to Taipei-Chiang Kai-Shek International, Taiwan.

Country	Supplier	Airport	Project
Thailand	Terma, Saab Sensis Thales	Bangkok	Terma's SCANTER A-SMG equipment is in operation at Bangkok International. Saab Sensis surface multilateration is in operation at Bangkok Airport. The airport also employs Thales STREAMS systems.
Vietnam	Northrop Grumman Park Air Terma	Hanoi	Northrop Grumman Park Air Systems has supplied an integrated tower solution and A-SMGCS to the recently built 80 metre high tower at Noi Bai International Airport, Hanoi. Equipment includes GAREX VCCS, record system and PAE T6 multimode air-ground radios. The delivery also includes the NOVA 9000 display display processing system with 16 controller working positions and a surface movement radar.
Vietnam	Northrop Grumman Park Air, Terma	Noi Bat	
Vietnam	HITT	Tan Son Nhat	The Vietnam Air Navigation Services Corporation has selected HITT's solution for Tan Son Nhat International Airport.

EUROPE

Country	Supplier	Airport	Project
Austria	Terma, Saab Sensis	Vienna	A Terma SCANTER SMR is in place at Vienna airport. Saab Sensis surface multilateration is in operation at Vienna.
Belgium	Belgocontrol, Terma, Saab Sensis	Brussels	The Airport Movement System entirely developed by Belgocontrol combines radar and flight plan data and integrates the international concepts of A-SMGCS and CDM (Collaborative Decision Making). Terma SCANTER SMR and Saab Sensis MDS in operation at the airport.
Czech Republic	Era, Northrop Grumman Park Air Terma	Prague	The surveillance sensors in Prague RuzynD include a mobile radar, a P3D-AS passive system made by Era and an E2000 system. The supplier of the data fusion unit, workstations and the recording system is Northrop Grumman Park Air.
Denmark	HITT, Terma	Copenhagen	The Terma Scanter 5000 solid state radar combined with HITT's A3000 A-SMGCS began operational trials at Copenhagen Airport in May 2011.
Estonia	Era, Avibit	Tallinn	Estonian Air Navigation Service (ANS) has selected Avibit to provide a surface movement surveillance solution at Tallinn Airport. The ADS-B and multilateration system has been supplied by Era, comprising the company's MSS surveillance system and Squid vehicle tracking units to provide surface situational awareness. AviBit is responsible for integrating the data for the A-SMGCS.
Finland	Era, Saab Sensis Terma	Helsinki	Finavia has selected Era to supply 135 Squid vehicle tracking units at the Helsinki Airport. The Squid units will support the airport's A-SMGCS. Finavia has selected Saab to supply an e-strip system to Helsinki/Vantaa tower, integrated with the A-SMGCS.

Country	Supplier	Airport	Project
France	Northrop Grumman Park Air Saab Sensis Terma	Paris Charles De Gaulle	Saab Sensis multilateration in operation at both airports.
France	Thales, Terma	Nice	Terma secured a contract to supply its SCANTER 2001i SMR to Nice International Airport in May 2011. The SCANTER Radar will form part of the Thales A-SMGCS STREAMS delivery and will be the fifth SMR installation in France under a contract with Thales and DSNA. Besides Nice International Airport, Terma has supplied the SMR for Lyon (2002), Toulouse (2004), Basel Mulhouse (2006) and Marseilles (2010). Terma has also supplied its SCANTER radars for the two airports operated by Aeroport de Paris; Charles de Gaulle and Orly (2001) bringing the total to seven airports operating the SCANTER SMR.
France	Thales, Terma	Basle, Lyon, Marseilles, Toulouse	Thales A-SMGCS systems are located at Basle, Lyon, Marseille and Toulouse airports. They are integrated in the STNA 'Grandes Approches' architecture programmes.
Germany	Saab Sensis Era Terma	Frankfurt	Fraport selected Saab Sensis to expand and upgrade its multilateration surface system to accommodate capacity expansion and growth of operational areas at Frankfurt Airport. Frankfurt Airport was the industry's first airport to select multilateration for surface surveillance, awarding Saab Sensis a contract back in 1999. Fraport has selected Era to supply 228 Squid vehicle tracking units at Frankfurt Airport where they will support the airport's A-SMGCS.
Germany	Thales	Frankfurt	Fraport has awarded Thales a five-year contract to cover technical and support services for the upgraded A-SMGCS supplied by Thales at Frankfurt Airport. Thales will support both hardware and software from its local customer support centre.
Germany	Era, Saab Sensis	Frankfurt	Fraport has selected Era to supply 228 Squid vehicle tracking units at Frankfurt Airport where they will support the airport's A-SMGCS. Fraport selected Saab-Sensis to expand and upgrade its multilateration surface system to accommodate capacity expansion and growth of operational areas at Frankfurt Airport. Frankfurt Airport was the industry's first airport to select multilateration for surface surveillance, awarding Saab-Sensis a contract back in 1999.
Germany	HITT, Terma	Frankfurt	HITT has received factory acceptance tests of a major upgrade to the A-SMGCS, to the latest release of HITT's A3000 A SMGCS. This includes the integration of a third Terma radar to enhance coverage of the West runway.
Germany	Era, Terma	Munich, Hamburg	Munich has also chosen the Era Squid vehicle tracking units to provide air traffic controllers with a complete view of all ground movements.
Germany	Thales, Terma	Munich	Thales STREAMS equipment in place

Country	Supplier	Airport	Project
Germany	AviBit, Era, Terma	Hamburg	AviBit has supplied DFS with a second A-SMGCS system to Hamburg; the airport began operating the A-SMGCS system supplied by AviBit in April 2010. The company's ACEMAX system integrates information from four surveillance systems including the Era multilateration system, a Terma surface movement radar (SMR), an existing RACAL SMR and the existing SSR.
Germany	Thales, Terma	Stuttgart	Thales STREAMS equipment in place
Germany	AviBit, Terma	Nuremberg	
Germany	AviBit, Era, Terma	Berlin - Brandenburg	DFS has selected Era to deploy a multilateration and ADS-B surveillance system at Berlin-Brandenburg International Airport. The sensors will be integrated into the airport's A-SMGCS. DFS selected AviBit's A-SMGCS solution at Berlin. The system will integrate surveillance data from four surveillance sensors. AviBit is the prime contractor and will supply data fusion, displays, record and replay and Surface Movement Radar supplied by Terma.
Greece	Northrop Grumman Park Air, Terma	Athens	
Greece	Northrop Grumman Park Air	Thessaloniki	Under the contract awarded by Greek consultants ATESE Northrop Grumman Park Air delivered its NOVA 9000 A-SMGCS system for operation by the Hellenic Civil Aviation Authority (HCAA).
Hungary	Northrop Grumman Park Air, HITT, Era Terma	Budapest	The public procurement procedure for the supply of the A-SMGCS at Budapest-Ferihegy was won by Northrop Grumman ParkAir Systems AS (Norway). In 1999 HITT was awarded a EUR3.5 million contract to modernise SMGCS at Budapest-Ferihegy Airport. Era Corporation has supplied systems to Budapest Ferihegy Airport with site acceptance March 2008.
Ireland	HITT, Era	Dublin	IAA selected HITT and Era to supply the A-SMGCS in 2009.
Italy	SELEX	Rome, Milan	Two SELEX SI ADAM multilateration systems are in place at Milan-Malpensa and Rome-Fiumicino airports aiming to enhance the current A-SMGCS systems.
Lithuania	Indra	Vilnius	Oro Navigacija of Lithuania has selected Indra to implement a multilateration system to identify aircraft at Vilnius airport. The sensors will complement the SMR and A-SMGCS implemented by Indra in 2008.
Netherlands	Saab Sensis, Terma	Amsterdam/Schiphol	
Norway	Era, HITT, Terma	Oslo	Era Systems reports completion of the ADS-B, multilateration, and Squid vehicle tracking system at Oslo Airport, providing tracking data to the A-SMGCS system supplied by HITT. Oslo is also equipped with primary x-band radar and taxiway guidance lighting system.



Country	Supplier	Airport	Project
Norway	HITT, Saab Sensis Terma	Bergen	The site acceptance by Norwegian ANSP Avinor AS of the enhancement of the A-SMGCS for Bergen - Flesland airport, includes the integration of multilateration and ADS-B. Avinor selected Saab Sensis to deploy multilateration at Bergen Airport.
Poland	Thales, Terma	Warsaw	Thales STREAMS equipment in place
Portugal	Avibit, Saab Sensis Terma	Lisbon	Saab Sensis is deploying surface multilateration to Lisbon Airport.
Portugal	Avibit	Lisbon	
Portugal	AviBit Terma	Porto	Nav Portugal has selected AviBit to supply its ACEMAX solution to Porto Airport to provide aircraft tracking, data fusion, safety logic, record and replay, monitoring and control.
Romania	AviBit, Terma	Bucharest/ Otopeni	Romatsa has selected AviBit to supply an integrated A-SMGCS at Otopeni International Airport in Bucharest. AviBit will supply its ACE-MAX A-SMGCS and electronic flight strip system DIFLIS, integrate two Terma surface movement radars and a multilateration system supplied by ERA. Project completion is due in mid-2012. Otopeni will be the first installation for Terma's new SCANTER 5502 redundant solid state surface movement radar (SMR).
Russia	NITA	Nadym and Salekhard	NITA finished commissioning for ground-based ADS-B mode 4 stations in Nadym and Salekhard ATC centers in September 2011. The work was carried out under Federal Task Program "Modernization of unified ATC system in Russian Federation till 2015" in respect of ADS-B technology implementation. The stations installed are a part of ground surveillance network designed for air traffic control in the lower airspace of Yamal peninsula. A similar station has been installed in Bovanenkovo airport, which was commissioned in 2010. Early field trials are planned to cover the lower airspace with a network of ground-based stations for navigation and surveillance in remotes area with high-intensity air traffic, such as the Nadym-Bovanenkovo air route and within the area of the Bovanenkovo oil-gas fields.
Russia	Era, Terma	Moscow	Era is to supply its MSS multilateration and ADS-B system, as well as 150 Squid vehicle tracking units to Moscow Domodedovo International Airport. Under a contract award from Lianozovo Electromechanical Plant (LEMZ), Era's equipment will be integrated into the airport's A-SMGCS.
Russia	ERA LEMZ R&P Corp Terma	Pulkovo	Era has entered into a licensing agreement with Lianozovo Electromechanical Plant (LEMZ R&P Corporation) for the manufacturing and delivery of Era's air traffic management (ATM) surveillance products within the Russian Federation. The initial agreement lasts for 10 years and includes the installation of an Era MSS multilateration and ADS-B surveillance solution at Pulkovo Airport.

Country	Supplier	Airport	Project
Spain	Indra	Madrid, Palma de Mallorca, Barcelona	
Sweden	Saab Sensis Terma	Stockholm	Saab Sensis's Multistatic Dependent Surveillance (MDS) system at Stockholm Arlanda has been integrated into the airport's A-SMGCS.
Sweden	HITT, Terma	Gothenburg	Factory acceptance has been completed for the upgrade of the Surface Movement Radar (SMR) system to HITT's A3000 A-SMGCS for Gothenburg's Landvetter Airport, first installed in 1998.
Switzerland	Northrop Grumman Park Air, Saab Sensis Terma	Geneva, Zurich	Zurich and Geneva became the latest airports to adopt the Runway Incursion Monitoring and Conflict Alert System (RIMCAS) as part of their A-SMGCS system. Surveillance sensors at Zurich and Geneva include surface movement radar, and a multilateration system supplied by Saab Sensis.
Turkey	HITT Terma	Ankara, Istanbul, Antalya	HITT has won an order worth EUR8 million to equip three airports in Turkey with ground movement control systems. HITT will supply Ankara, Istanbul and Antalya airports with A-SMGCS systems to track aircraft and vehicles on the airport under all weather conditions.
UK	Saab-Sensis Terma	London/ Heathrow, Stansted and Gatwick	Saab Sensis Corporation's surface multilateration system at London Stansted went into full operation in June 2010.
UK	HITT, Terma	Manchester	
Ukraine	Indra	Donetsk	Siemens sub contract. Includes equipment supply and installation, commissioning and training
Ukraine	Thales, Terma	Kiev-Borispol	Thales STREAMS equipment in place.

LATIN AMERICA

Country	Supplier	Airport	Project
Mexico	Thales	Mexico City	Thales STREAMS equipment in place.

NORTH AMERICA

Country	Supplier	Airport	Project
Canada	Rannoch	See comment	NAV CANADA awarded two contracts to Rannoch in 2004 for A-SMGCS, ADS-B equipment and aircraft geometric height measurement processing software: a multilateration system for Calgary International Airport and ADS-B processing software for several ground receiver systems.
Canada	Terma	Dorval, Edmonton, Ottawa, Quebec	

Country	Supplier	Airport	Project
Canada	Saab Sensis Terma	Calgary	NAV CANADA is deploying Saab Sensis surface multilateration to Calgary International, along with Saab Sensis VeeLo NextGen vehicle locators.
Canada	Saab Sensis Terma	Montreal	Saab Sensis is deploying surface multilateration to Montreal Pierre Elliott Trudeau International Airport.
USA	Thales, Terma	Manchester	Thales STREAMS equipment in place.
USA	Saab Sensis	Various	The FAA recently selected Saab Sensis for the Airport Surface Surveillance Capability (ASSC) program to bring advanced surface situational awareness and advanced warning of potential runway incursion to nine U.S. airports, using multilateration and other sensor sources.
USA	Saab-Sensis		<p>The FAA has deployed ASDE-X, supplied by Saab Sensis, to 35 of the nation's airports. ASDE-X combines ground surveillance data from a number of sources to provide controllers with real-time, accurate position and location information of all aircraft and vehicles on the airport surface. By integrating surface movement radar, transponder multilateration and ADS-B surveillance data, ASDE-X provides seamless, redundant coverage in all weather conditions. Controllers in the tower see this information presented as a colour display of aircraft and vehicle positions overlaid on a map of the airport's runways/taxiways and approach corridors. The system essentially creates a continuously updated map of the airport movement area that controllers can use to spot potential collisions. It is especially helpful to controllers at night or in bad weather when visibility is poor. The FAA has enhanced ASDE-X with visual and audio alarms that will alert controllers to possible collisions. The 35 major airports are:</p> <ul style="list-style-type: none"> ● Baltimore-Washington International Thurgood Marshall Airport (Baltimore, MD) ● Boston Logan International Airport (Boston, MA) ● Bradley International Airport (Hartford, CT) ● Chicago Midway Airport (Chicago, IL) ● Chicago O'Hare International Airport (Chicago, IL) ● Charlotte Douglas International Airport (Charlotte, NC) ● Dallas-Ft. Worth International Airport (Dallas, TX) ● Denver International Airport (Denver, CO) ● Detroit Metro Wayne County Airport (Detroit, MI) ● Ft. Lauderdale/Hollywood Airport (Ft. Lauderdale, FL) ● General Mitchell International Airport (Milwaukee, WI) ● George Bush Intercontinental Airport (Houston, TX) ● Hartsfield-Jackson Atlanta International Airport (Atlanta, GA) ● Honolulu International-Hickam Air Force Base Airport (Honolulu, HI) ● John F. Kennedy International Airport (New York, NY) ● John Wayne-Orange County Airport (Santa Ana, CA) ● LaGuardia Airport, (New York, NY) ● Lambert-St. Louis International Airport (St. Louis, MO) ● Las Vegas McCarran International Airport (Las Vegas, NV) ● Los Angeles International Airport (Los Angeles, CA) ● Louisville International Airport-Standiford Field (Louisville, KY)



Country	Supplier	Airport	Project
			<ul style="list-style-type: none"> ● Memphis International Airport (Memphis, TN) ● Miami International Airport (Miami, FL) ● Minneapolis St. Paul International Airport (Minneapolis, MN) ● Newark International Airport (Newark, NJ) ● Orlando International Airport (Orlando, FL) ● Philadelphia International Airport (Philadelphia, PA) ● Phoenix Sky Harbor International Airport (Phoenix, AZ) ● Ronald Reagan Washington National Airport (Arlington, VA) ● San Diego International Airport (San Diego, CA) ● Salt Lake City International Airport (Salt Lake City, UT) ● Seattle-Tacoma International Airport (Seattle, WA) ● Theodore Francis Green State Airport (Providence, RI) ● Washington Dulles International Airport (Chantilly, VA) ● William P. Hobby Airport (Houston, TX)

OCEANIA / AUSTRALASIA

Country	Supplier	Airport	Project
Australia	Saab Sensis	Perth, Sydney, Brisbane, Melbourne	The Perth installation includes Saab Sensis' latest VeeLo NextGen units for tracking and identification of vehicles on the airport surface and Aerobahn airport management tool.

Please note: this table is compiled from published data supplied by manufacturers. It was compiled at the start of 2012 and updated in April 2012. Further additions/ amendments are likely.



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