

PREPARED FOR PRESENTATION TO:
TACTICAL FIRE REMOTE SENSING
ADVISORY COMMITTEE

TFRSAC

25 MAY 2017



PRESENTS:

FIRESAT

A CONSTELLATION OF PLATFORM-INDEPENDENT SATELLITE-INSTALLED SENSORS
FOR THE NEAR REAL-TIME DETECTION OF GLOBAL ENVIRONMENTAL EVENTS

DEVELOPED WITH SUPPORT FROM: • NASA / CALTECH JET PROPULSION LABORATORY (VIA SPACE ACT AGREEMENT)
• BEYOND SENSORS • ECLIPTIC ENTERPRISES • TECHNOSYLVA • AND MANY MORE!

100 ARTICLES IN OVER 10 LANGUAGES
FEATURED IN MORE THAN



LETTERS OF SUPPORT AND REGISTERED INTEREST RECEIVED FROM: • UNITED STATES FOREST SERVICE • GLOBAL FIRE MONITORING CENTER (UNITED NATIONS INTERNATIONAL STRATEGY FOR DISASTER REDUCTION WILDLAND FIRE ADVISORY GROUP) • CHILEAN NATIONAL FOREST SERVICE (CONAF) • CANADA CENTRE FOR MAPPING AND EARTH OBSERVATION • ARIZONA STATE FORESTRY • NEVADA DIVISION OF FORESTRY • NORTH DAKOTA FOREST SERVICE • ARKANSAS FORESTRY COMMISSION • DELAWARE FOREST SERVICE • KANSAS FOREST SERVICE • MANITOBA WILDFIRE PROGRAM • NEW MEXICO STATE FORESTRY • NORTHWEST TERRITORIES DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES FOREST MANAGEMENT DIVISION • SOUTH CAROLINA FORESTRY COMMISSION • ALABAMA FORESTRY COMMISSION • FLORIDA FOREST SERVICE • THE SASKATCHEWAN MINISTRY OF ENVIRONMENT'S WILDFIRE MANAGEMENT BRANCH • LA SOCIÉTÉ DE PROTECTION DES FORÊTS CONTRE LE FEU (QUÉBEC) • BRITISH COLUMBIA WILDFIRE SERVICE • TEXAS A&M FOREST SERVICE • COMMONWEALTH OF VIRGINIA DEPARTMENT OF FORESTRY • STATE OF ALASKA DEPARTMENT OF NATURAL RESOURCES, DIVISION OF FORESTRY/FIRE & AVIATION • GOVERNMENT OF NEWFOUNDLAND AND LABRADOR FORESTRY & AGRIFOODS AGENCY, FOREST ENGINEERING & INDUSTRY SERVICES DIVISION • YUKON COMMUNITY SERVICES WILDLAND FIRE MANAGEMENT • SOUTH DAKOTA DEPARTMENT OF AGRICULTURE WILDLAND FIRE DIVISION • NEW BRUNSWICK DEPARTMENT OF NATURAL RESOURCES • PENNSYLVANIA BUREAU OF FORESTRY • MINNESOTA DEPARTMENT OF NATURAL RESOURCES DIVISION OF FORESTRY • MICHIGAN DEPARTMENT OF NATURAL RESOURCES • GEORGIA FORESTRY COMMISSION • AGENCY, MINISTERIAL, POLITICAL, INSTITUTIONAL, NGO, AND INDIVIDUAL SUPPORT FROM: • POLAND • SIERRA LEONE • RUSSIAN FEDERATION • SOUTH AFRICA • AUSTRALIA • MOZAMBIQUE • LATVIA • NEW ZEALAND • NIGERIA • GERMANY • TAJIKISTAN • SPAIN • AND MANY MORE!

• INDEPENDENT NEAR REAL-TIME PLANETARY HEALTH DATA • JOIN US!

FIRESAT

FIRESAT IS A CONSTELLATION OF PLATFORM-INDEPENDENT SATELLITE-INSTALLED SENSORS DESIGNED TO PROVIDE NEAR REAL-TIME DETECTION OF SPECTRALLY DISCERNIBLE GLOBAL ENVIRONMENTAL EVENTS.

FIRESAT WILL DELIVER ENVIRONMENTAL EVENT INFORMATION WITHIN ~15 MINUTES² OF OCCURRENCE, PROVIDING END USERS WITH SIMPLIFIED AND ACTIONABLE DATA PERTINENT TO WILDFIRES, OIL SPILLS, CLOUDS, WATER MANAGEMENT, SOIL COMPOSITION, VEGETATION MAPPING, FLOOD PREDICTION, ERUPTIONS, EMISSIONS, FLARING, AND MANY OTHER INDUSTRIAL RISK AND ENVIRONMENTAL DETECTIONS¹.

FIRESAT'S DATA WILL DRAMATICALLY IMPROVE SUPPORT FOR TIME-CRITICAL ENVIRONMENTAL RESPONSE DECISIONS (THE STATUS QUO FOR SATELLITE DATA UPDATES IS CURRENTLY BETWEEN 4 AND 12 HOURS), INFORM INDIVIDUAL AND COMMUNITY RESOURCE BEHAVIOURS, AND ENHANCE OPPORTUNITIES FOR ENVIRONMENTAL ACCOUNTABILITY.

WITH DEVELOPMENT ASSISTANCE FROM A RANGE OF HIGHLY SPECIALIZED TECHNICAL ORGANIZATIONS, FIRESAT'S LOW-MASS, LOW-POWER, LOW-BANDWIDTH SENSORS ARE DESIGNED SUCH THAT JUST ABOUT ANY SMALL SATELLITE WITH MODEST EXCESS MASS CAPABILITY IN LOW EARTH ORBIT CAN HOST THEM WITH MINIMAL IMPACT.

OPTIMISED FIRESAT SENSORS MEASURE ~10 x 10 x 20 CM, WEIGH ~2 KG, REQUIRE AN AVERAGE OF 2.5 WATTS OF POWER, AND HAVE MAXIMUM DATA RELAYS OF 100 KILOBITS PER SECOND (10 KBPS ON AVERAGE). ENCRYPTED DATA IS ALGORITHM-PROCESSED ONBOARD AND ON-GROUND AND RELAYED ANYWHERE IN THE WORLD.

ENHANCED DATA SUBSCRIPTIONS TO AGENCIES, ORGANIZATIONS, AND INSTITUTIONS ARE TARGETED AT ~\$2 PER IMAGE³.

SATELLITE OPERATORS AGREEING TO FIRESAT'S DATA-DISTRIBUTION AND REVENUE-SHARING TERMS WILL BE GRANTED AS MANY SENSORS AS THEY WANT TO PUT ON THEIR SATELLITES. SENSORS ARE DESIGNED TO 3-YEAR RADIATION TOLERANCES AND CAN BE CUSTOMIZED TO HOST REQUIREMENTS.

FIRESAT REPRESENTS A SIGNIFICANT ECONOMIC AND TECHNICAL OPPORTUNITY TO REALIZE A HIGHLY COVETED GLOBAL ENVIRONMENTAL DATASET AND WILL PROTECT AGAINST BILLIONS OF DOLLARS IN ANNUAL LOSSES TO ENVIRONMENTAL EVENTS IMPACTING HABITATS, INFRASTRUCTURE, LIVES, AND LIVELIHOODS ON A GLOBAL SCALE.

PLANNING FOR FIRESAT IS DEVELOPED BY QUADRA PI R2E WITH SUPPORT VIA SPACE ACT AGREEMENT FROM NASA'S JET PROPULSION LABORATORY.

1. INVESTIGATIONS FOR THE SENSING OF EMISSIONS, SOIL CARBON SEQUESTRATION, HYDROLOGY, AND VEGETATION ARE ONGOING.
2. ON THE BASIS OF A 60 SENSOR CONSTELLATION.
3. ALL FINANCIAL VALUES ARE STATED IN UNITED STATES DOLLARS.

CONTACT US

THANK YOU FOR YOUR SUPPORT OF THE FIRESAT PROJECT. FOR MORE INFORMATION, PLEASE CONTACT US AT +1 (415) 365-1049 OR PROJECT@FIRESAT.INFO.



SERVICE HIGHLIGHTS

NEAR REAL-TIME LOCATION, PERIMETER, AND MOVEMENT INFORMATION FOR ENVIRONMENTAL EVENTS

MAPPED POPULATION, INFRASTRUCTURE, RESPONDING RESOURCES, AND HAZMAT IDENTIFICATIONS

24/7/365 15M x 15M DETECTIONS UNDER LIGHT CLOUD COVER CONDITIONS

HISTORICAL AND PROJECTED EVENT ASSESSMENTS

LESS COST, MORE COVERAGE IN COMPARISON TO DRONES, UAV'S, TOWER CAMERAS, SPECIAL-PURPOSE SATELLITES, AND OTHERS

WILDFIRE STATISTICS

1 IN 5 WILDFIRES ARE INTENTIONALLY SET

FIRE SUPPRESSION COSTS HAVE INCREASED NEARLY FOURFOLD SINCE 1985 (~\$4 BILLION IN 2015 IN CANADA + USA)

TOTAL WILDFIRE COSTS CAN RANGE ANYWHERE FROM 2 TO 30 TIMES THE DIRECT SUPPRESSION COSTS

THE ANNUAL NUMBER OF LARGE WILDFIRES HAS INCREASED BY MORE THAN 75 PERCENT SINCE THE 1970'S

WILDFIRES ARE PROJECTED TO WORSEN OVER TIME AS RISING TEMPERATURES AND DROUGHTS LEAD TO MORE FREQUENT, LARGE, AND SEVERE WILDFIRES AND LONGER FIRE SEASONS

UCSUSA.ORG

DATA DELIVERY

DATA DELIVERY:
THIRD PARTY SOFTWARE, KML, GEODATABASE

INTEGRATION:
TECHNOSYLVA, CAD, ESRI

IDENTIFICATIONS:
PERIMETER (LINE), INTENSE HEAT (POLYGONS, ISOLATED HEAT SOURCES (POINTS))

ALTERNATES:
AD HOC CLIENT GIS INTEGRATIONS

SENSOR SPECIFICATION

PRIMARY SENSOR COMPONENTRY:

THERMAL IMAGER:
UNCOOLED MICROBOLOMETER WITH READOUT INTEGRATED CIRCUIT (ROIC) (3 μ M TO 5 μ M WAVELENGTH SENSITIVITY + 8 μ M TO 12 μ M WAVELENGTH SENSITIVITY)

OPTICS:
3-13 μ M RADIOMETRIC ATHERMALIZED 60MM LENS

DATA PROCESSING COMPONENTRY:

IMAGE PROCESSING HARDWARE:
RAD-TOLERANT IMAGE PROCESSING BOARD DESIGNED TO COMPUTE INTENSIVE IMAGE PROCESSING APPLICATIONS; XILINX ULTRASCALE; NAND AND MRAM MEMORY; HIGH SPEED RS-422, LVDS INTERFACES; GPIO, RS232, SPI, AND I2C INTERFACES; POWER AND THERMAL MONITORING; WATCHDOG TIMER; SENSOR POWER OUTPUT AND MONITORING

IMAGE PROCESSING SOFTWARE/FIRMWARE:
DERIVED GEOLOCATION, DATA COMPRESSION, AND FIRE DETECTION ALGORITHMS

POWER SUPPLY:
RAD-HARD POWER SUPPORT BOARD; POWER INPUT 22-36 VDC; POWER OUTPUT 3.3, 5, AND 12 VDC; VPT RAD-HARD EMI FILTERS AND DC/DC CONVERTERS; CURRENT AND TEMPERATURE MONITORING; RAD-HARD MICROPROCESSOR WATCHDOG

FIRESAT HIGHLIGHTS

FIRESAT VIIRS COMPARISON TABLE

FIRESAT VIIRS COMPARISON TABLE		VIIRS	FIRESAT V1			FIRESAT V2 60 UNITS	FIRESAT V3 12 UNITS	COMBINED V1,V2,V3
			20 UNITS	40 UNITS	60 UNITS			
SPATIAL		375 m	200 m	200 m	200 m	100-150 m	100-150 m	100-200 m
DETECTABLE FIRE SIZE		~100 m x 100 m	20 m x 20 m	20 m x 20 m	20 m x 20 m	15 m x 15 m	15 m x 15 m	15 m x 15 m
TEMPORAL (REVISIT TIME USA)	AVG. BEST CASE	4 hrs	3 hrs	45 min	10 min	10 min	10 min	5 min
	AVG. WORST CASE	12 hrs	4 hrs	2 hrs	30 min	30 min	30 min	20 min
ALERT (LOCATION AND SIZE DATA) FROM TIME OF OBSERVATION (TOO)	AVG. BEST CASE	1 hr	5 min	5 min	5 min	2 min	2 min	2 min
	AVG. WORST CASE	3 hrs	30 min	15 min	10 min	5 min	5 min	5 min
PRODUCT AVAILABILITY (IMAGE, MAP, SPREAD PREDICTION, ETC) FROM TOO	AVG. BEST CASE	1 hrs	30 min	30 min	15 min	15 min	15 min	15 min
	AVG. WORST CASE	4 hrs	1 hr	1 hr	45 min	45 min	45 min	45 min
TIME FROM START OF FIRE TO DETECTION ALERT FOR USA	AVG. BEST CASE	5 hrs	3 hrs	15 min	15 min	15 min	15 min	7 min
	AVG. WORST CASE	13 hrs	5 hrs	30 min	30 min	30 min	30 min	20 min
TIME OF DETECTED FIRE MONITORING UPDATE FOR USA	AVG. BEST CASE	5 hrs	3 hrs	1.5 hrs	30 min	15 min	15 min	15 min
	AVG. WORST CASE	17 hrs	4 hrs	2.5 hrs	1 hr	45 min	45 min	45 min
INTEGRATED REALTIME OPS POSITIONING		No	Yes	Yes	Yes	Yes	Yes	Yes
INTEGRATED RISK ASSESSMENT TOOLS		No	Yes	Yes	Yes	Yes	Yes	Yes
USER COST		VARIABLE	\$2 PER IMAGE					
CAPEX		\$1.1B	\$2M	\$2M	\$2M	\$8.5M	~\$20M	~\$32.5M
OPEX			\$1M					

SUPPLEMENTAL CONSIDERATIONS:



PROJECTED ANNUAL FIRESAT
REDUCTION IN GLOBAL CO2
EMISSIONS DUE TO EARLY FIRE
DETECTION



AVERAGE FOREST FIRES
AREA BURNED IN USA +
CANADA FOR LAST 25
YEARS



PROJECTED AVERAGE
FOREST FIRES AREA
BURNED IN USA +
CANADA IN 2050

ALTERNATIVES TO FIRESAT:



LAND-BASED COVERAGE
AREA COMPARED TO
FIRE DETECTION TOWERS
WITH 15KM DETECTION
RADIUS AT EQUAL CAPITAL
INVESTMENT



LAND-BASED COVERAGE
AREA COMPARED TO
UAV'S WITH 300KM SWATH
DETECTIONS AT EQUAL
CAPITAL INVESTMENT

FIRESAT TECHNOLOGY READINESS:



FIRE DETECTION
SOFTWARE, GROUND
SYSTEM



GEOLOCATION SOFTWARE



OTHER SPACEBOURNE
COMPONENTS



DETECTOR & FOCAL PLANE
ELECTRONICS, MEMORY, ANALOG-
TO-DIGITAL CONVERTOR, POWER
SUPPLY, ONBOARD COMPUTING
ENGINE, MECHANICAL/THERMAL
HOUSING, OPTICS

SUPPORTING ASSUMPTIONS FOR ALL PROJECTIONS ARE AVAILABLE ON REQUEST