PRESS KIT/ SEPTEMBER 2013

SPACEX

UPGRADED FALCON 9 DEMONSTRATION MISSION

www.spacex.com

SpaceX CASSIOPE Mission Press Kit

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HIGH RESOLUTION PHOTOS AND VIDEO

SpaceX will post photos and video after the mission.

High-resolution photographs can be downloaded from: spacex.com/media
Broadcast quality video can be downloaded from: vimeo.com/spacexlaunch/

MORE RESOURCES ON THE WEB

For SpaceX coverage, visit:

spacex.com
twitter.com/elonmusk
twitter.com/spacex
facebook.com/spacex
plus.google.com/+SpaceX
youtube.com/spacex

For MDA information, visit:

www.mdacorporation.com

WEBCAST INFORMATION

The launch will be webcast live, with commentary from SpaceX corporate headquarters in Hawthorne, CA, at spacex.com/webcast.

Web pre-launch coverage will begin at 8:15 AM PDT.

The official SpaceX webcast will begin approximately 40 minutes before launch.

SpaceX hosts will provide information specific to the flight, an overview of the Falcon 9 rocket and CASSIOPE satellite, and commentary on the launch and flight sequences.

SpaceX CASSIOPE

Mission Overview

Overview

SpaceX's customer for its CASSIOPE mission is MacDonald, Dettwiler and Associates Ltd (MDA) of Canada, one of the first companies to work with SpaceX and choose its launch services.

During this demonstration flight, the recently upgraded Falcon 9 rocket will deliver MDA's CASSIOPE to Low Earth Orbit (LEO). CASSIOPE, the Cascade Smallsat and Ionospheric Polar Explorer is a small satellite space mission which serves as a demonstrator for a new Canadian small satellite bus design and carries two advanced payloads:

- e-POP for scientific experimentation; and,
- Cascade CX for communications technology demonstration

The mission represents a collaboration between the Canadian Government, the Canadian space industry and Canadian academia.

The CASSIOPE launch window will open at approximately 9:00 a.m. PDT on Sunday, September 29th from Space Launch Complex 4E at Vandenberg Air Force Base, California.

If all goes as planned, CASSIOPE will be deployed approximately 14 minutes after liftoff.

Satellite Payloads

CASSIOPE

CASSIOPE is a multifunctional mission designed to serve both a scientific and a demonstration of technology purpose. The small satellite measures 1.8 m in diameter x 1.4 m high and weighs 481 kg. It will fly in a slightly elliptical orbit that goes back and forth, over the Equator, from the North to the South Polar Regions.

The science payload of CASSIOPE, called the enhanced Polar Outflow Probe, or e-POP, will be Canada's first space environment sensor suite, consisting of eight instruments, including plasma sensors, radio wave receivers, magnetometers, CCD cameras, and a beacon transmitter. These instruments will enable the collection of new data on space storms and associated plasma outflows in the upper atmosphere and their potentially devastating impacts on radio communications, GPS navigation and other space-based technologies.

The Cascade CX payload is a new experimental communications concept of operation focused on large capacity data transfer.

SECONDARY PAYLOADS

Falcon 9 will deliver three secondary payloads to orbit as part of the CASSIOPE mission:

- POPACS (Polar Orbiting Passive Atmospheric Calibration Spheres): A privately funded CubeSat mission to measure the effects of solar flares and coronal mass ejections on the density of Earth's upper atmosphere during solar cycles 24 and 25. POPACS is a mission by collaboration between Utah State University, Gil Moore, Planetary Systems Corporation and Drexel University.

- DANDE (Drag & Atmospheric Neutral Density Explorer): A 50 kg spherical spacecraft developed by students at the University of Colorado at Boulder. The goal of the DANDE mission is to provide an improved understanding of the satellite drag environment in the lower-thermosphere.
- CUSat: A technology demonstrator developed by Cornell University. CUSat will use a new, relative GPS algorithm called Carrier-phase Differential GPS (CDGPS) that will provide accuracy to the millimeter level.

Always a Challenging Mission

All spaceflight is incredibly complicated. Every component of the mission must operate optimally. Hardware, avionics, sensors, software and communications must function together flawlessly. If any aspect of the mission is not successful, SpaceX will learn from the experience and try again.

Prelaunch

Months before a Falcon 9 launch, both rocket stages are transported to SpaceX's development facility in McGregor, Texas for testing, and then trucked individually to SpaceX's hangar at Space Launch Complex 4E at Vandenberg Air Force Base in Lompoc, California. There, the stages, SpaceX's fairing and the mission payload are integrated for flight. The final major preflight test is a static fire, when Falcon 9's nine first-stage engines are ignited for a few seconds, with the vehicle held securely to the pad.

The spacecraft arrives between 30-45 days before launch. It takes approximately 30 days for the spacecraft to be processed and integrated. One day prior to launch, Falcon 9 and its payload are transported to the launch pad. All ground personnel leave the pad in preparation for fueling, which proceeds automatically.

Launch Sequence

The launch sequence for Falcon 9 is a process of precision necessitated by the rocket's approximately three-hour launch window, dictated by the desired orbit for the satellite. Because an off-time liftoff may negate the satellite's ability to reach its intended orbit, the launch window is limited. If the three-hour time window is missed, the mission will be attempted on the next day.

A little less than four hours before launch, the fueling process begins—liquid oxygen first, then RP-1 kerosene propellant. The plume coming off the vehicle during countdown is gaseous oxygen being vented from the tanks, which is why the liquid oxygen is topped off throughout the countdown.

Terminal countdown begins at T-10 minutes, at which point all systems are autonomous. The Launch Director at Vandenberg Air Force Base gives a final go for launch at T-two minutes and 30 seconds. At T-2 minutes, the Air Force Range Control Officer confirms the physical safety of the launch area and provides the final range status. One minute before liftoff, the launch pad's water deluge system, dubbed "Niagara," is activated. Its purpose is to suppress acoustic waves that radiate from the engine plumes, thereby mitigating the effect of vibration on the rocket. Fifty-three water nozzles set low on the launch pad provide a curtain of water flowing at 113,500 liters (30,000 gallons) a minute.

Three seconds before launch, the nine Merlin engines of the first stage ignite. The rocket computer commands the launch mount to release the vehicle for flight, and at T-0 Falcon 9 lifts off, putting out 1.3 million pounds of thrust.

Flight

At one minute, 10 seconds after liftoff, Falcon 9 reaches supersonic speed. The vehicle will pass through the area of maximum aerodynamic pressure—max Q—10 seconds later. This is the point when mechanical stress on the rocket peaks due to a combination of the rocket's velocity and resistance created by the Earth's atmosphere.

Around two and a half minutes into the flight, two of the first-stage engines will shut down to reduce the rocket's acceleration. (Its mass, of course, has been continually dropping as its propellants are being used up.) At this point, Falcon 9 is 90 kilometers (56 miles) high, traveling at 10 times the speed of sound. The remaining engines will cut off shortly after—an event known as main-engine cutoff, or MECO. Five seconds after MECO, the first and second stages will separate. Eight seconds later, the second stage's single Merlin vacuum engine ignites to begin a six-minute, 17-second burn that brings the satellite to its intended low-Earth orbit.

Satellite Deployment

Three minutes and thirty seven seconds after lift-off, the fairing that protects the payloads is deployed. After another five minutes and thirty seven seconds (at the nine minute, 14 second mark after launch), the second-stage engine cuts off (SECO). Three hundred seconds later, CASSIOPE is deployed into orbit, (14 minute and 14 second after lift-off).

CASSIOPE Mission Timeline

Times and dates are subject to change

LAUNCH DAY

COUNTDOWN

Hour/Min/Sec	Events
- 13:30:00	Vehicle is powered on
- 13:00:00	CASSIOPE Mission Manager provides the go for launch
- 03:50:00	Commence loading liquid oxygen (LOX)
- 03:40:00	Commence loading RP-1 (rocket grade kerosene)
- 03:15:00	LOX and RP-1 loading complete
- 00:06:00	Falcon 9 terminal count autosequence started
- 00:02:00	SpaceX Launch Director verifies go for launch
- 00:02:00	Range Control Officer (USAF) verifies range is go for launch
- 00:01:00	Command flight computer to begin final prelaunch checks. Turn on pad deck and Niagara water
- 00:00:40	Pressurize propellant tanks
- 00:00:03	Engine controller commands engine ignition sequence to start
00:00:00	Falcon 9 liftoff

LAUNCH

Hour/Min/Sec	Events
00:01:18	Max Q (moment of peak mechanical stress on the rocket)
00:02:43	1st stage engine shutdown/main engine cutoff (MECO)
00:02:50	1st and 2nd stages separate
00:02:57	2nd stage engine starts
00:03:37	Fairing separation
00:08:54	2nd stage engine cutoff (SECO)
00:14:15	CASSIOPE deploys
00:17:45	POPACS deploys
00:20:25	CUSat deploys
00:21:25	DANDE deploys

Falcon 9 Rocket

Falcon 9 is a two-stage rocket designed from the ground up by SpaceX for the reliable and cost-efficient transport of satellites and SpaceX's Dragon spacecraft.

QUICK FACTS

Made in America. All of Falcon 9's structures, engines, and ground systems were designed, manufactured, and tested in the United States by SpaceX.

21st-century rocket. As the first rocket completely developed in the 21st century, Falcon 9 was designed from the ground up for maximum reliability from a blank sheet to first launch in four and a half years (November 2005 to June 2010). An upgraded Falcon 9 with safety and reliability enhancements and greater lift capability flies for the first time on the CASSIOPE mission.

Designed for maximum reliability. Falcon 9 features a simple two-stage design to minimize the number of stage separations. (Historically, the main causes of launch failures have been stage separations and engine failures.) With nine engines on the first stage, it can safely complete its mission even in the event of a first-stage engine failure.

Statistics. Falcon 9 topped with SpaceX fairing is 224.4 feet (68.4 meters) tall and 12 feet in diameter (the fairing is 17 feet in diameter). Its nine first-stage Merlin engines generate 1.3 million pounds of thrust at sea level, rising to 1.5 million pounds of thrust as Falcon 9 climbs out of the Earth's atmosphere.

In demand. SpaceX has nearly fifty Falcon 9 missions on its manifest, with launches scheduled for commercial and government clients.

Designed to safely transport crew. Like the Dragon spacecraft, Falcon 9 was designed from the outset to transport crew to space.

Mission success record. Falcon 9 has achieved 100% of mission objectives on its five flights to date: June 2010 and December 2010 flights to orbit; a May 2012 launch of the Dragon spacecraft to the International Space Station (ISS) making SpaceX the first commercial company ever to visit the ISS; and two of at least 12 launches of Dragon to the ISS as official cargo resupply missions for NASA.

Why "Falcon"? Falcon 9 is named for the Millennium Falcon in the "Star Wars" movies. The number 9 refers to the nine Merlin engines that power Falcon 9's first stage; one Merlin vacuum engine powers the second stage.

ADVANCED TECHNOLOGY

First Stage

Falcon 9 tanks are made of aluminum-lithium alloy, a material made stronger and lighter than aluminum by the addition of lithium. Inside the two stages are two large tanks each capped with an aluminum dome, which store liquid oxygen and rocket-grade kerosene (RP-1) engine propellants.

The tanks and domes are fabricated entirely in-house by SpaceX. Sections of aluminum are joined together using SpaceX's custom-made friction stir welders to execute the strongest and most reliable welding technique available. The structures are painted in-house by SpaceX, concurrent with the welding process.

Falcon 9's first stage incorporates nine Merlin engines. After ignition, a hold-before-release system ensures that all engines are verified for full-thrust performance before the rocket is released for flight. Then, with thrust equal to greater than five 747s at full power, the Merlin engines launch the rocket to space. Unlike airplanes, a rocket's thrust actually increases with altitude. Falcon 9 generates 1.3 million pounds of thrust at sea level but gets up to 1.5 million pounds of thrust in the vacuum of space. The first stage engines are gradually throttled near the end of first-stage flight to limit launch vehicle acceleration as the rocket's mass decreases with the burning of fuel.

Interstage

The interstage, which connects the first and second stages, is a composite structure made of sheets of carbon fiber and an aluminum honeycomb core, and it holds the release and separation system. Falcon 9 uses an all-pneumatic stage separation system for low-shock, highly reliable separation that can be tested on the ground, unlike pyrotechnic systems used on most launch vehicles.

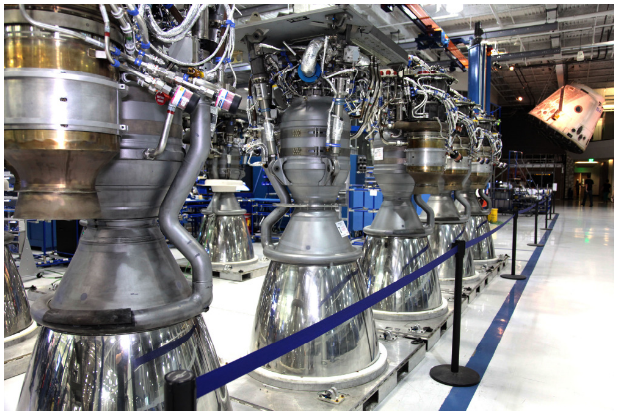
Second Stage

The second stage, powered by a single Merlin vacuum engine, delivers Falcon 9's payload to the desired orbit. The second stage engine ignites a few seconds after stage separation, and can be restarted multiple times to place multiple payloads into different orbits. For maximum reliability, the second stage has redundant igniter systems.

Like the first stage, the second stage is made from a high-strength aluminum-lithium alloy, using most of the same tooling, materials, and manufacturing techniques. This commonality yields significant design and manufacturing efficiencies.

Merlin 1D Engine

The Merlin engine that powers the first stage of Falcon 9 is developed and manufactured in-house by SpaceX . Burning liquid oxygen and rocket-grade kerosene propellant, a single Merlin engine emits 654 kilonewtons (147,000 pounds) of thrust at liftoff, rising to 716 kilonewtons (161,000 pounds) as it climbs out of Earth's atmosphere. Merlin's thrust-to-weight ratio exceeds 150, making the Merlin the most efficient booster engine ever built, while still maintaining the structural and thermal safety margins needed to carry astronauts.



Falcon 9 is the only vehicle currently flying with engine out capability; Falcon 9 can lose up to two of its Merlin engines on the first stage and still complete its mission. The nine-engine architecture on the first stage is an improved version of the design employed by the Saturn I and Saturn V rockets of the Apollo program, which had flawless flight records in spite of engine losses.

The Merlin 1D engine provides a number of improvements over its Merlin 1C predecessor, including greater performance, improved manufacturability by using high efficiency processes, increased robotic construction and reduced parts count.

High-pressure liquid oxygen and kerosene propellant are fed to each engine via a single-shaft, dual-impeller turbopump operating on a gas generator cycle. Kerosene from the turbopump also serves as the hydraulic fluid for the thrust vector control actuators on each engine, and is then recycled into the low-pressure inlet. This design eliminates the need for a separate hydraulic power system, and eliminates the risk of hydraulic fluid depletion. Kerosene is also used for regenerative cooling of the thrust chamber and expansion nozzle.

Octaweb

The Octaweb thrust structure of the nine Merlin engines improves upon the former 3x3 engine arrangement, increasing the Falcon 9's reliability while streamlining its manufacturing process. It houses the nine Merlin 1D engines and was designed to handle the increase in thrust from the Merlin 1C to Merlin 1D engine design.

The new layout also provides individual protection for each engine, and further protects other engines in case of an engine failure. With this design, Falcon 9 is also prepared for reusability – the Octaweb will be able to survive the first stage's return to Earth post-launch.

Reliability

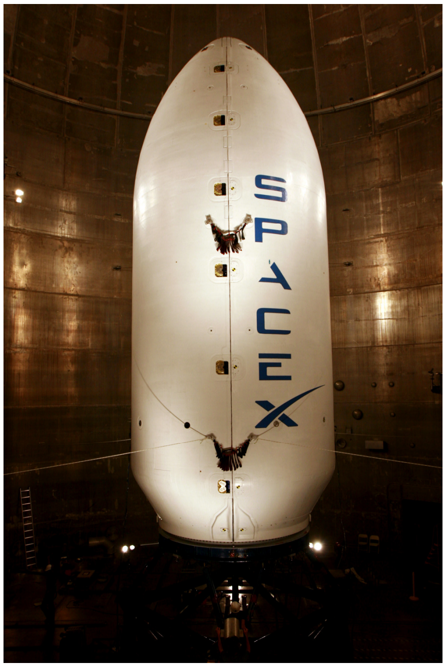
This flight represents the sixth flight of the Falcon 9, following five successful missions.

An analysis of launch failure history between 1980 and 1999 by the Aerospace Corporation showed that 91% of known failures can be attributed to three causes: engine failure, stage-separation failure, and, to a much lesser degree, avionics failure. Because Falcon has nine Merlin engines clustered together to power the first stage, the vehicle is capable of sustaining an engine failure and still completing its mission. This is an improved version of the architecture employed by the Saturn I and Saturn V rockets of the Apollo program, which had flawless flight records despite the loss of engines on a number of missions. With only two stages, Falcon 9 limits problems associated with separation events.

SpaceX maximizes design and in-house production of much of Falcon 9's avionics, helping ensure compatibility among the rocket engines, propellant tanks, and electronics. In addition, SpaceX has a complete hardware simulator of the avionics in its Hawthorne factory. This simulator, utilizing electronics identical to those on the rocket, allows SpaceX to check nominal and off-nominal flight sequences and validate the data that will be used to guide the rocket.

SpaceX uses a hold-before-release system—a capability required by commercial airplanes, but not implemented on many launch vehicles. After the first-stage engines ignite, Falcon 9 is held down and not released for flight until all propulsion and vehicle systems are confirmed to be operating normally. An automatic safe shutdown occurs and propellant is unloaded if any issues are detected.

SpaceX Fairing



The payload fairing sits atop Falcon 9 for the delivery of satellites to destinations in low-Earth orbit (LEO), geosynchronous transfer orbit (GTO) and beyond. SpaceX designed and developed its 5-meter fairing and manufactures every unit in Hawthorne, Calif. With an all-pneumatic deployment system (like Falcon 9's interstage), the fairing experiences low shock and can be tested on the ground.

The fairing is a composite structure made of sheets of carbon fiber and an aluminum honeycomb core. Large enough to carry a city bus, the fairing stands 17' in diameter and 43' tall and is designed to reliably meet all mission requirements. Inside the fairing is an EELV 5m IPC Class Envelope.

There are two halves to the fairing. One side is passive, and one is active with all actively controlled systems.

Structurally, the lower joint connects the fairing to the payload attach fitting and the 2nd stage. There is a vertical seam connecting the two fairing halves. The same latch mechanism is used in 14 locations along the vertical seam. Four pushers that share similar design components with the stage separation system separate the fairing halves at deployment.

Falcon 9 uses an all-pneumatic stage separation system for low-shock, highly reliable separation that can be tested on the ground, unlike pyrotechnic systems used on most launch vehicles.

Space Launch Complex 4E

SPACE LAUNCH COMPLEX 4E, VANDENBERG AIR FORCE BASE

Lompoc, California

SpaceX's Space Launch Complex 4E at Vandenberg Air Force Base has a long history dating back to the early 1960s. Originally an Atlas launch pad activated in 1962, 4E was in active use until a 2005 Titan IV launch. SpaceX's groundbreaking was in July 2011, and the pad was completed in November 2012 in just 17 months – something that normally takes several years. SpaceX took advantage of some existing infrastructure, but implemented extensive modifications and reconstruction of the pad. Part of the renovation included tearing down a 30+ story mobile service tower and a 20+ story umbilical tower, and 97% of these units were recycled.

The complex consists of a concrete launch pad/apron and a flame exhaust duct. Surrounding the pad are fuel storage tanks and the integration hangar. Before launch, Falcon 9's stages, SpaceX's fairing and the launch payload are housed inside the hangar. A crane/lift system moves Falcon into a transporter-erector system and the fairing and its payload are mated to the rocket. The vehicle is rolled from hangar to launch pad shortly before launch to minimize exposure to the elements.

SpaceX had to modify 4E to accommodate Falcon Heavy, which will be the world's most powerful rocket (4.3 million pounds of thrust). With very minor additions, 4E is ready to launch Falcon Heavy.

SpaceX Launch and Landing Center, located on the base, is responsible for Falcon 9 and its payload all the way to orbit.

SpaceX Company Overview

SpaceX designs, manufactures, and launches the world's most advanced rockets and spacecraft. The company was founded in 2002 by Elon Musk to revolutionize space transportation, with the ultimate goal of enabling people to live on other planets. Today, SpaceX is advancing the boundaries of space technology through its Falcon launch vehicles and Dragon spacecraft.

Transforming the Way Rockets Are Made

SpaceX's proven designs are poised to revolutionize access to space. Because SpaceX designs and manufactures its own rockets and spacecraft, the company is able to develop quickly, test rigorously, and maintain tight control over quality and cost. One of SpaceX's founding principles is that simplicity and reliability are closely coupled.

Making History

SpaceX has gained worldwide attention for a series of historic milestones. It is the only private company ever to return a spacecraft from low-Earth orbit, which it first accomplished in December 2010. The company made history again in May 2012 when its Dragon spacecraft attached to the International Space Station (ISS), exchanged cargo payloads, and returned safely to Earth—a technically challenging feat previously accomplished only by governments. SpaceX began official cargo resupply to the ISS in October 2012, with the first of 12 commercial resupply (CRS) missions.

Advancing the Future

Under a $1.6 billion contract with NASA, SpaceX will fly at least 10 more cargo supply missions to the ISS for a total of 12—and in the near future, SpaceX will carry crew as well. Dragon was designed from the outset to carry astronauts and now, under a $440 million agreement with NASA, SpaceX is making modifications to make Dragon crew-ready.

SpaceX is the world's fastest-growing provider of launch services. Profitable and cash-flow positive, the company has nearly 50 launches on its manifest, representing close to $5 billion in contracts. These include commercial satellite launches as well as NASA missions.

Currently under development is the Falcon Heavy, which will be the world's most powerful rocket. All the while, SpaceX continues to work toward one of its key goals—developing reusable rockets, a feat that will transform space exploration by radically reducing its cost.

Key SpaceX Milestones

- **March 2002** SpaceX is incorporated
- **March 2006** First flight of SpaceX's Falcon 1 rocket
- **August 2006** NASA awards SpaceX $278 million to demonstrate delivery and return of cargo to ISS
- **September 2008** Falcon 1, SpaceX's prototype rocket, is first privately developed liquid-fueled rocket to orbit Earth
- **December 2008** NASA awards SpaceX $1.6 billion contract for 12 ISS cargo resupply flights
- **July 2009** Falcon 1 becomes first privately developed rocket to deliver a commercial satellite into orbit
- **June 2010** First flight of SpaceX's Falcon 9 rocket, which successfully achieves Earth orbit
- **December 2010** On Falcon 9's second flight and the Dragon spacecraft's first, SpaceX becomes the first commercial company to launch a spacecraft into orbit and recover it successfully
- **May 2012** SpaceX's Dragon becomes first commercial spacecraft to attach to the ISS, deliver cargo, and return to Earth
- **August 2012** SpaceX wins $440 million NASA Space Act Agreement to develop Dragon to transport humans into space
- **October 2012** SpaceX completes first of 12 official cargo resupply missions to the ISS, beginning a new era of commercial space transport

Profile

SpaceX is a private company owned by management and employees, with minority investments from Founders Fund, Draper Fisher Jurvetson, and Valor Equity Partners. The company has more than 3,000 employees at its headquarters in Hawthorne, California; launch facilities at Cape Canaveral Air Force Station, Florida, and Vandenberg Air Force Base, California; a rocket-development facility in McGregor, Texas; and offices in Houston, Texas; Chantilly, Virginia; and Washington, DC.

For more information, including SpaceX's Launch Manifest, visit the SpaceX website at www.spacex.com.

SpaceX Leadership

ELON MUSK
Founder and Chief Designer

Elon Musk is the CEO/chief designer Space Exploration Technologies (SpaceX) and CEO and Product Architect of Tesla Motors.

At SpaceX, Elon is the chief designer, overseeing development of rockets and spacecraft for missions to Earth orbit and ultimately to other planets. SpaceX has achieved a succession of historic milestones since its founding in 2002. The SpaceX Falcon 1 was the first privately developed liquid-fuel rocket to reach orbit. In 2008, SpaceX's Falcon 9 rocket and Dragon spacecraft won a NASA contract to provide the commercial replacement for the cargo transport function of the space shuttle, which retired in 2011. In 2010, SpaceX, with its Dragon spacecraft, became the first commercial company to successfully recover a spacecraft from Earth orbit. In 2012, SpaceX became the first commercial company to attach a spacecraft to the International Space Station and return cargo to Earth.

At Tesla, Elon has overseen product development and design from the beginning, including the all-electric Tesla Roadster, Model S, and Model X. Transitioning to a sustainable-energy economy in which electric vehicles play a pivotal role has been one of his central interests for almost two decades, stemming from his time as a physics student working on ultracapacitors in Silicon Valley.

In addition, Elon is the non-executive chairman and principal shareholder of SolarCity, which he helped create. SolarCity is now the leading provider of solar power systems in the United States.

Prior to SpaceX, Elon cofounded PayPal, the world's leading Internet payment system, and served as the company's Chairman and CEO. Before PayPal, he cofounded Zip2, a provider of Internet software to the media industry.

He has a physics degree from the University of Pennsylvania and a business degree from Wharton.

GWYNNE SHOTWELL
President and Chief Operating Officer

As President and COO of SpaceX, Gwynne Shotwell is responsible for day-to-day operations and for managing all customer and strategic relations to support company growth. She joined SpaceX in 2002 as Vice President of Business Development and built the Falcon vehicle family manifest to nearly 50 launches, representing nearly $5 billion in revenue.

Prior to joining SpaceX, Gwynne spent more than 10 years at the Aerospace Corporation where she held positions in Space Systems Engineering & Technology as well as Project Management. Gwynne was subsequently recruited to be Director of Microcosm's Space Systems Division, where she served on the executive committee and directed corporate business development.

Gwynne participates in a variety of STEM (Science, Technology, Engineering and Mathematics)-related programs, including the Frank J. Redd Student Scholarship Competition. Under her leadership the committee raised more than $350,000 in scholarships in 6 years.

Gwynne received, with honors, a Bachelor of Science and a Master of Science in mechanical engineering and applied mathematics from Northwestern University.

MDA Company Overview

MDA is a global communications and information company providing operational solutions to commercial and government organizations worldwide.

MDA's business is focused on markets and customers with strong repeat business potential. In addition, the Company conducts a significant amount of advanced technology development. The Company's well-established global customer base is served by more than 4,500 employees operating from 11 locations in the United States, Canada and internationally.

MDA LEADERSHIP

Daniel E. Friedmann

As President and CEO for MacDonald, Dettwiler and Associates Ltd. (MDA), Mr. Friedmann is responsible for all aspects of MDA's operations.

From 1996 to present, under his leadership, MDA has embarked on further expansion into the surveillance and intelligence, communication, and advanced technology markets. Most recently, this expansion included the acquisition of SSL, the global market leading provider of commercial communications satellites. The acquisition transformed MDA into a major player in commercial communications and provided the Company with critical mass in the U.S. market. The transaction met MDA's long-term objective of gaining a stronger presence in the U.S. market.

From 1988 until 1995, Mr. Friedmann served as a Vice-President and then as Executive Vice-President of MDA. He was initially responsible for project management, business development, long-term operating plans and operational procedures. In 1992 he was designated Chief Operating Officer and joined the board of directors. In March 1995, Mr. Friedmann was appointed to his current position as President and Chief Executive Officer.

From 1982 until 1988, Mr. Friedmann was initially a Product Manager, and then a Marketing Manager, for MDA. By 1988, his responsibilities included the marketing and sales of all systems. He was also responsible for developing a plan, subsequently implemented by the company, to establish international offices and operations and to expand from remote sensing into the space, defence and aviation markets.

From 1979 to 1982, at MDA, Mr. Friedmann performed various engineering research jobs and helped develop significant new ways of processing data from remote-sensing satellites. This work laid the foundation for the technology employed in MDA-built remote-sensing ground stations from 1985 on.

Mr. Friedmann attended the University of British Columbia, where he received a B.A.Sc. Engineering Physics degree in 1979. He joined MacDonald, Dettwiler and Associates Ltd. (MDA) in July 1979 and continued to work for the company while studying for his M.A.Sc. Engineering Physics degree, which he obtained from the University of British Columbia in 1983.

While still an undergraduate, Mr. Friedmann headed a number of projects, including the development of a new, patented Electric Field Detector, the development of a microprocessor system to aid the disabled, and the development of a high-powered laser.

Anil Wirasekara

As Executive Vice President and Chief Financial Officer for MacDonald, Dettwiler and Associates Ltd. (MDA), Anil Wirasekara is responsible for providing corporate leadership in Treasury management, international trade finance, M&A activities, finance and administration.

Mr. Wirasekara joined MDA in 1992 as the Manager of Operations Information and Financial Management, and has been the Executive Vice-President and Chief Financial Officer since 1996. As the CFO, Mr. Wirasekara played a key role in completing the merger between MDA and Orbital Sciences Corporation in 1995, and then in leading the Company's divestiture from Orbital Sciences Corporation (USA) and reestablishing the Company as a Canadian Public Corporation. Over the past six years he has been a key manager in implementing the Company's growth and diversification strategy.

Prior to joining MDA, Mr. Wirasekara held a variety of financial management positions with a large multi-national organization as well as 5 years with Ernst & Young Chartered Accountants.

Mr. Wirasekara's professional affiliations include the Chartered Institute of Management Accountants (UK), The Society of Management Accountants of B.C. and the Institute of Chartered Accountants (Sri Lanka). He is also a graduate of the Chartered Institute of Marketing and Management (UK).