**Elon Musk reveals plan to get humans to Mars within 10 years**

**SpaceX CEO says a craft could carry 100 people**

By Laura Wright, [CBC News](http://www.cbc.ca/news/cbc-news-online-news-staff-list-1.1294364) Posted: Sep 27, 2016 11:33 AM ET Last Updated: Sep 27, 2016 5:06 PM ET

SpaceX CEO Elon Musk says that he wants to send an uncrewed Dragon spacecraft to Mars as early as 2018, a first step in his goal to fly people to another planet. (Mario Anzuoni/Reuters)

SpaceX CEO Elon Musk updated the world on his ambitious plans to get humans to Mars within the next 10 years, something he said would insure the human race against some kind of doomsday event, which he said is likely inevitable at some point in the distant future. It's a feat facing considerable technical and financial challenges, he acknowledged. He laid out his plan in a keynote speech called "Making Humans a Multiplanetary Species" at the International Astronautical Congress in Guadalajara, Mexico. "If things go super well," he said, he would send a craft with 100 people aboard to Mars, and it could take as little as 80 days to get there. But even though he said Mars is the best and closest option for habitation, any plan will be incredibly expensive. He said it will likely need the support of private and public funding.

Musk said he will continue with his already announced plans to send an uncrewed Dragon craft to Mars in about two years, with the plan of sending another one two years after that. He said he wants to make these trips "fairly routine" in order to encourage potential funders. "Right now, we're just trying to make as much progress as we can with the resources we have available to keep moving forward," he said. "And if we show that this is possible, that this dream is real — not just a dream but something that can be made real — I think the support will snowball over time."

**Costs and challenges**

Musk said there were four main challenges:

* Rocket reusability.
* Refuelling in orbit.
* The ability to produce rocket propellant on Mars.
* Choosing the right kind of propellant.

"Whatever system is designed, it has to have those four features addressed," said Musk. He said figuring out all these factors will significantly reduce costs. He said he hopes to eventually lower the cost to something like $200,000 US per person, so that anyone who wants to go to Mars could conceivably do so, either through saving their own money or through funding opportunities. Musk said it would take 40 to 100 years to achieve a self-sustaining civilization there. His company also released an animation called "SpaceX Interplanetary Transport System" that has some technical details about the plans (and a lot of dramatic music).

Musk said the animation is based on SpaceX rocket models, so it's very similar to what the company wants to build.

If people do make it to Mars, they will have a challenging environment to contend with. The planet is cold, dry and windy, with powerful UV rays. "It's a very harsh environment, so anyone who goes there will have to take measures to protect themselves from these environmental realities," said Richard Léveillé, adjunct professor in the department of Earth and planetary sciences at McGill University.

While a civilization on Mars is perhaps decades away, Musk has made significant progress. Earlier this year, Musk announced plans to send an unmanned spacecraft, called the Red Dragon, to Mars by 2018, in conjunction with NASA.

The Dragon craft has been tested in space before — in 2012, it became the [**first commercial spacecraft to carry cargo to and from the International Space Station**](http://www.cbc.ca/news/world/spacex-dragon-lands-on-earth-1.1275630).

"He's really changed the game in many ways for developing private capabilities for space travel," said Léveillé. "It's really a game-changer in terms of where we are going in terms of space and future destinations and in terms of humanity."

Robert Zubrin, a Colorado-based aerospace engineer, president of the Mars Society and author of the book *The Case for Mars,* is an unabashed supporter for colonizing Mars. He said SpaceX will survive its recent rocket explosion, but it will take a lot of successful launches in a row to convince anyone to put even cargo — let alone people — on one of Musk's vehicles.

"This is a fragile thing," said Zubrin. "But he is coming on strong and he is showing that he's able to develop things in one-third of the time and one-tenth of the cost that the mainline aerospace industry can."

Zubrin said going to Mars has been a difficult sell, politically. "It's expensive and also a program would happen after [the next U.S. president's] term of office — it's more than eight years out." But he said Musk has been consistently building up his arsenal of hardware that would be needed to send humans to the Red Planet. "Musk is going to make money sending humans to Mars by being the guy who has the stuff needed to do it when the time comes," said Zubrin.

**High pressure**

Despite past successes, there's a lot of pressure on Musk. His companies — Tesla Motors and SpaceX — have both had highly publicized problems recently.  This summer, a [**driver was killed**](http://www.cbc.ca/news/business/tesla-autopilot-crash-1.3661576) while using the Autopilot function of a Tesla vehicle.

On Sept. 1, after several successful landings, one of [**SpaceX's rockets exploded**](http://www.cbc.ca/news/technology/spacex-explosion-1.3744151) during what was meant to be a routine pre-launch test. A Falcon rocket and the satellite it was carrying were destroyed. A rocket like the Falcon would be needed to boost a Dragon into space.

The company has still not confirmed what caused the explosion, but it announced last week that a breached helium system was the source. Musk called the Sept. 1 failure the [**most difficult and complex**](http://www.cbc.ca/news/technology/spacex-elon-musk-calls-explosion-failure-1.3755645) one in the company's 14-year history.

**Teleportation across Calgary marks 'major step' toward creation of 'quantum internet'**

**Fibre-optic system between university and city hall enables long-distance 'disembodied' transfer of info**

By Robson Fletcher, [CBC News](http://www.cbc.ca/news/cbc-news-online-news-staff-list-1.1294364) Posted: Sep 20, 2016 6:03 PM MT Last Updated: Sep 25, 2016 11:34 AM MT

In a "major step" toward practical quantum networking, researchers at the University of Calgary have successfully demonstrated the teleportation of a light particle's properties between their lab and the city's downtown area, six kilometres away.

"What is remarkable about this is that this information transfer happens in what we call a disembodied manner," said physics professor Wolfgang Tittel, whose team's work was [**published**](http://www.nature.com/nphoton/journal/vaop/ncurrent/full/nphoton.2016.180.html) this week in the journal Nature Photonics. "Our transfer happens without any need for an object to move between these two particles."

Their research relies on advanced lasers, a dedicated fibre-optic line, and light-detecting sensors that must be kept incredibly cold because they won't work at temperatures above –272 C. It also relies on the increasingly well-known but still baffling phenomenon of quantum entanglement.

The concept is so bizarre that a dubious Albert Einstein famously dubbed it "spooky action at a distance" in the 1940s, as he described what he saw as flaws in the emerging theory of quantum mechanics. But today, an increasing body of evidence has confirmed the most counterintuitive predictions of quantum theory, including the strange behaviour of "entangled" particles. These are pairs of particles that are fundamentally linked, such that the properties of each one is intrinsically tied up in the other and actions affecting one particle have an immediate effect on the other, no matter how far apart the particles are.

For their demonstration, the U of C team used a specialized laser to create a pair of entangled photons — elementary particles of light — and sent one to Calgary City Hall via a dedicated fibre-optic line while keeping the other in their lab at the university in the city's northwest. At the same time, a third photon was sent to city hall from another location (a data centre in the southeast community of Manchester) so that it would meet and interact with the entangled photon.

"We had to make sure it arrived at the same time at city hall as the photon that was created at the data centre," said Tittel.

"And that's pretty tricky, because 'the same' in our case means with a provision of a few picoseconds."

(For the non-physics crowd: A picosecond is one-trillionth of a second, or 0.000000000001 seconds — which means not much room for error.)

Tittel said the team had to create feedback mechanisms in the experimental setup to ensure "very precise timing" of the photons' arrivals at city hall, as small changes in outdoor temperature that cause the fibre-optic cables to expand or contract by minuscule amounts could throw off the timing.

**Success from kilometres away**

In the end, though, the system worked and the transfer of properties between the photon at city hall and the photon at the university — 6.2 kilometres away, as the crow flies — was confirmed.

"It's fascinating to see that, not only teleportation exists, but that you can … transfer the state without transferring the photon over a large distance," Tittel said.

"From a fundamental point of view, that is fascinating. From a practical point of view, we used a standard fibre network to do so, which of course moves this whole demonstration into the realm of something that will be practical and useful."

The team's article in Nature Photonicssays the demonstration "constitutes a milestone towards a global quantum internet," as it is one of the longest distances over which quantum teleportation has been achieved using a fibre-optic network in this way.

"The way we localized all the different stations within the city of Calgary reflects what needs to be done in a future quantum repeater that will allow us to send quantum information, in principle, over arbitrarily long distances," Tittel said.

"So, it's a major step forward toward that goal."

Coincidentally, in the same edition of the same journal, an independent team of Chinese researchers published the results of [**their own demonstration**](http://www.nature.com/nphoton/journal/vaop/ncurrent/full/nphoton.2016.179.html)  — one that used a slightly different setup but employed the same principles and confirmed quantum teleportation using a fibre-optic network over a span of 12 kilometres.

"Our experiment marks a critical step towards the realization of a global 'quantum internet' in the real world," the Chinese team wrote.

**What is the 'quantum internet,' anyway?**

It doesn't exist yet, but the dream of a "quantum internet" involves taking advantage of a key element of quantum mechanics — the fact that observing a particle's quantum state changes that particle's quantum state.

This creates the opportunity to communicate with a degree of security never before possible, because no one can intercept a communication without the intended receiver of the information knowing about it.

"If you encode keys into quantum states and send them from person to another — for instance, through teleportation — then it turns out that you can verify at the receiver's side … if an eavesdropper has acquired any information about that key," Tittel said.

"If you find out that nobody has tampered with this transmission, you know that you share a perfectly secure key and then you can use it to encrypt some sensitive data."

**Partnership between university, municipality**

The development of functional quantum networks is still a long time off, but Sylvain Mayer, an information architecture engineer with the City of Calgary, said the city plans to continue working with the university to speed up the process.

The fibre-optic network the U of C team used normally carries information between various city departments, but a dedicated portion of it was made available to the researchers through the [**Urban Alliance**](http://www.ucalgary.ca/research/external-community/urban-alliance), a partnership developed in 2007.

"We're happy that part of our fibre infrastructure can be used by these fellows to be able to research cutting-edge technology," Mayer said.

"The city just wants to be able to continue to be able to help educational institutions in their pursuit of next-generation types of services that will eventually be able to help everyone around the world."