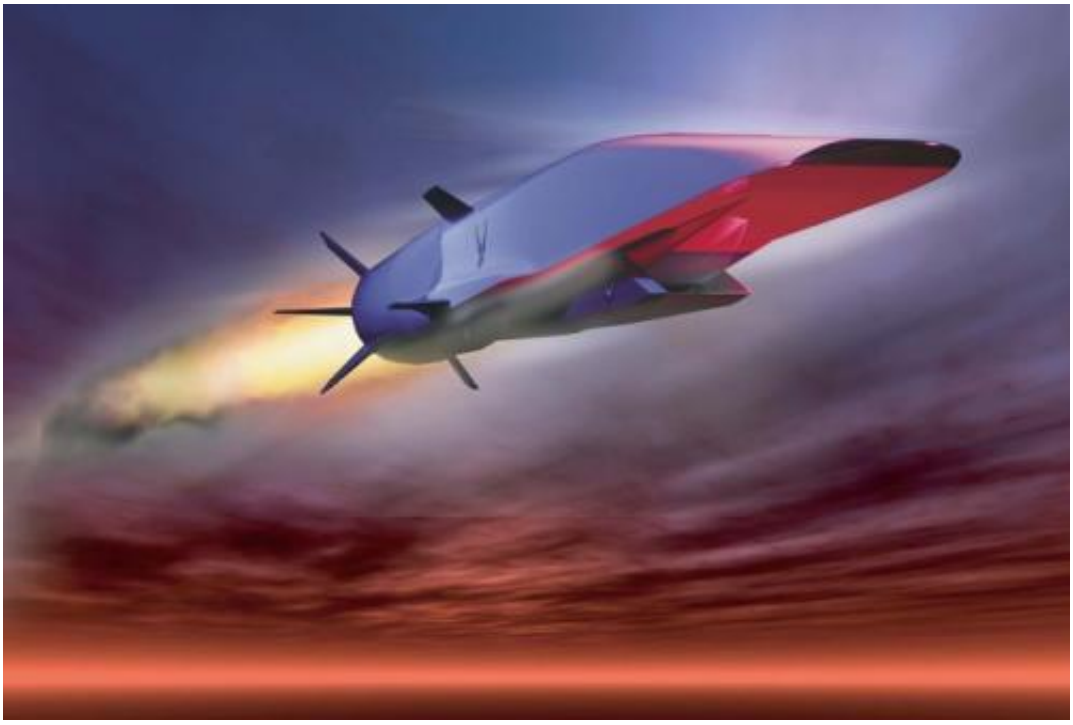
Obstacles to a revolution in air technology

October 13 2014, by Richard Brown



Boeing's X-51A Waverider (artist's impression). Credit: US Air Force

When in 1873 Jules Verne published his novel of planet-trotting high adventure, the world was on the verge of an explosion in global travel. New trans-continental railways and the Suez canal promised an increase in the speed with which one might circumnavigate the world. Yet the denizens of the Reform Club in old-world London remained stolid in their opinion that protagonist Phileas Fogg's proposed 80-day circumnavigation would simply be impossible.

Could we today be on the verge of another revolution in the speed at which we traverse the globe, this time a leap from 80 days to just 80 minutes? To any world-weary traveller standing in the queue at any of a thousand featureless airports, facing hours squeezed into an airborne aluminium tube, it must certainly seem a remote prospect.

Indeed we are predicted to face a crisis in the air. The air-lanes are becoming ever more congested, and demand is growing into a systemic problem. We have not seen any fundamental advances in air technology over the last century. Orville Wright might turn to Wilbur with a raised eyebrow at the sight of a modern-day Flyer. But even as speed, height and passenger capacity have improved, the engineering principles have remained very much the same. It is a long time that bright-eyed futurologists have been talking about two-hour journeys from London to Sydney without much sign of progress.

The Ryanair factor

Yet the very reasons for the current situation may provide the best justification for a revolution in our travels. In air travel, long-distance carriers generally have to be treated with the highest priority, simply because they might otherwise run out of fuel. The simplest remedy is to pass on this effect and disrupt the schedules of lower-priority flights. This is why your commuter airline trip can be subject to uncertain departure times or umpteen queasy circuits of the holding pattern before coming in to land. If you introduced new long-haul designs capable of very high speeds, you could make the whole network operate much more efficiently – a solution that will become increasingly attractive as congestion gets worse.

But these new aircraft will only be part of the solution. We'll also need to think about rationalising the transport infrastructure so that fewer people travel individually and those that do select the right mode of travel for

the length of their route. Given the realistic limitations of transferring commuters from cars to high-speed trains, aviation presents an answer. After all, a connection route can be created with some imagination and the stroke of the legislative pen.

The low-cost airlines realise this, but are forced by the state of current aviation technology to shoehorn unsuitable aircraft into inappropriate routes. Aircraft concepts such as the tiltrotor are ideal for short point-to-point services (indeed the technology was operating from Battersea pier in the early 1960s). If adopted en masse, they will liberate planners to design more appropriate and flexible air routes. Since the tiltrotor works by vertical take-off, these would potentially eliminate the need for runway extensions, or even for runways at all.

Green obstacles

Tally-ho! It's like 1910 all over again. Credit: Martin Stitchener, CC BY

There are also environmental issues to overcome. Long-range air transport can follow one of two paths – "low and slow" or "high and fast". The former is favoured almost exclusively by the manufacturers as a low-risk and logical extension of their current and very conservative product range. To my mind it is only green in comparison to current aviation practice, and is untenable. The energy density of chemical fuels remains unsurpassed, but that doesn't negate its likely long-term environmental effects.

The "high and fast" approach favoured by operators and passengers offers a brighter environmental future because they are best suited to using liquid hydrogen and oxygen as propellants. These might perhaps be produced by electrolysis of sea water using offshore wind energy. Even then, though, we would need to properly address the fact that the water produced by burning these greener fuels is an atmospheric pollutant that has important ecological consequences if concentrated at the wrong altitude.

On top of that, there are also some remaining technical challenges for "high and fast" long haul. Mitigating the effects of sonic boom on those unlucky enough to be flown over at high speed is an unsolved problem, for instance. So is the issue of preventing possible damage to the ozone layer as countless hypersonic aircraft punch through it.

100 other obstacles

These environmental issues are just a taster of the huge technological hurdles that still need to be overcome before high-speed passenger flight can become a reality. We need new high-temperature materials and structural designs that can withstand temperatures that would cremate, let alone fry, an egg. We need new engines that can propel the vehicle

from a standstill at the departure gate all the way to the edge of space (and possibly beyond) and still be able to source part of their propellant from the oxygen-depleted upper reaches of the atmosphere. And a major challenge will be to take solutions and concepts from the theoreticians (such as Nonweiler's "waverider") and turn these into craft with doors that can be slammed shut, operated by sleepy pilots, and maintained in third-world airports far from their technological comfort zones.

Recent hype has suggested that the current moves towards space tourism might present a solution to many of these problems, but I doubt it. The technology required for climbing rapidly to high altitude and coming straight back down again is conceptually and practically unrelated to that required for sustained atmospheric flight.

Other problems with future high-speed air transport will need political rather than technical solutions. There is a lot of money to be lost and gained at the high-stakes negotiating table where cross-border flights are concerned, and there will be many vested interests dragging the system back towards the status quo. We can't afford a repeat of what happened with Concorde, where entrenched industrial interests reduced it to a single route for over-moneyed businessmen and joyriders.

Death benefits

Tiltrotor technology in action. Credit: US Navy/Wikimedia

When will this progress happen? How much will it cost? Frustratingly, "not soon", and "a lot" are about as exact as the answers can be at this stage. The most enthusiastic proponents of hypersonic passenger transport would say the first prototypes might be 20 years away, but I would say that is not being realistic about all the remaining hurdles – particularly the political and industrial climate.

If history teaches us anything, it will be the military that gets there first – as ever, technologies that can make death more swift and unexpected also hold the promise of such global connectivity that can fundamentally change the way we work, live and play. The military is already very interested, needless to say. In November 2004 the American X-43, funded by NASA, managed sustained flight at 10,617km/hr for at least

ten seconds before plunging into the Pacific Ocean. We will probably see the first serious military applications of such technologies in the next five years, which will of course be an important milestone towards a consumer version.

The reasons for designing and flying vehicles that are capable of global reach in the time taken to read the morning newspaper are technically attractive, and militarily obvious. The economic and social justifications are perhaps less easily pinned down, but are nonetheless compelling. What will be the impact of treating Sydney as a commuter suburb for Beijing, or of being able to visit Antipodean gran for Sunday roast – with a serious prospect of being home in time for dinner and telly? Or will we inexorably descend into a sub-species of our former selves that is characterised by neverending jet-lag and chronic Melatonin abuse?

The idea of high-speed air travel is certainly not new. But well motivated technological breakthroughs, spurred on by the social imperative to change fundamentally the way we conduct our affairs on this planet, may just be capable of turning fiction into reality.