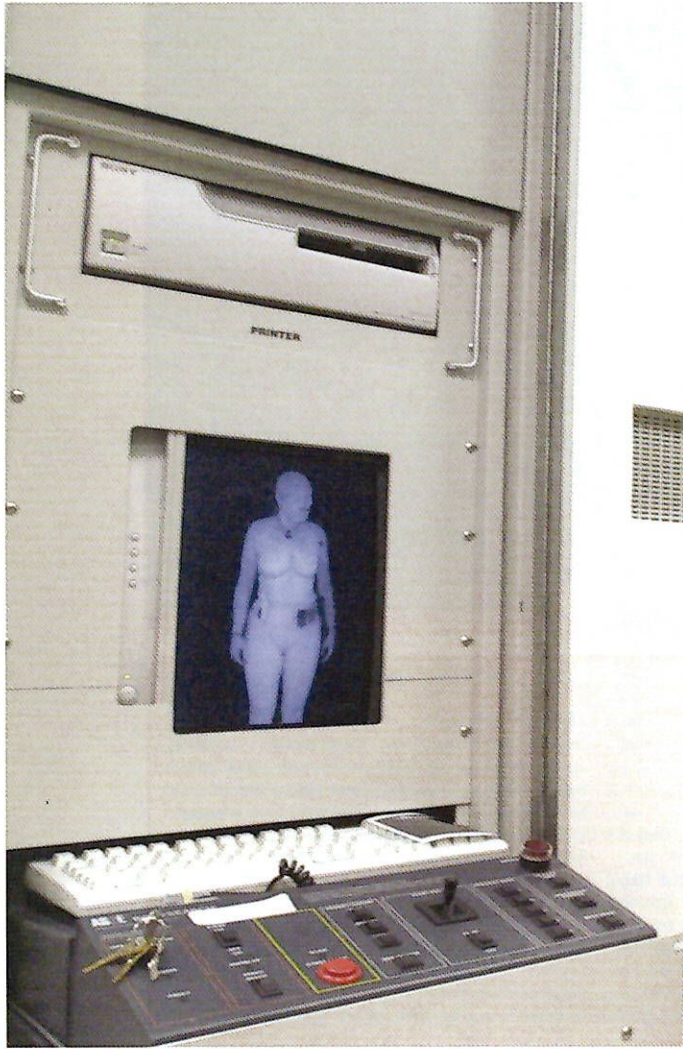


X-RAY X-RATED: passenger screening



The hijacking of a Qantas flight en route to Tasmania in May 2003 was a clear demonstration of the fallibility of screening passengers using metal detection technology alone. Since long before 11th September 2001, manufacturers have been attempting to find a solution that is both effective and acceptable to the flying public. Millimetre wave imaging and actual passenger X-ray are just two of the solutions being mooted. Philip Baum investigates just how far along the road we have gone in the attempt to provide adequate passenger screening.

The archway metal detector and hand-held magnetometer are part and parcel of almost every passenger screening checkpoint around the globe. Introduced in the early 1970s, metal detection proved a successful tool for the identification of weapons traditionally used by hijackers – handguns and grenades.

Post-Lockerbie, many countries finally appreciated the threat posed to aviation by explosive devices, and checked luggage was perceived as the likely method of infiltrating such a device onto an aircraft. Consequently, and even understandably, the manufacturers were encouraged to develop explosive detection technologies that specifically concentrated on suitcase analysis. After all, no passenger was knowingly going to carry a bomb onto an aircraft were they?

The earlier bombings of TWA 840 in 1986 and KAL 858 in 1987, both incidents being the result of explosive devices being secreted in the aircraft cabin by deplaning passengers, had not resulted in a concerted effort to address the issue.

Barringer, Ion Track Instruments and Thermedics (using their original names!) were, behind the scenes, trying to develop portal explosive detectors that could be integrated with archway metal detectors to provide a tool that would identify both metallic weapons and explosive devices.

On facing page: Susan Hallowell, director of the TSA's security laboratory, holds up a gun that was detected using X-ray backscatter technology. (Photo: AP Photo/Brian Branch-Price)

The problem, however, is that each technology we have introduced identifies a different type of threat object material rather than providing a screening tool that will aid in the identification in the entire gambit of weapons that could be used by a hijacker.

The Risk

It is a sobering fact that, in 2003, passengers carrying non-metallic weapons can walk through almost every airport in the world and gain access to passenger flights. There are a few airports testing the explosive portals, some governments requiring random pat down searches and certain airlines utilise passenger profiling techniques that might identify threat passengers through behavioural analysis, but they are few and far between.

The fact remains that we are exposed to the threat of potential hijackers armed

with carbon or ceramic knives, small blades (below the sensitivity level of most archway metal detectors) and, as was proved in Australia in May, wooden stakes.

There is no doubt that many of those companies providing metal detection solutions, like CEIA, Garrett and Metorex, have made significant enhancements to their products, so that the specific location of a potential threat object is more easily identifiable.

One company, Ranger, has even developed the Body Orifice Security Scanner (B.O.S.S.) to facilitate metal detection in oral, nasal, vaginal and anal orifices. However, Ranger is suffering significant cash flow problems at present, perhaps indicative that metal detection technology alone is not what is being sought. Then again, given the strength of their competitors, Ranger's financial crisis may have other causes.





Unlike most medical X-ray machines, the Rapiscan Secure 1000 is less intimidating and simply requires the passenger to stand still for a few seconds whilst being screened

The Solutions

We must ask ourselves what we actually want to be able to detect. We know that a passenger can do a lot of damage with their bare hands, duty free bottles, ties, belts or any number of other objects regularly carried in the aircraft cabin. There is no technology that is going to reveal these as threat items, so we can only rely on our behavioural analysis skills to identify a passenger who may intend to use such objects to overpower the crew and gain access to the cockpit.

On the other hand, many of the weapons carried onto aircraft are either non-metallic or are metallic but of insufficient size to generate an alarm, so we do need to utilise equipment that will aid in their identification.

The solutions exist but it is argued that passengers would be unwilling to subject themselves to scrutiny by such technologies due to either privacy issues or perceived health risks posed by the systems.

Neither argument carries much weight...

There are basically two solutions currently being mooted...actual passenger X-ray (both backscatter and transmission) and millimetre wave imaging (both active and passive).

Passenger X-ray

Radiation! Conjures up images of Hiroshima, Nagasaki, Three Mile Island and Chernobyl doesn't it? It certainly does have negative connotations, and granted recent warnings about skin cancers caused by solar radiation, brain tumours from excessive use of mobile phones and the very visible protective measures that are taken at dental surgeries and hospitals when our teeth or other body parts are examined for medical purposes, it is perfectly natural for people to have some misgivings about subjecting themselves to additional X-rays in the name of aviation security.

Yet rather than write-off the technology, perhaps we should actually start to educate the travelling public a little more about radiation. Now I accept that for a cash-strapped industry such as aviation, it may not be the best marketing tool to advise people the extent to which they are exposed to cosmic radiation when they fly and that, for that very reason, even crew members are restricted to the number of hours they may spend aloft. However, somehow we need a reality check. The minimal dose to which the passengers might be exposed to in the screening process is equivalent to 30 seconds flying at 33,000 feet.

Cosmic Radiation

To use the World Health Organisation's definition, "Cosmic radiation contributes about 13% of the natural background

radiation level. It is believed to come from Milky Way galaxy but its' origin is unclear. Cosmic radiation consists primarily of charged and neutral particles (protons, alpha particles, heavier ions, and electrons) and secondary particles generated by interaction of cosmic radiation with atmosphere's air (ions, neutrons, gamma rays, electrons, etc). Along with solar radiation it constantly bombards Earth's atmosphere. The Earth's magnetic field deflects many charged particles that would otherwise reach ground level but, at jet aircraft altitudes, cosmic radiation can contribute significantly to doses accumulated over hundreds flight-hours by flight crew and frequent flyers."

A flight from London to New York would expose the passenger to about the same dose of radiation as they would receive by being X-rayed approximately 900 times using most of the commercially available passenger X-ray backscatter screening systems.

The Risk of Flying

According to the World Health Organisation, "the annual cosmic radiation exposure dose limit for a member of general public is 1 milli-Sieverts (mSv) and occupational limits is 5 mSv. Exposure dose from cosmic radiation at flight altitudes is usually not higher than 0.005 mSv per hour. Rough estimates show that it will take a minimum of 200 flight hours to approach annual dose limit for general public." So



*James Bond technology is already more reality than fantasy. Bond's famous X-ray glasses, donned in the casino scene of the film *The World Is Not Enough*, are not a far cry from some of the technologies set to be deployed at passenger screening checkpoints.*

fly round-trip across the Atlantic every week for a year and you will be exposed to almost four times the recommended amount of cosmic radiation exposure. How many employers...or employees for that matter...consider that?

The issue is of concern to aircrew especially as they are, as a group, prone to higher rates of breast and skin cancer than the general population. However it has yet to be proven that cosmic radiation is necessarily the cause. They are, after all, known to sunbathe more than the general population too.

The risk of breast cancer in female flight attendants was studied in Iceland by Vilhjálmur Rafnsson and Hrafn Tulinius (Department of Preventive Medicine, University of Iceland), Jón Gunnlaugur Jónasson (Department of Pathology, Landspítali-University Hospital, Reykjavik) and Jón Hrafnkelsson (Department of Oncology, Landspítali-University Hospital).

Of the 1532 women who formed part of the study group, 64 cancers were observed whereas 51.63 were expected and a significantly increased risk for malignant melanoma was found. Those hired in 1971 or later had the heaviest exposure to cosmic radiation at a young age and had significantly increased risk of overall cancer and breast cancer. The study concluded that:

"The increased risk of breast cancer and malignant melanoma among cabin attendants seems to be occupationally related. The part played by occupational exposures, i.e. cosmic radiation, disturbance of the circadian rhythm, and electromagnetic fields or combination of these factors in the etiology of breast cancer among the cabin crew, is still a puzzle." The report stressed that, "The relationship between the sunbathing habits of the cabin crew and the increased risk of malignant melanoma needs to be clarified."

Bearing in mind the other health risks to which we are exposed to by flying, the health hazard posed by X-ray screening equipment, claim the security equipment manufacturers, is simply a matter of ignorance rather than having any basis on fact.

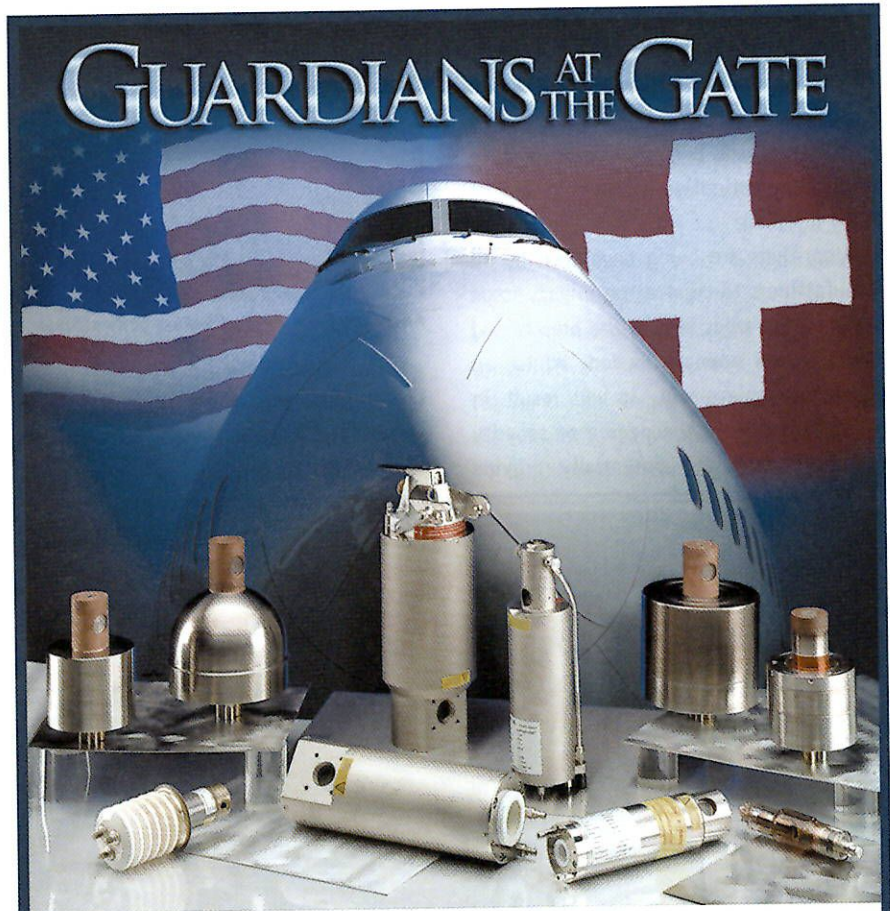
Privates on Parade

Potentially harder to resolve is the privacy issue. Using backscatter X-rays, one can certainly get a very clear image of the body form as Susan Hollowell, director of the Transportation Security Administration's R&D laboratory, bravely demonstrated herself on 25th June this year. In the eyes of the world's media Hollowell, wearing a dark skirt and blazer in the flesh (as it were) appeared naked on screen, save for

the gun and bomb she had hidden under her outfit.

"It does basically make you look fat and naked, but you see all this stuff," Hollowell said, leading by example.

Of course one can always rely on the American Civil Liberties Union to object to most effective screening technologies and methodologies. In a September 2001 report they stated that, "We oppose using this as part of a routine screening



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procedure. Passengers expect privacy underneath their clothing and should not be required to display highly personal details of their bodies such as evidence of mastectomies, colostomy appliances, penile implants, catheter tubes and the size of their breasts or genitals as a pre-requisite to boarding a plane."

In the same way the pacemaker patients can request a pat down search rather than be screened by an archway metal detector, so could others request alternative screening procedures to be effected should there be a valid medical reason backed up with appropriate documentation. And, as to size, I'd rather support the civil liberties of those passengers who wish to reach their destination without the fear of being hijacked.

Algorithms are being developed by all manufacturers to resolve the privacy issue in order that areas around the breasts and genitalia will appear clouded. Whilst an admirable achievement, it will result in a net reduction in the degree of security afforded and could potentially provide



An image from MMC's ConPass body scanner

the criminal with a means of effectively secreting a weapon thereby negating the value of the technology.

Transmission vs. Backscatter

There are three commercially available products for use in the airport environment. Rapiscan and American Science & Engineering both have personnel scanners that utilise X-ray backscatter technology, thereby generating images of the body such as Ms. Hallowell demonstrated.

MMC International (MMC), however, utilises transmission X-rays that generate images that are more similar to medical X-rays inasmuch as the screener gets an inside view of the body rather than a view of the passenger naked.

Transmission X-ray requires one scan only, whereas the backscatter approach necessitates the passenger to be screened four times to give views of the front, back and each side. Transmission also provides a much clearer image and enables the better detection of internal carries, such as drugs and diamonds that have been swallowed by couriers. Each passenger becomes somewhat sexless so the privacy issue becomes less of a concern; whilst the underwire of



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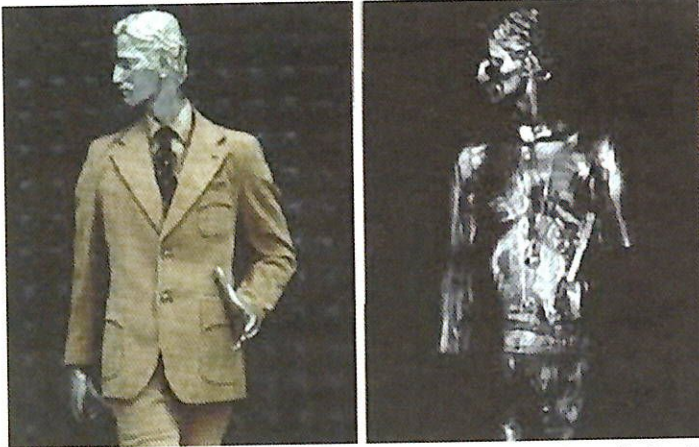


Image using millimetre wave technology (Photo: Pacific Northwest National Laboratory)

a brassiere may give away the person's sex (let alone their physical presence in the scanner), there are no resultant images of breasts or genitalia.

MMC has, to date, sold 146 of its Con Pass systems, of which the vast majority have been sold to the mining industry to prevent the theft of gold and diamonds. However, there are 10 systems in use in airports, mostly by customs authorities, yet two, recently installed in Korea's Incheon airport, are being used as part of the passenger screening process.

Whilst the privacy issues are resolved by the use of transmission X-ray, it certainly does not allay the general public's fears about exposure to radiation and many will be asking themselves why, if one can see the bones, hospitals are so cautious. Backscatter technology causes less of a concern in this regard.

Rapiscan's Secure 1000 operates by scanning the subject with a narrow beam of X-rays. Some of these X-rays will be reflected by the body as backscatter in the opposite direction, and be gathered by sensitive x-ray detectors. Advanced image processing algorithms use this information to generate the images.

Whilst, American Science & Engineering's BodySearch uses similar technology and generates equivalent images, the system itself has a much larger footprint making deployment in airport terminals difficult.

Millimetric Wave Imaging

An emerging technology has been that of millimetric wave imaging which generates an image similar to that of the systems

issue is still a battle to be won.

QinetiQ, in the UK, actually carried out trials of its millimetre wave scanner at London's Gatwick airport in June 2002 and the results were extremely encouraging, not only in respect of image quality, but also in respect of passenger acceptance.

I spoke with QinetiQ's Kevin Murphy who explained that, "QinetiQ psychologists tested the reactions and views of 400 passengers who had passed through the mm-wave system. The passengers were broadly split evenly between male and female and across age groupings. All had been made aware before cooperating with the trials team that the system would be able to 'see' beneath their clothing.

"The responses showed that a comfortable majority would prefer a screening technology to a pat down search, and many were reassured that new passenger screening technology was on the horizon that would make them safer in the skies. A few admitted to feeling a little embarrassed but only one passenger out of the

utilising X-ray backscatter technology yet without subjecting the passenger to any radiation. Health hazards are no longer an issue (providing the general public believe the claim!) whilst the privacy

400 we tested was so uncomfortable that they refused to be screened."

The result of the research will be the launch of a commercially available system within months. And, furthermore, QinetiQ expects to have a walk-through version on the market within the next few years, thereby negating the need to screen passengers from all four sides.

QinetiQ is also developing privacy software. Israel has shown great interest in the product, yet even the nation that has the most invasive passenger screening system in the world feels that images of naked people may not go down well at home, especially (and understandably) amongst the religious communities. A similar reaction is to be expected from the Arab world.

The Americans too, whilst (excuse me) being brasher individuals than their European counterparts, are much more conservative when it comes to screening. The hand-held magnetometer has replaced the pat down search and in trials conducted in Orlando passenger acceptance was

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slightly less affirmative than in London. Must be the British stiff upper lip!

Passive vs. Active

In the same way that two X-ray solutions are proffered, there are two alternative approaches to millimetre wave imaging: passive and active.

The initial prototype QinetiQ solution was passive. The system looked without emitting any signal. As QinetiQ's Kevin

Murphy puts it in military terminology, "you can see without being seen." In essence it was a CCTV system whereby the passive millimetre wave imager was a camera that could detect objects through clothing, dense fog, walls and other visibly opaque materials using millimetre wave radiation that occurs naturally in the atmosphere. The camera could detect hidden objects by measuring differences in invisible heat energy emitted by a

person's body and any item concealed on their person.

However, this was all very well in an outdoor environment where the system utilised naturally occurring radiation in the atmosphere, but once transferred to an indoor site, such as an airport terminal, the system had to be converted to an active millimetre wave system by augmenting the greatly reduced radiation with an illuminator. The radiation is incoherent (like a light bulb, in layman's terms).

Safe View Inc. has an active system, the Personal Security Scanner, developed by Pacific Northwest National Laboratory in the United States. It emits millimetre waves that penetrate clothing, but bounce off the body and other objects. These reflected waves are quickly picked up by a transceiver, digitised and sent to a computer. Three-dimensional holographic image-processing techniques form high-resolution radar images of the person under surveillance along with any associated body-worn concealed object. The goal for screening time is two seconds and the image generated can, with a software option, be gender-neutral thereby allaying many of the privacy concerns. Unlike the QinetiQ solution, SafeView uses coherent radiation (in layman's terms, like a laser), so the radiation emitted is greater yet still poses no health risk.

On 29th May, 2003, InVision Technologies Inc. announced that it has made a strategic equity investment in SafeView Inc. The investment will be used in part to commercialise the portal and InVision will be the exclusive distributor of SafeView's portal systems in commercial aviation and airport markets in North America and Europe.

Sergio Magistri, InVision's President and Chief Executive Officer said, "We anticipate that authorities will begin to upgrade passenger checkpoints to next-generation technology so that every person and item boarding an airliner is screened as effectively as checked baggage is today."

Conclusion

New York Times columnist Thomas L. Friedman once wrote, "If everybody flew naked, you would never have to worry

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about the passenger next to you carrying box cutters or wearing exploding shoes...and no religious fundamentalists would be caught dead flying nude, or in the presence of nude women, and that alone would keep many potential hijackers out of the skies."

Ridiculous as the concept might seem, Naked Air's B-727 took to the skies on 3rd May 2003. The passengers who boarded the charter flight from Miami to Cancun, Mexico were permitted, once at cruising altitude, to drop their pants, shed their bras and underwear and move about the cabin au naturel. (The crew remained clothed and no hot drinks were served!)

Whilst I refer to this genuine flight in jest, the reality is we can achieve Friedman's goal of actually determining what items people might carry beneath their clothing using today's technology.

Yet, it is the procedures that will ultimately be key. The health issues require public debate and then the players in the industry need to "do a Susan Hallowell" and lead by example.

The privacy issues can also be managed with a little creative thinking. For example, the "fear of being seen naked" apparently diminishes if the screener is placed out of sight of the real passenger. In other words, if the screener can only ever see a stream of X-ray or millimetre wave images and never see the actual passengers in their dressed state, the privacy becomes much less of a factor.

Pat down searches are, in my opinion, both much more invasive and far less likely to result in the detection of a threat object. They also necessitate greater manpower deployment at screening points as male and female screeners need to be available to effect searches on persons of a similar gender. Given certain passengers homophobic attitudes even this can be cause for a conflict.

There is no doubt that both X-ray and millimetre wave imaging offers much greater screening potential than either metal detection or explosive detection technology, but we must remember that even these offer no guarantee against



Fly naked – one way of ensuring passengers do not carry weapons on board! Taken on board Naked Air's flight from Miami to Cancun on 3 May 2003.

assault by duty free bottles, fists or, as a passenger travelling on Thai Airways to Sydney in July this year discovered, even a fork from a meal tray. ☺

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