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Elements of a concept of operations (CONOPS) for preboard screening of passengers and their cabin luggage prior to boarding flights from US airports.

This paper is presented as an element in strategic planning of security adaptations needed to counter new forms of terrorist attacks against civil aviation. The paper particularly addresses the extant threat of suicidal terrorists bringing the components of an improvised explosive device (IED) through security checkpoints, assembling them, and then detonating the IED in the cabin of an airliner in flight. The Transportation Security Administration, as the operator of screening in U.S. airports, could use the CONOPS to guide design and systems integration of the new checkpoints that are now clearly required. We believe that the TSA, rather than pursuing research and development of new detection technologies, ought to review, select and carefully integrate items of detection equipment that have been available for several years

Other AIASP papers have shown the need for more effective screening of passengers and their cabin luggage than is currently provided by checkpoints in US airports. The papers have also pointed out that this high security screening requires considerably more space, equipment, staff, and time than the current screening processes. In this paper, we therefore suggest that high security screening can practicably be conducted only on a rationally selected fraction of passengers. Most passengers should be screened as they are now, and, in order to balance the overall system and prevent congestion at checkpoints, a third category of passengers - "registered travelers" - should have speedier and more convenient screening than the current norm. Registered traveler lanes are essential to the practicality of effective screening. To become registered travelers, applicants would undergo rigorous background checks, for which they would be charged. Most would be frequent flyers, the 30% of airline customers who make up 80% of passengers on any day. Validly identified aircrew would also use the registered traveler lanes.

Careful systems engineering will be needed to make high security lanes effective. Detectors and data need to be carefully integrated if small IEDs, or their components, whether carried by a single passenger or distributed among several passengers and their luggage, are to be detected and kept off airliners. Merely using individual "best of their kind" detectors will not achieve high enough performance over the broad range of threat items. Even more necessary is a comprehensive conceptualization of an effective preboard security process, from passenger check-in to final alarm resolution and boarding. That concept of operations would at a minimum have the following elements:

1. Check-in. "No fly" would-be passengers need to be identified as soon as their reservations are made, and arrangements made for additional steps such as arrest. There should of course be practically no possibility of a no-fly person obtaining a boarding pass on-line or at a kiosk. Instead, interlocks in check-in systems should direct such persons to the counters, where they would be identified as no-flys and dealt with appropriately.

2. Pre-screening. Categorization of passengers according to their threat levels must be nearly infallible in one respect: anybody who poses a threat to the flight must be selected to be screened in a high security lane. If a terrorist is instead sent to a normal screening lane, there is a shockingly low probability that the type of IED, or its components, that terrorists now carry will be detected there. This implies that the pre-screening system should be multi-layered. If any pre-screening layer indicates that the passenger should be a selectee, then that must be the pre-screening system's final determination, even if all other layers indicate non-selection. In turn that implies the possibility of a fairly high false positive rate in pre-screening. The false positive rate can be determined in advance of the screening system's implementation, by dry runs with representative passenger manifests. Dry runs will give checkpoint designers an essential datum: the expected numbers of passengers in each category (high security, normal, and registered traveler) by date and time.

3. Identification, categorization, and routing. Reception, identification and routing of passengers will become more complex when passengers are categorized by their risk levels. Selectees will have to be positively directed into the high security lanes and a record of their passage through them should be stored. Registered travelers (who have voluntarily undergone government checks to establish their low risk levels), aircrew, and many airport workers will be directed to expedited, less stringent screening lanes. All others will be directed into normal screening lanes. For this to work in all but the smallest, least busy terminals, more automation will be required. Security should be paramount in design of checkpoint entrances and passenger routing; convenience is a secondary though important consideration.

4. Target definition. A first step in designing high security lanes is to define the amounts, types, and configurations of explosives and other IED components that terrorists might attempt to carry – on their persons or in their luggage – onto airliners. This definition (the threat profile) is essential in the first place for selection, calibration, and integration of detection technologies, and secondly in order to instruct TSOs on the threat objects' appearance and feel, as well as their characteristic detection signatures. It must be kept in mind that if the targets of screening are not defined, they are unlikely to be found. Otherwise expressed: if you don't know what you're looking for, you have to be really lucky to find it.

5. Effectiveness goals. Before moving into selecting technologies and other components of high security lanes, the TSA, as the responsible authority, should set the required net probability of detecting and stopping any attempt to bring an IED or hijacker's weapon onto an airliner. It will make a vast difference if the required probability is 0.9 rather than a lower figure, say 0.6. But the Executive and Legislative branches, on a basis of high level strategic planning, should be of accord on the requirement and be prepared to back the TSA in achieving it, despite the costs and inconveniences that may ensue. The strategic plan, including the agreed upon required figure, should be classified.

6. Equipping the high security lanes. Given the detection targets and the required P_i (probability of interdiction, which is the product of the probabilities of automatic detection, successful alarm resolution, and finally preventing the attacker, IED or weapon from entering the cabin), the necessary combinations of equipment can be chosen. They must be chosen on the basis of the

performance of candidate technologies that might be linked orthogonally to screen people and their clothing or luggage: X-ray (transmission, multiple view, multiple energy, CT, diffraction, scatter), quadrupole resonance, dielectric constant, nuclear methods, ion mobility and mass spectrometry, millimeter wave, various chemical reagents, etc.

The high security lanes would be designed, built, tested, and deployed as single multi-technology operating units, in much the same way as ships and airplanes are. The system design would include the capability to trade out or add different technological components with minimal trade-out and testing times, in order to adapt effectively to changes in the threat profile. The resulting system would be required to meet the determined probability of interdiction, P_i. It is then likely that there will be a high false positive rate from the system, and it will remain to be proved that TSOs, no matter how well trained, can be successful in ultimate alarm resolution by manual and visual searches. In the case of positives on people, the ultimate alarm resolution could cause considerable inconvenience and embarrassment, and take a great deal of time. To avoid this, the designers of high security lanes must give priority to achieving high P_i without inflicting excessive inconvenience or embarrassment on innocent passengers. Resolution of alarms may be the most difficult part of the screening process, particularly because the ratio of false positives to true detections of real IED components will be hundreds of millions to one. (Firearms and knives will be found much more frequently, but only a tiny fraction of them will be carried by terrorists.)

7. <u>Evaluating threats distributed among several passengers and their luggage.</u> The intertwined challenges of detection and alarm resolution are aggravated by having to take account of terrorist teams, in which several members may each carry, on the person or in luggage, just one or two IED components, with the intent of assembling them in the sterile area or on the airliner. To deal with that particular threat, each stage of the screening process must communicate its alarms on possible IED components, even if they are subsequently resolved as negative, to a central integrator. At that point, several such alarms, though resolved as negative, on different passengers on a single flight, could be integrated to give an indication of a possible team attack in progress. This would require even more intensive re-screening. The design of the high security lane would therefore require brilliant intersystem integration software programs to provide timely indication and warning, if any team attempt is to be interdicted prior to the targeted flight departing from its gate, and without making the screening process intolerably time-consuming. *(A separate AIASP paper addresses in more detail the design requirements for detection of bomber team attempts.)*

8. <u>Communication with hold baggage screening.</u> There are circumstances, such as detection of explosives traces on a passenger or his/her luggage, which require more intensive screening of that passenger's hold baggage. Rapid, dependable communications between the checkpoints and hold baggage handling/screening is therefore essential. Fast, reliable identification and location of luggage (cabin and checked) and passengers will also be essential.

9. <u>Staffing and training.</u> The high security lanes must be staffed adequately with competent, well-trained TSOs. Their instruction has to be thorough. Staffing levels must take into account

the time required for initial and recurring training, which may take weeks per year and thus add significantly to the number of personnel required.

10. Operational capacity assessment. Knowing the technological and procedural components of the high security lane, the time taken per passenger from entrance to exit, throughput per unit of time can be calculated. That figure combined with the expected number of passengers selected by the pre-screening system (element 2), will, along with the application of queuing theory, determine the number of high security lanes needed in particular checkpoints. That may result in realization that certain checkpoints' floor area has to be expanded, that more space is needed.

11. Testing, Testing is essential for validating the expected P_d of component technologies and overall P_i; ensuring that equipment is calibrated to detect the target IED components; identifying needed redesign of layout and processes; for feedback to staff members, supervisors and managers on the performance of staff; and finally as a basis for constant performance improvement. The automatic detection of equipment can be easily tested, either with simulants or if necessary with live IED components, outside the hours of checkpoint operation. Testing the overall system performance, particularly its human elements, will require testers to have high competence and ingenuity. Likewise, developers of explosives simulants with the necessary verisimilitude for several orthogonal detectors and manual procedures will face considerable challenges.

12. Overload management. Despite being designed for accurately predicted required throughput, high security lanes may occasionally come close to overload, due to factors such as equipment malfunction or high staff absence during epidemics. When overload becomes imminent, it should be prevented by temporarily lowering the pre-screening system's selection rate. One way of doing that would be to stop random selections. Otherwise, the score for selection could be marginally adjusted. Changing the selection rate is a preferable alternative to permitting expedited, lower P_d screening processes within the high security lane. There is ample evidence from the checked baggage screening program that permitting faster, less labor intensive, lower P_d screening processes, at the TSO supervisor's discretion, soon leads to abuses and erosion of screening diligence.

These elements provide the conceptual framework for achievable improvements in security for all who fly on airliners. They can be implemented by using technologies, controls, and data management tools that are widely available today.