

The year is 2070 *ad*. Airports have changed a lot since the beginning of the century, but terrorist attacks are hardly a thing of the past. Anti-terror technology has improved substantially, arguably to compensate for the sheer irrationality of mankind when it comes to resolve issues such as economic greed, religious fanaticism, and group favouritism, all of which remain with us from evolutionary times when they may have been useful.

Airports are now completely staffed by robots, specially London Heathrow, where different robot models are employed for various specific tasks. In particular, security is now completely under the control of specialised robots: due to a legacy from XX and early XXI century, Heathrow is still number one... terrorist threat target, that is. The majority of the staff, however, is formed by CPH903 robots. These are **cute, polite, handy** robots who welcome people into the airport, give them a “hand” with pieces of luggage (e.g. lifting them to place on a trolley), and, of course, provide any information (in natural language, also using multi-media presentations whenever useful) that costumers may need.

Most of the security-related tasks are carried out by model MDS79 robots. The **multi-device security** robots are very expensive pieces of equipment, as they are endowed with all that technology can provide, in 2070, for bomb detection. They use advanced versions of the technology in use by the beginning of the century: x-ray, metal detectors, and computed tomography for detecting explosive devices, ion trap mobility spectrometry (ITMS) for detecting traces of explosives, as well as equipment for detecting radioactive materials (gamma ray and neutrons) used in “dirty bombs”.

These days at Heathrow, check-in and security checks are no longer centralised, being carried out directly at the boarding gates. Thus, there are one or two replicas of robot model MDS79 at each departure gate. When unattended luggage is reported, all staff in the vicinity are informed of its location through a wireless local area network to which they all are connected. The robots then start a process of negotiation (with a very tight deadline for a final decision) in order to reach an agreement on which of them will be relocated to handle the unattended luggage report.

All staff robots know that, *normally*, one MDS79 and one CPH903 robot can cooperate to ensure that reported unattended luggage has been cleared away. The way they actually do it is as follow. The MDS79 robot replica uses all of its devices to check whether there is a bomb in the unattended luggage. If there is any chance of there being a bomb in the luggage, the MDS79 robot sends a high priority message to the bomb-disarming team of robots. (Obviously, robots communicate using speech-act based languages, such as those used for agent communication since the end of last century.) Only three of these very specialised robots are operational for all Heathrow terminals at the moment. Once these robots are called in, the MDS79 and CPH903 robots that had been relocated can go back to their normal duties. The bomb-disarming robots decide whether to set off a security alert to evacuate the airport, or alternatively they attempt to disarm the bomb or move it to a safe area, if they can ensure such courses of action would pose no threat to the population.

In case the MDS79 robot detects no signs of a bomb in the unattended luggage, the job is passed on to the accompanying CPH903 robot. Luggage these days usually come with a magnetic ID tag that records the details of the passenger who owns it. Replicas of robot CPH903 are endowed with a tag reader and, remember, they are heavily built so as to be able to carry pieces of luggage (unlike MDS79). Besides, MDS79 are expensive and much in demand, so they should not be relocated to carry the piece of luggage after it has been cleared. So, in case the luggage is cleared, it is the CPH903 robot’s task to take the unattended luggage to the gate where the passenger is (details of flights and passengers are accessed through the wireless network) if the passenger is known to be already there, or to the lost luggage centre, in case the precise location of the passenger in the airport cannot be determined (which is rather unusual these days).

In summary, the way that one MDS79 and one CPH903 robot can cooperate to bring about a state where the the unattended luggage has been cleared away is as below, possibly with slight variations in the order of some of the actions:

1. The MDS79 replica moves to the location of the unattended luggage.
2. The CPH903 replica moves to that same location.
3. MDS79 runs all of the security checks *normally* available to it:

- (a) x-ray, metal detector and computed tomography to scan for explosive devices;
 - (b) the ITMS equipment to check for traces of explosive substances;
 - (c) and finally the radiation detection system to check for dirty bombs.
4. If nothing suspicious is detected by MDS79, then:
- (a) MDS79 informs CPH903 that it is safe to pick up the luggage;
 - (b) CPH903 picks up the luggage and takes it either to its owner or to the lost luggage centre.

Otherwise, MDS79 calls the team of robotic bomb-disarmers.

Thus, all staff robots have, as part of their knowledge representation, that *normally* a MDS79 robot and a CPH903 robot can cooperate to eventually bring about a state where the unattended luggage has been cleared away. The robots use this formula to take action when unattended luggage is reported. They negotiate (for a very limited period of time, after which a quick overriding decision based simply on distance to the unattended luggage is used) so as to determine the best group of robots to be relocated to sort out the incident. Ideally, the MDS79 robot to be relocated will be currently at a gate where two MDS79 robots are available, to avoid excessive delays in boarding at that gate. Robots of type CPH903 are easy to relocate as they exist in large numbers and do not normally execute critical tasks.

An important aspect to note is that the whole negotiation process, under normal circumstances, is about the specific MDS79 robot to be relocated, and the choice of one CPH903 robot to help out. On the 9th of May 2070, at Heathrow, an unattended piece of luggage was reported near gate 54. It turned out that the robot with ID S39 (an MDS79 replica) was helping out another MDS79 in charge of gate 56 close by. It immediately volunteered to check out the reported unattended luggage, and so did H124 (a CPH903 replica). On running a self check, S39 realises that its internal ITMS equipment had just been damaged, which it reported to other robots involved in the negotiation.

In the light of that recent information, negotiation was resumed among the involved robots, to try and define an alternative course of action. Another MDS79 robot (s_2) could have been relocated, which would have led to delays at one of the nearby gates (gate 52), as that MDS79 robot was alone taking care of security at that gate. Based on an argument put forward by S39, the agreed course of action was that another (suitably positioned) CPH903 robot would be relocated to take (from a storage facility in that terminal) a handheld ITMS device, while S39 and H124 made their way to the location of the unattended luggage. Any of the three relocated robots can actually operate the portable ITMS device, so together they can also bring about a state of affairs where the unattended luggage has been cleared away.