With current technology prediction errors in Low Earth Orbit (LEO) are frequently greater than the estimated separation distance between objects undergoing conjunction. Current predictions are thus frequently false alarms, and real collisions have been missed resulting in expensive losses. The February 2009 collision between the active Iridium 33 and the inert Kosmos-2251 was predicted to have a miss distance of 584 metres, but this was less than the error, and so the prediction was ignored, and the actual collision and destruction of Iridium-33 came as a complete surprise.

As well the inherent errors in existing ground based measurements of spacecraft, a significant problem for satellite tracking and collision prediction is the lack of coverage of ground stations. Less than 20% of the Earth's surface area is suitable for siting ground stations [plus a limited number of isolated island sites]. For example, for BDS [a Chinese navsat system], inadequate ground stations and the poor distribution of the network have limited the accuracy of BDS orbit determination.

The increasing flux density of orbital objects is driving the community to improve orbital determination of all space objects, or as many as possible. Recently studies have determined that collision prediction accuracy can be greatly improved for spacecraft who carry on board GNSS transponders. We are developing a system using autonomous tracking devices (an application of our Pixie nanospacecraft) which are attached to a host satellite and communicate accurate location data autonomously of the main spacecraft. The data collected is sent to a central Earth station via an established satellite relay from the device. This intersatellite link is available continuously without regard to the position of the host satellite relative to the Earth's surface (e.g., whether it is over regions with no tracking stations). Consequently, positional and velocity data of the host satellite is available without gaps, allowing greatly improved knowledge of the orbital parameters and position of the host satellite versus existing methods. The attached device contains several sensors including a GPS or GNSS receiver, which allows determination of the host spacecraft position accurate to within 10 metres or better, compared with one kilometre (or worse) for conventional ground station methods. The improved knowledge of spacecraft position will allow greatly improved predictions of collisions between space objects, by orders of magnitude versus the existing technology, and yet is cheaper than the less accurate methods using ground stations.

It is difficult to quantify the economic damage due to space object collisions since commercial operator might not publish all collision events, preferring to keep them confidential. Nevertheless, it is widely agreed that economic impact can be severe. In addition, damage to the International Space Station is a major concern, it is the largest "target". Furthermore, it is becoming increasingly difficult to correctly identify the increasing number of satellites. There have been recent launches of multiple spacecraft on a single vehicle in which radio contact was not established with many of the objects, and hence it has become impossible to identify them. This is a concern for several reasons, including liability. Attaching Pixies will resolve this problem.

Over time, the improvement in knowledge of space object position by installing the Pixie black boxes will reduce the number of collisions by improving positional knowledge accuracy and reducing the number of false alarms. Collision avoidance maneuvers can be planned and executed in a more controlled and reliable manner, reducing expenditure of propellant. Once Pixies have been successfully demonstrated then it is entirely possible that the international community could mandate the use of Pixie black boxes to be attached to all spacecraft, in a similar manner than Flight Data Recorders and Cockpit Voice Recorders are mandated on most passenger aircraft.

The large quantity of new more accurate space object positional data generated will facilitate new methods for organizing large numbers of rapidly moving space objects. New algorithms will be developed to optimize multi-dimensional positional knowledge and situational awareness. Artificial intelligence would be appropriate to leverage the new data pool. Improved conjunction predictions will be facilitated, and probabilistic risk assessment methods should be applied to assist decision making, e.g. when to initiate collision avoidance maneuvers. Potentially this decision making could be automated.