

# Report: High Altitude Wireless Network for Disasters

Mikio Suzuki, Ryu Miura and Hiroyuki Tsuji

National Institute of Information and Communications Technology

The most effective way to rescue in disasters should be the approach from air when the ground road or communication facilities and cables suffered crushing damage by a disaster or when activity on ground was completely paralyzed with a fire and a muddy stream, the building which collapsed, danger of a poisonous gas more.

Under the information-oriented society of late years developing rapidly, when a hindrance appeared to communication infrastructure by a natural disaster such as an earthquake, a typhoon and an unexpected accident, the serious damage should be done as it shakes human life and society base. A study of the wide area aero wireless technology that should be temporary deployable in emergency those would be used as the communication platform on the local environment and the temporary event time, or as the search inquiry and communication infrastructure for search rescue is expected.

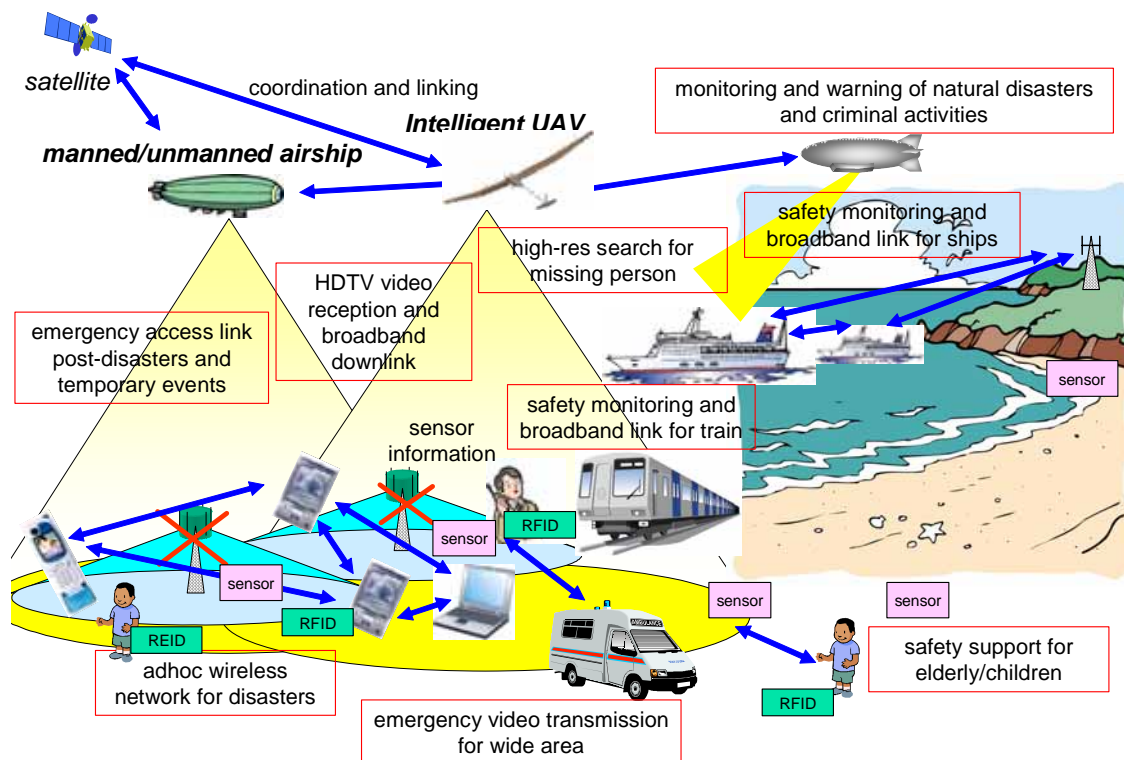


Fig 1 . Concept of wide area wireless system

On the other hand, there are the present conditions that maintenance of communication infrastructure does not readily advance in a remote area and an a population of depopulated area because in those area it does not concentrate on a prospect of profit from an urban region although a cellular phone and expansion of speedup and service of wireless LAN advance around an urban region while there is strong needs to high speed

radio communication to be usable in a wide area without choosing a place. In addition, it is the present conditions that there are marked difference in the communication environment in a passenger moving on the Sinkansen and a long-distance train and a crewman such as a ship coasting.

**1. The wide band radio relay experiment that assumed emergency by Zeppelin NT airship**

In late years technology of an array antenna has been matured, so the possibility that could introduce the wide area radio system to the train which moved a depopulated area and coast ships in cost comparatively low, by installing it in an as possible good high place with installed many elements on.

National Institute of Information and Communications Technology did a conceptual design of a wide area wireless system with many elements array antenna to realize such a system and also developed many elements array antenna device for base station and transmission and reception device. And in 2006 those were equipped to Zeppelin NT airship that are commercially operated in the Japan sky and carried out a flight experiment.

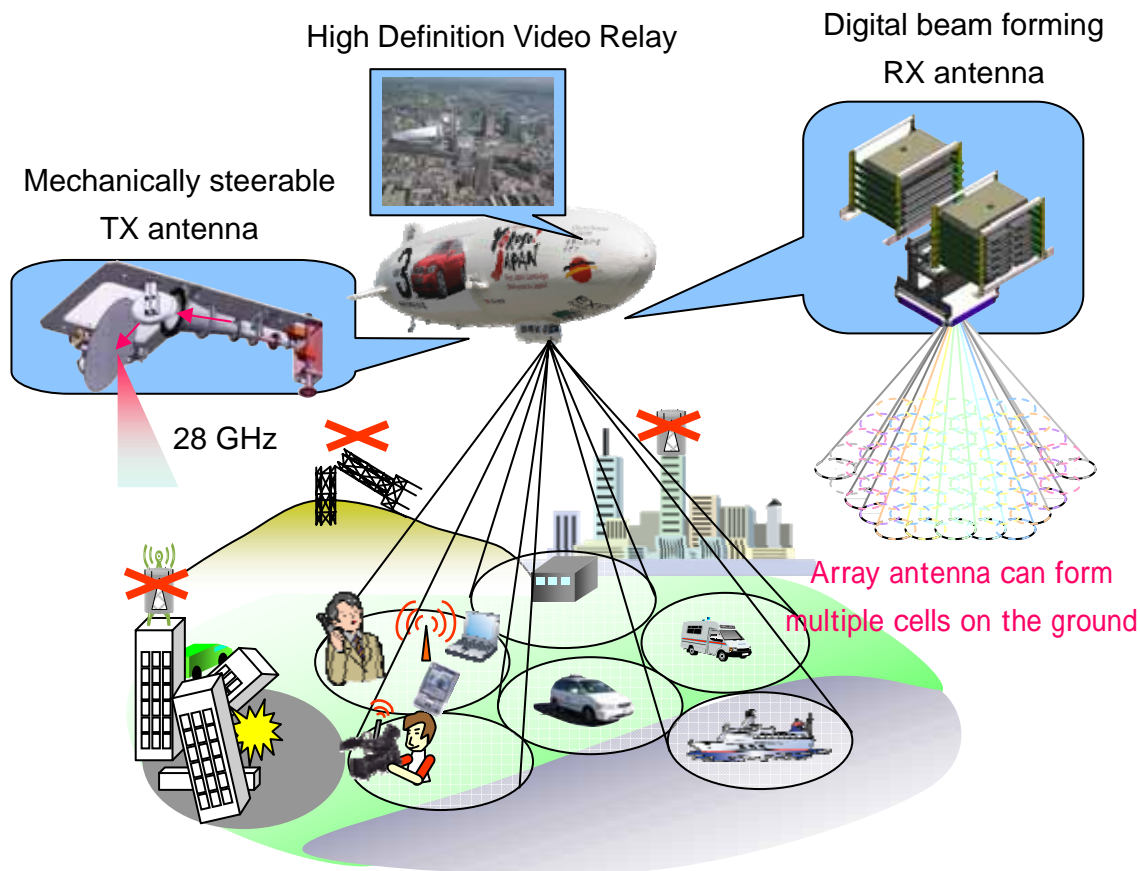


Fig 2 . Outline of Experiment

Many elements array antenna used DBF technology with multibeam to many portable stations from good base station connected to IP net should be realized wide area wireless system that could achieve the IP wide band wireless connection. In the case of portable station, those would be loaded to Shinkansen and ships coasting and are connected with base station by wireless radio, and in the case of base station those are the fixed relay station with antenna connected to base station. Those fixed relay station should make wireless LAN hotspot around the cabin of Shinkansen and ships and so on, or around the base stations, so end user can connect to IP net using handheld PC with LAN and receive internet service, E-mail, IP telephone, file transfer, remote access to another PCs.



Fig 3 . Airship and equipments loaded in cabin



Fig 4 . Cockpit and quiet cabin



Fig 5 . High definition video camera and mobile station

The wireless communication experiment simulated the construction of temporary telecommunication line at the time of a disaster in Saitama and Tokyo where there was a base of an airship from December 2006 to January 2007, and it was carried out that the realization of high speed communication of 50 Mbps using Ka band (28/31GHz) and high definition video transmission by IP communication, Internet, confirmation of an E-mail, simultaneously 81 beam forming ability by 100 elements array antenna.



Fig 6 . 100 elements DBF Antenna

## 2. Mobile Localization Experiment Using Unmanned Aerial Vehicle (UAV)

As for the position information of a radio station terminal radiated electromagnetic wave, the use to various fields such as control of an antenna, a search of a victim, monitor of an illegal radio station, a position inquiry of an urgent report are expected. NICT dispersed widely and arranged an array antenna on the main wing and the body of a plane constituted wide opening array and developed system which identified the position by measuring an arrival direction of an electric wave from ground in resolving power from high altitude and calibration system of phase deference. In November 2006, it was equipped with an array antenna on Unmanned Aerial Vehicle (UAV) in U.S.A. and tested it.

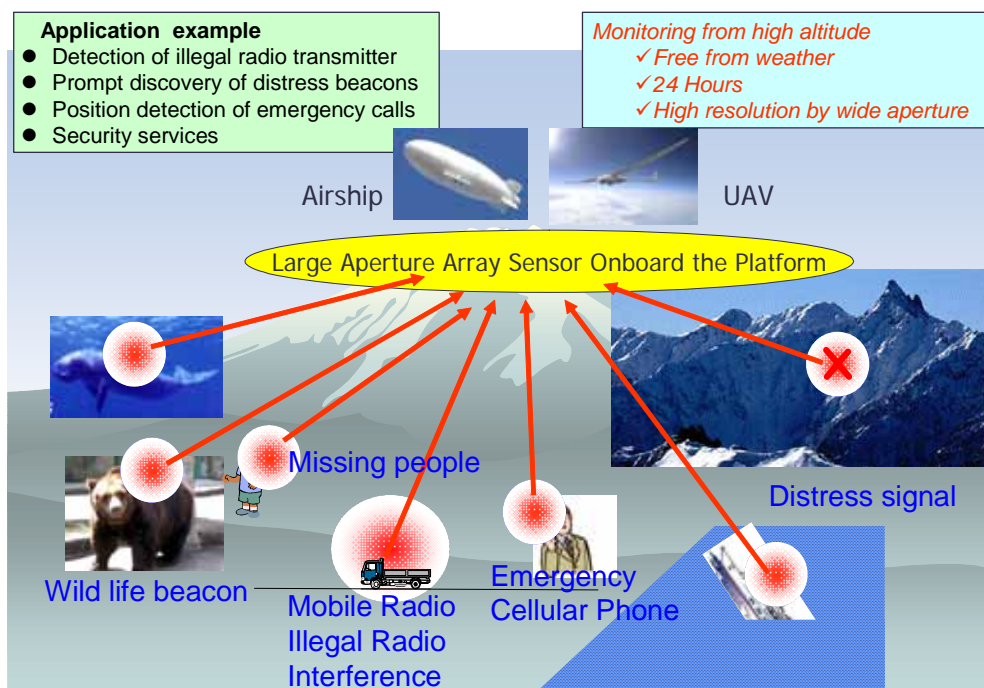


Fig 7 . Concept of Mobile Location Estimation from High Altitude

Global observer prototype (length of a wing 15m) made by Aerovironment in USA was used and the array antenna were posted four elements under the body and each 2 element under the lower part of right and left wing in every inequality. On the ground, five reference stations known those positions were distributed, and those radiated reference signal with calibration data and about an altitude of 300m flew UAV. We aimed at the real time measurement in the future, but we saved data in memory at rate 508Hz by an experiment on board and did an offline calculation.

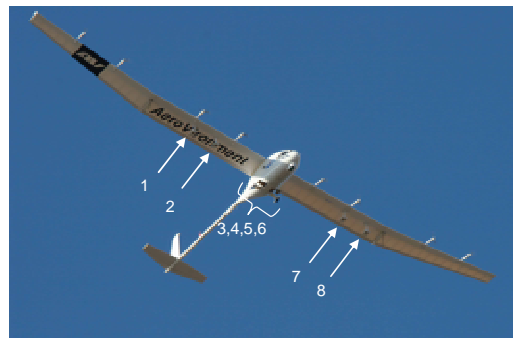
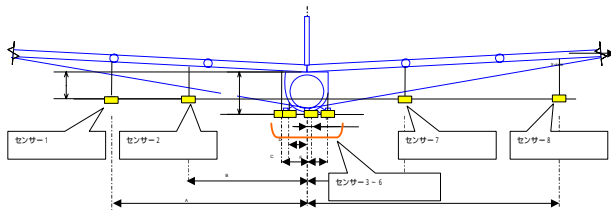


Fig 8 . Array antenna loaded on wing and body

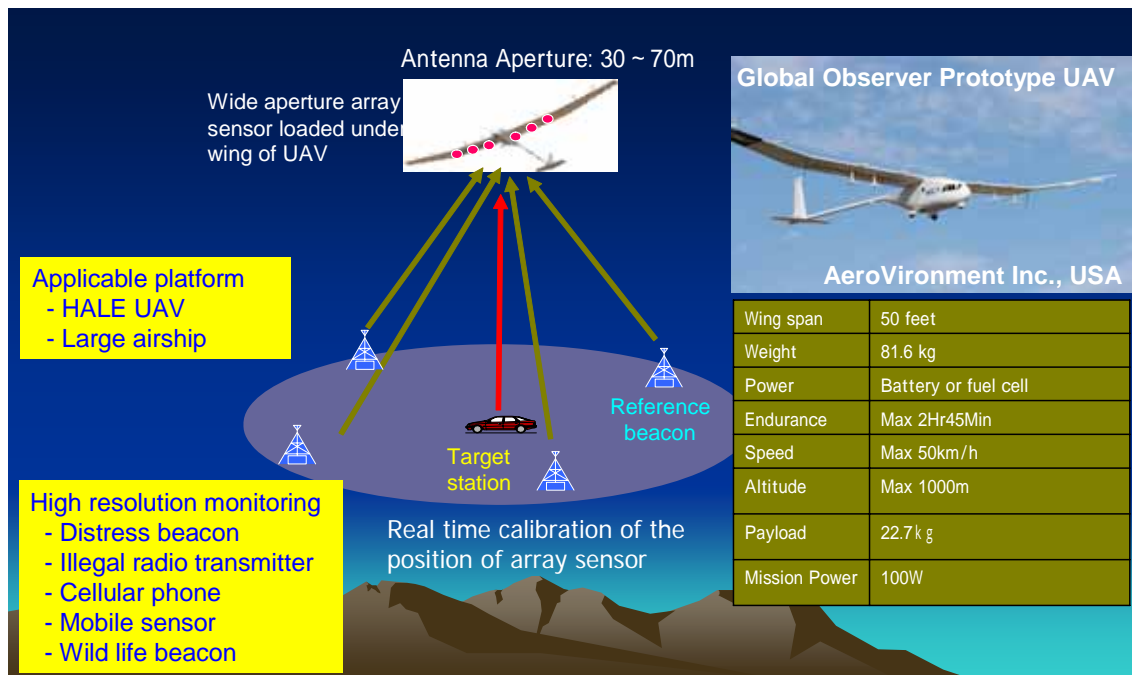


Fig 9 . Outline of Experiment

Resolving value 0.1 degrees and position estimate error about around 1.2m were got when antenna element position and inside phase error were calibrated with a signal of the reference station at the same time and estimated with applied MUSIC method.



### 3. Summary

Aero wireless communication system which can cover a wide area should apply it to security, search rescue of wide area and wide band communication on emergency by loading those to an unmanned plane and airship in the future. And those systems are expected to be permanent communication infrastructure for relief security. In addition, mobile location estimation is effective tool like a search of a victim and a position inquiry of urgent report as national security besides monitoring of an illegal radio station, so NICT will continue to carry the demonstration test using Zeppelin NT airship with array antenna on it after this year.