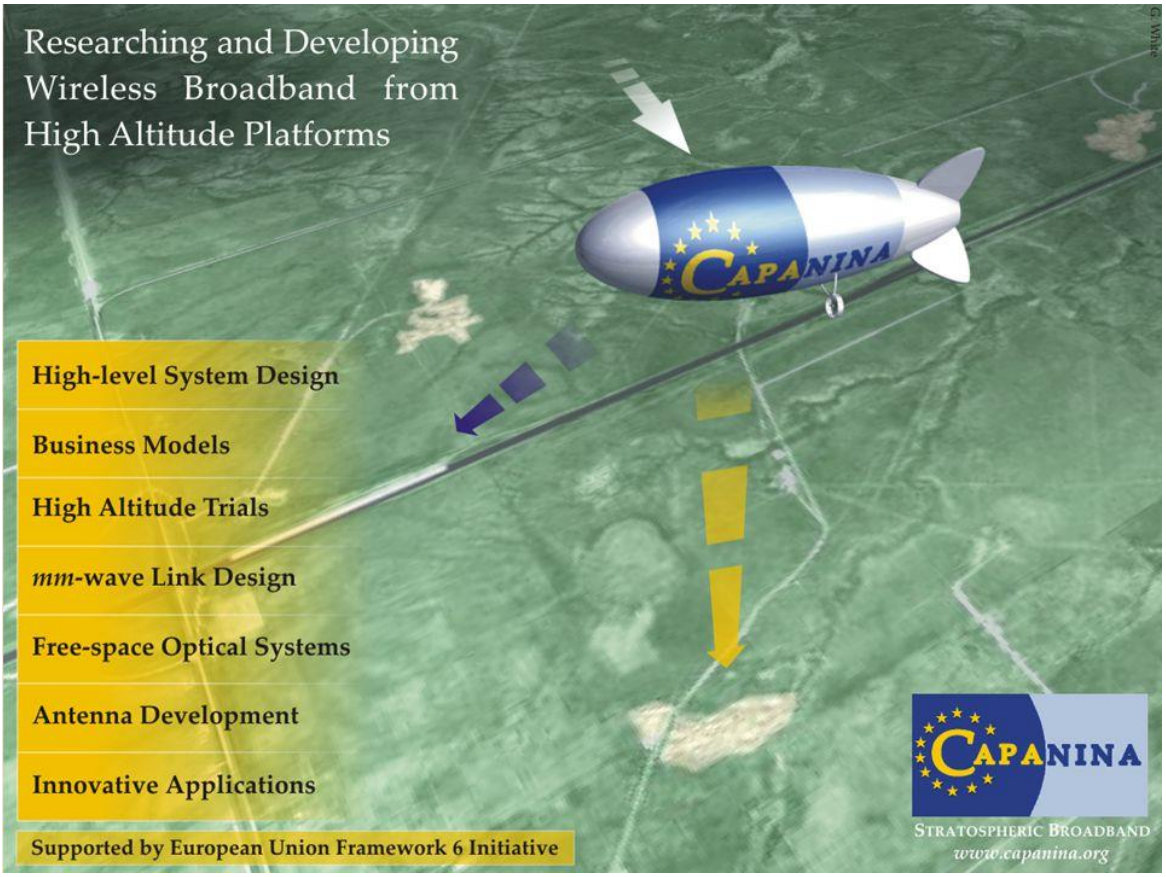
CAPANINA Stratospheric Broadband

Peter Lobner, 3 April 2021

1. Introduction

CAPANINA was a European Union (EU) project led by the Communications Research Group at the University of York, UK, with the goal of delivering “Broadband for All.” CAPANINA was partially funded by the EU under their Framework Program 6 (FP6) during the period from January 2003 to January 2007 and was considered to be a Specific Targeted Research Project (STReP). This means it was a mid-sized project that involved partners in several EU countries. CAPANINA had 13 partners, including Japan’s National Institute of Information and Communications Technology (NICT) and Japan Stratosphere Communications. Total funding for the four-year project was €5.6 million, including €3.1 million from the EU.



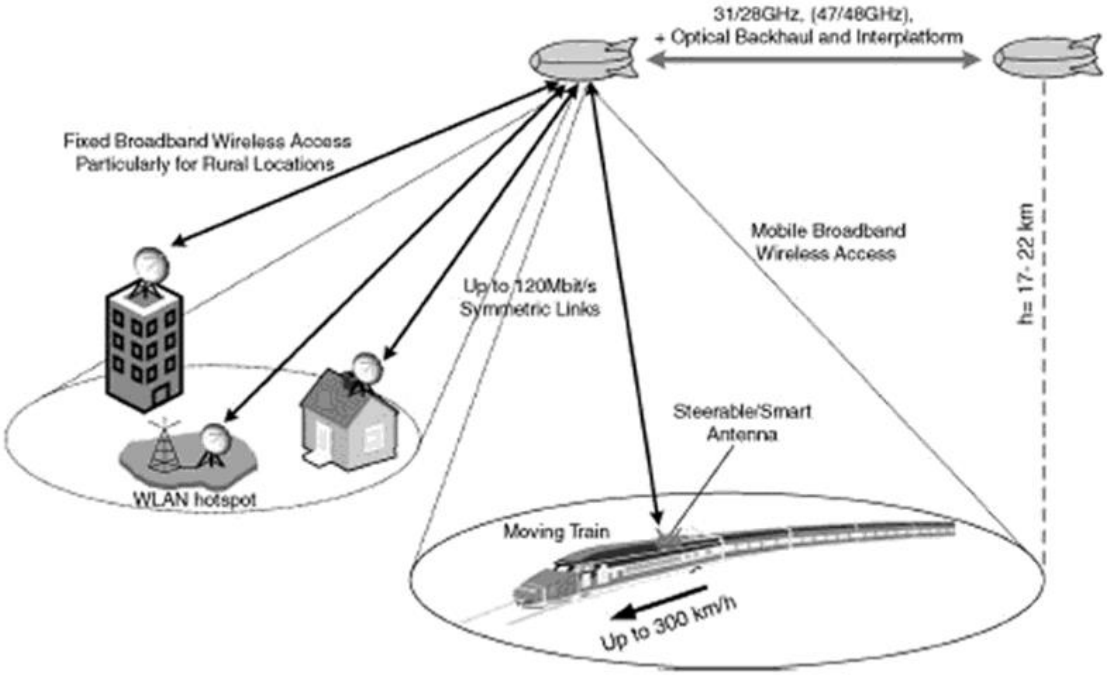
Source: capanina.org / University of York

While the project is now finished, the University of York maintains the CAPANINA website roughly as it was in 2006. These web pages and their links are not being updated, but are available for reference here: https://www.york.ac.uk/electronic-engineering/research/communication-technologies/projects/capanina/

2. The CAPANINA architecture

The CAPANINA team developed and demonstrated wireless and optical broadband technologies in the context of an airborne broadband network system architecture for delivering communication services from a variety of High Altitude Platforms (HAPs), including airships and fixed-wing aircraft. From a target altitude of 20 km (65,000 ft), the service area for a single HAP is about 60 km (37.3 miles) in diameter.

The basic system architecture, with networked HAP airships providing broadband access particularly for fixed rural locations and mobile users on high-speed public transportation (trains and buses), is shown in the following diagram. Millimeter wave and free-space optical data links among HAPs will expand the service area.



CAPANINA system architecture.
Source: Grace & Mohorcic, Wiley, 2011

CAPANINA network applications include:

- Communications backbone for rural areas and
- Broadband and 3G cellular communications for developing countries
- Disaster management / event servicing
- Environmental monitoring
- Homeland security
- Military applications

The first trial of the CAPANINA system architecture occurred in the UK between August and October 2004 using a tethered aerostat at an altitude of 300 m (984 ft). The trial successfully demonstrated fixed broadband wireless access, end-to-end user connectivity for internet and on-demand video services, and optical communications.

The second trial was conducted in Sweden using a stratospheric free balloon (no station-keeping capability) on a single nine-hour mission. The trial demonstrated the integration of a multi-payload system and successful use of several broadband applications. The balloon payload included the CAPANINA Stratospheric Optical Payload Experiment (STROPEX), which successfully demonstrated the use of a 1.25 Gbit/sec HAP-to-ground data link.

The third and final trial occurred in November 2006 in California aboard the AeroVironment (AV) Global Observer fixed-wing prototype, which was limited to low altitude flights. The trial demonstrated station keeping and altitude models that also applied to HAPs.

3. The notional CAPANINA stratospheric airship

The CAPANINA team developed a concept for a high-altitude airship that was designed to transmit broadband Internet data to stationary and moving users at rates of up to 120 Mb/s. The airship would be about 200 meters (655 ft) long, weigh 30 metric tons and carry a 1 metric ton payload to a target altitude of about 20 km (65,000 ft), well above the jet stream. The team claimed the use of proprietary “lifting-gas technology” for high altitude operations. The airship’s flight

control and propulsion systems would be able to maintain a geostationary position in the stratosphere within 1 km (0.5 nm) of an assigned location. A hybrid solar electric power system would power airship systems and the communications payload and enable the airship to remain on station station for three years.

CAPANINA notional stratospheric airship.
Source: capanina.org / University of York

4. For more information

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https://www.researchgate.net/publication/237397137_CAPANINA_-_Communications_from_Aerial_Platform_Networks_Delivering_Broadband_Information_for_All/figures?lo=1

- Rob Coppinger, “Europe set to fly internet airship,” FlightGlobal, 31 December 2005: https://www.flightglobal.com/europe-set-to-fly-internet-airship-/63493.article
- D. Grace & M. Mohorcic, “Broadband Communications via High Altitude Platforms,” Section 1.5.3, “Capanina,” ISBN-13: 9781119957553, Wiley, 2011