An Overview of the CAPANINA Project and its Proposed Radio Regulatory Strategy for Aerial Platforms

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Introduction

This document discusses the future radio regulatory strategy for aerial platform based broadband communications, proposed by the European funded FP6 project CAPANINA, which is examining delivery of broadband to fixed and mobile users from aerial platforms. This is placed specifically in the context of the ITU-R spectrum sharing activities underway in Working Party 9B, which is undertaking studies on the more narrowly defined High Altitude Platform Stations (HAPS).

A brief overview of CAPANINA is presented first, concentrating on the issues pertinent to the radio regulatory strategy and future commercial exploitation of the technology. This is followed by a description of the proposed strategy, which identifies how we propose to influence the technical area. To highlight the additional benefits to the wider aerial platform constituency, relevant commercial organisations and other special interest bodies outside of CAPANINA are then presented. This is followed finally by conclusions.

CAPANINA Overview

CAPANINA is 3-year research project that commenced on 1st November 2003. A consortium of 14 partners is involved, representing a mixture of large industry, SMEs, and academia/research organisations [1].

CAPANINA is focussing on development of low-cost broadband technology from HAPs aimed at providing efficient coverage to users who may be marginalised by geography, distance from infrastructure, or those travelling inside high-speed public transport vehicles (e.g. trains travelling up to 300 km/h)[2]. The aim is to exploit this future wireless technology to deliver burst data rates to users of up to 120 Mbit/s anywhere within a 60 km coverage area. Both mm-wave band and free space optical communications technologies are being considered.

The project is adopting a three-strand approach:

1. Identification of appropriate applications and services and associated business models. This includes establishing the most appropriate integrated network architectures, and will include

[1] CAPANINA Partners are: University of York (UK)·, Jozef Stefan Institute (Slovenia), Politecnico di Torino (Italy), Universitat Politecnica de Catalunya (Spain), Carlo Gavazzi Space (Italy), Budapest University of Technology & Economics (Hungary), DLR (Germany), BT (UK), SkyLINC Ltd (UK), EuroConcepts Srl (Italy), CSEM (Switzerland), Contraves AG (Switzerland), National Institute of Information & Communications Technology (Japan), and Japan Stratosphere Communciations.

[2] More information can be found at: www.capanina.org, or D. Grace, M. Mohorcic, M. H. Capstick, M. Bobbio Pallavicini, M. Fitch, Integrating Users into the Wider Broadband Network via High Altitude Platforms, IEEE Wireless Communications, Vol. 12, No. 5, October 2005

wireless and free space optical link technologies, multiple platform technologies and spectrum sharing.

The business models take into account future developments in HAPs and broadband technology. This work has been led by BT (UK), with additional work being carried out by Budapest University of Technology and Economics (HU) and the University of York (UK). Key applications include event servicing/disaster relief communications, high speed Internet, backhaul for WiFi hotspots. These models will help ensure the eventual commercial exploitation of this technology. A key output of the project will be a roadmap for broadband service delivery from aerial platforms, highlighting what can be achieved in the short, medium and long terms, and the critical technology and regulatory advances that are required at each stage.

2. The development of a system testbed that will allow nearer-term tests of broadband services/applications to fixed users. Two practical technology trials have been carried out to date:
    - Trial 1 took place in Pershore, UK in the period August-October 2004, organised by SkyLINC Ltd, BT, and DLR. The vehicle used was a tethered platform operating at 300m altitude. A variety of broadband applications were tested, including high speed Internet, video-on-demand, hot-spot backhaul.
    - Trial 2 took place in Kiruna, Sweden on 31st August 2005. A free-floating stratospheric balloon was used. In the 9 hour mission the balloon reached altitudes of 25km and supported link lengths of 60km. A low cost, lightweight payload delivering mm-wave broadband wireless LAN was tested by University of York, and achieved throughputs of 4Mbps. DLR tested a free space optical platform to ground link at 1.25Gbps. Partners contributing to the trial were Carlo Gavazzi Space, University of York, Euroconcepts, DLR and CSEM.

    The key purpose of these trials was to examine the technical viability of developing hardware for such an environment and the constraints imposed by the platform. A third trial is scheduled for 2006.

3. Longer-term state-of-the-art research and innovation examining advanced mobile broadband wireless access. An outline system design and critical hardware will be developed for a scenario that will deliver broadband to trains, integrating with on-board wireless LAN base stations.

Spectrum Sharing & Spectrum Management

The University of York and National Institute of Communications and Information Technology (Japan) are undertaking the majority of the work on spectrum sharing.

The use of aerial platforms for the delivery of broadband communications requires a multi-stranded approach to radio regulation. The ITU-R has chosen to define the concept of a High Altitude Platform Station (HAPS), which would operate between the altitudes of 20-50km, differentiating it from satellite and conventional terrestrial Fixed Services (FS). To date worldwide radio regulatory strategy has been based on requesting use of little used frequency bands, e.g. 47/48GHz (available for primary services worldwide) and 31/28GHz now available in 40 countries (with HAPS given a secondary status, operating on a non-harmful interference, non-protected basis[3]). Frequency bands for the delivery of 3G from aerial platforms have been made available on a worldwide basis. The

[3] The status of "FS using HAPS" in the bands are described in the Footnotes 5.537A and 5.543A of Radio Regulations, which stipulate that the use of the bands 31/28 GHz by systems using HAPS shall not cause harmful interference to, nor claim protection from, other types of fixed-service systems.

current HAPS definition covers a subset of proposed aerial platform deployments, but the HAPS frequency allocations are used to enhance the whole aerial platform sector's market potential, thereby helping to reduce risk and ultimately to facilitate investment.

The biggest handicap on furthering the radio regulatory process for aerial platforms has been the absence of commercial craft available in the near term, which has meant that other more established technologies have received priority access to the spectrum. This poses a classic chicken and egg scenario, which calls for new thinking and ultimately a multi-stranded approach. CAPANINA partners will contribute to the ongoing regulatory aspects, through national, European and international regulatory bodies. As mentioned above, in parallel they are undertaking technology trials from different types of aerial platform using experimental licences granted for the bands in different countries, e.g. UK, and Sweden, as well as undertaking long-term research into spectrum management.

The CAPANINA Position on Proposed Frequency Bands for Aerial Platforms

To operate aerial platform technologies commercially will require appropriate spectral allocations. Broadband applications delivered from HAPS within Europe on a permanent basis at the moment require 48/47GHz to be used, but for large parts of the world the 31/28GHz bands (the CAPANINA preferred frequencies) are already licensed. The fact that 31/28GHz is available means that there is already a large potential market for this technology, significantly reducing the commercial risks. Export potential of HAP technology will almost certainly be much greater than the European home market. Developing markets will be the proving ground for long-term broadband applications from aerial platforms, due to their advantageous geographical location and specific technology requirements. Spectrum is already available in such markets. European markets will initially be focussed on event serving/disaster relief situations and other short-term missions. These can operate under a temporary or an emergency licensing regime. Spectral allocations for permanent services can then follow, facilitated by demonstration of an increasingly proven technology.

CAPANINA has partners and influence across the world. We are keen to ensure that the requirement to influence the regulatory process is not used as an inhibitor to the commercialisation of aerial platform technologies. The strategy described below will ensure that the risks of this happening are significantly reduced. Aerial platforms do not need long-term allocations of spectrum now. They will first need experimental licences, followed by temporary operating licenses, and then finally permanent spectrum (within Europe) ideally within the 31/28GHz bands, or technology equivalent bands.

The lack of commercially available technology should not be used as a barrier to regulatory body submissions from Europe, which contain factual technical data describing possible aerial platform operating scenarios. Europe must play a full part in the worldwide deliberations on the merits and drawbacks of aerial platforms operating in these bands.

Radio Regulatory Strategy

We consider it important that CEPT, as the regulatory body for Europe, is informed of our strategy towards frequency allocations in Europe for aerial platforms, a strategy that is driven by sound technical analysis and commercial requirements. A white paper will be produced detailing the strategy and delivered direct to relevant people within CEPT or via national regulatory bodies. Figure 1 illustrates the paths open to CAPANINA.

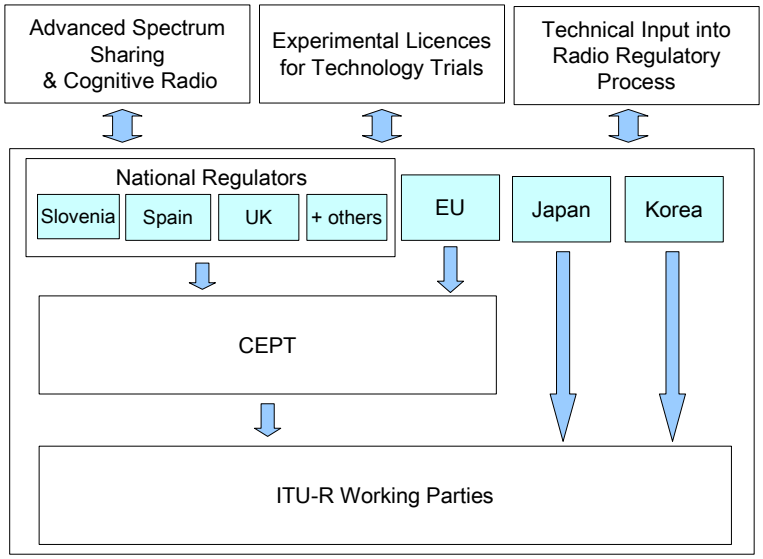

Figure 1 CAPANINA approach for influencing the radio regulatory environment

The CAPANINA approach to contributing to the radio regulatory environment is best described as holistic, tackling short, medium, and long term goals in parallel.

- **Short Term – To obtain experimental licences within HAPS bands.** This will enable us to perform technology trials and illustrate future applications and the capabilities of aerial platforms.

- **Medium Term – To produce technical documents for eventual submission to ITU-R Working Party 9B.** So far these include:

    - Preliminary Draft Revision of Recommendation (PDRR) ITU-R F.1569, Alternative HAPS system model for interference evaluation in the 28 and 31 GHz bands
    - Working Document toward PDRR ITU-R F.1569, Measured radiation patterns of prototype onboard antenna designed for HAPS in the 28 GHz band
    - PDRR ITU-R SF.1609, Interference evaluation from fixed service systems using high altitude platform stations to conventional fixed service systems in the bands 27.5-28.35 GHz and 31-31.3GHz.

  These documents deepen the analysis already contained within the respective ITU Recommendations and consider more representative characteristics of early HAPS systems, which will have more stringent payload, power, weight, and volume constraints, and a reduced impact on the shared bands. We intend to ideally submit these through European national regulatory bodies, and on into CEPT through to the ITU-R working group. We have alternative routes for these documents via Japan and Korea, but as a predominantly European project, CAPANINA should as a priority influence European bodies.

- **Long Term - To develop advanced spectrum management techniques for aerial platforms**. Currently, we are examining various dynamic spectrum sharing and coexistence techniques, including cognitive radio and assessing performance and impact on other systems. We intend to submit these findings initially to appropriate national regulatory bodies, e.g. OFCOM in the UK.

Wider Aerial Platform Constituency

These activities have a wider reach than just the CAPANINA project. There are a number of commercial organisations in the UK, Europe and worldwide that will benefit from this approach. These include QinetiQ, Lindstrand Balloons, Geoscan, EADS (UK), Zeppelin (DE), and Lockheed Martin, Sanswire Networks, NASA/AeroVironment (USA), who all have notable aerial platform activities. Other commercial organisations that are watching developments in the technology include mobile operators, e.g. Vodafone (UK), and equipment manufacturers, e.g. Ericsson.

A new 4 year European COST Action, COST 297, investigating 'High Altitude Platforms for Communications and Other Services, will contribute to spectrum sharing activities in other potential frequency bands. The Aeronautics and Space area of the European FP6 initiative has the USEHAAS activity, which is developing a strategic agenda to catalyse future RTD activities within the European Union on the aerial vehicles. University of York is actively involved in both initiatives.

Conclusions

Aerial platforms have the potential to deliver broadband communications cost effectively. Appropriate ways to achieve this are being examined by the FP6 project CAPANINA, an RTD project that is made up of a consortium of industry and academic organisations. The project has adopted a multi-centred approach, including the development of business models, technology trials from a variety of aerial platforms, spectrum sharing activities and longer-term research.

It is important that the future radio regulatory strategy is sufficiently flexible to ensure that frequency bands are appropriate licensed, as the platforms and commercial applications become available. It is crucial that the decisions to license such bands are based on sound technical arguments, presented at the appropriate forums, to ensure that the future commercial potential is not impeded. CAPANINA and associated projects are willing to carry out these activities, particularly in relation to the ongoing ITU activities in WP 9B.

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