



# Telecommunications over High Altitude Platforms

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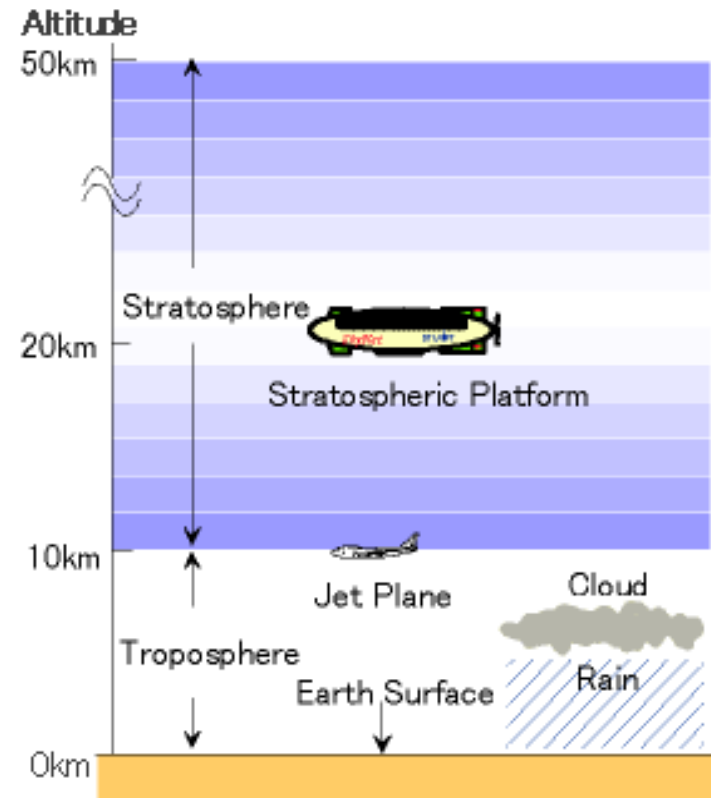
# Outline



- 
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  - HAP network architectures
  - HAP research activities
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    - 6FP~IST CAPANINA
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  - VoIP system architecture for HAP network
  - Summary
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# Introduction

- High Altitude Platforms are an alternative or complement to terrestrial and satellite infrastructure for providing broadband wireless access in remote and hard to reach areas
- They are based on unmanned airships and manned/unmanned aircrafts
- HAP are typically operating in lower stratosphere ( $h \approx 20$  km)
- They are particularly well-suited for temporary provision of basic or additional capacity requirements, e.g. for short-term large-scale events and establishment of ad-hoc networks for disaster relief.



# High Altitude Platforms

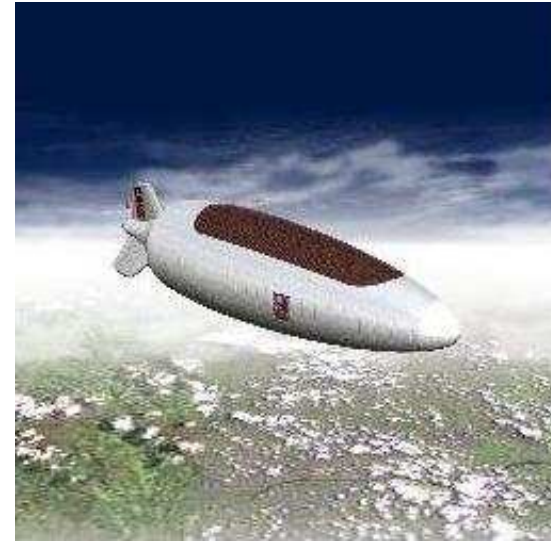
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- Comparing to terrestrial wireless access networks:
    - large coverage area from a single site
    - line-of-sight links
    - more straightforward cell planning
    - less ground-based communications infrastructure
    - suitable for broadcast and multicast services
  - Comparing to satellite communication systems:
    - quasi-stationary coverage area
    - low propagation delays
    - broadband capability using small sized antennas and terrestrial terminal equipment
    - easy maintenance and upgrading of the payload
-

# Types of HAPS

- **airships (lighter than air)**
  - unmanned
  - solar powered
  - can stay aloft for few months
- **aircrafts (heavier than air)**
  - manned, jet engine, up to 8 hours aloft
  - unmanned, solar powered, aloft for few months



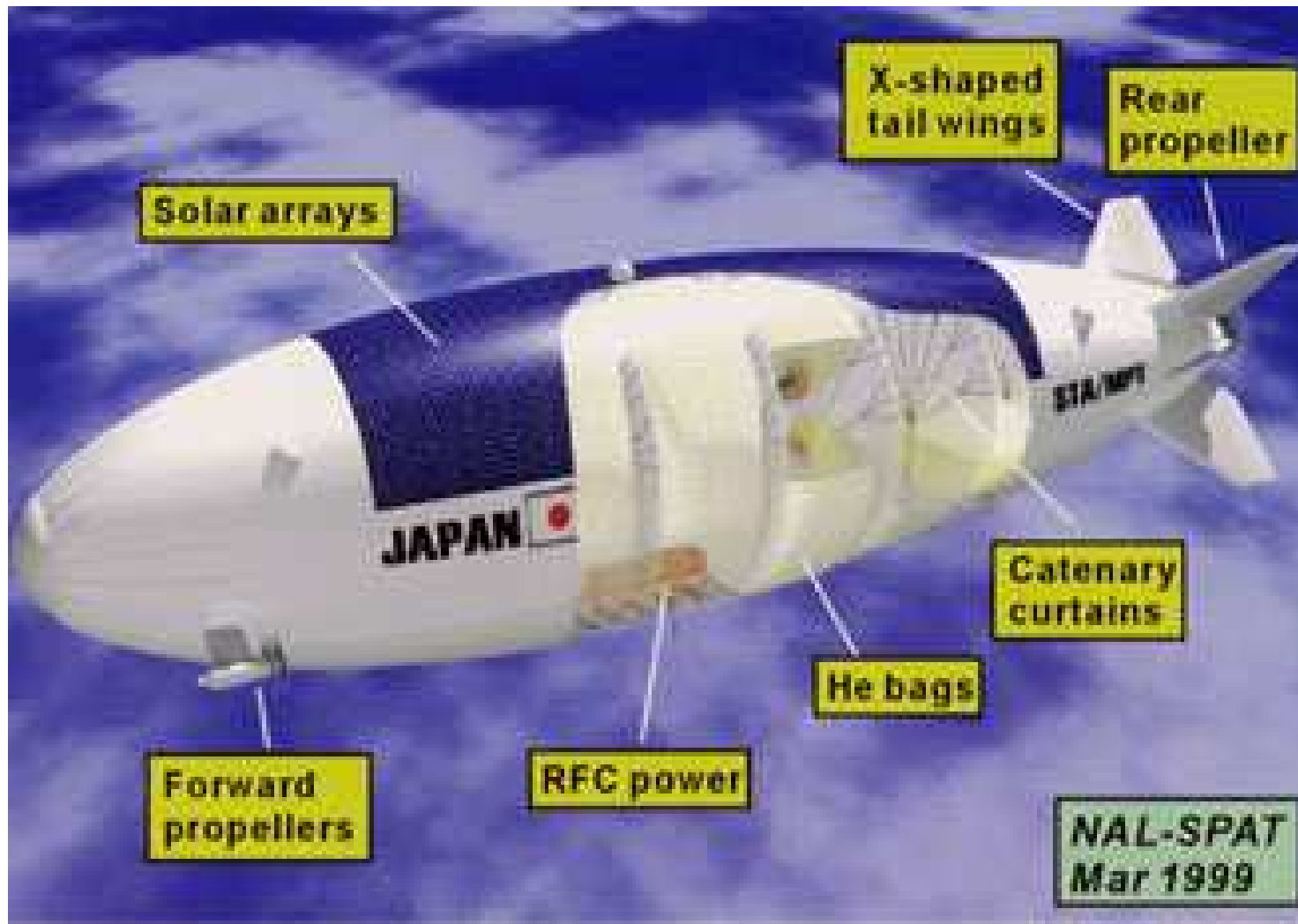
# HALO



# Helios

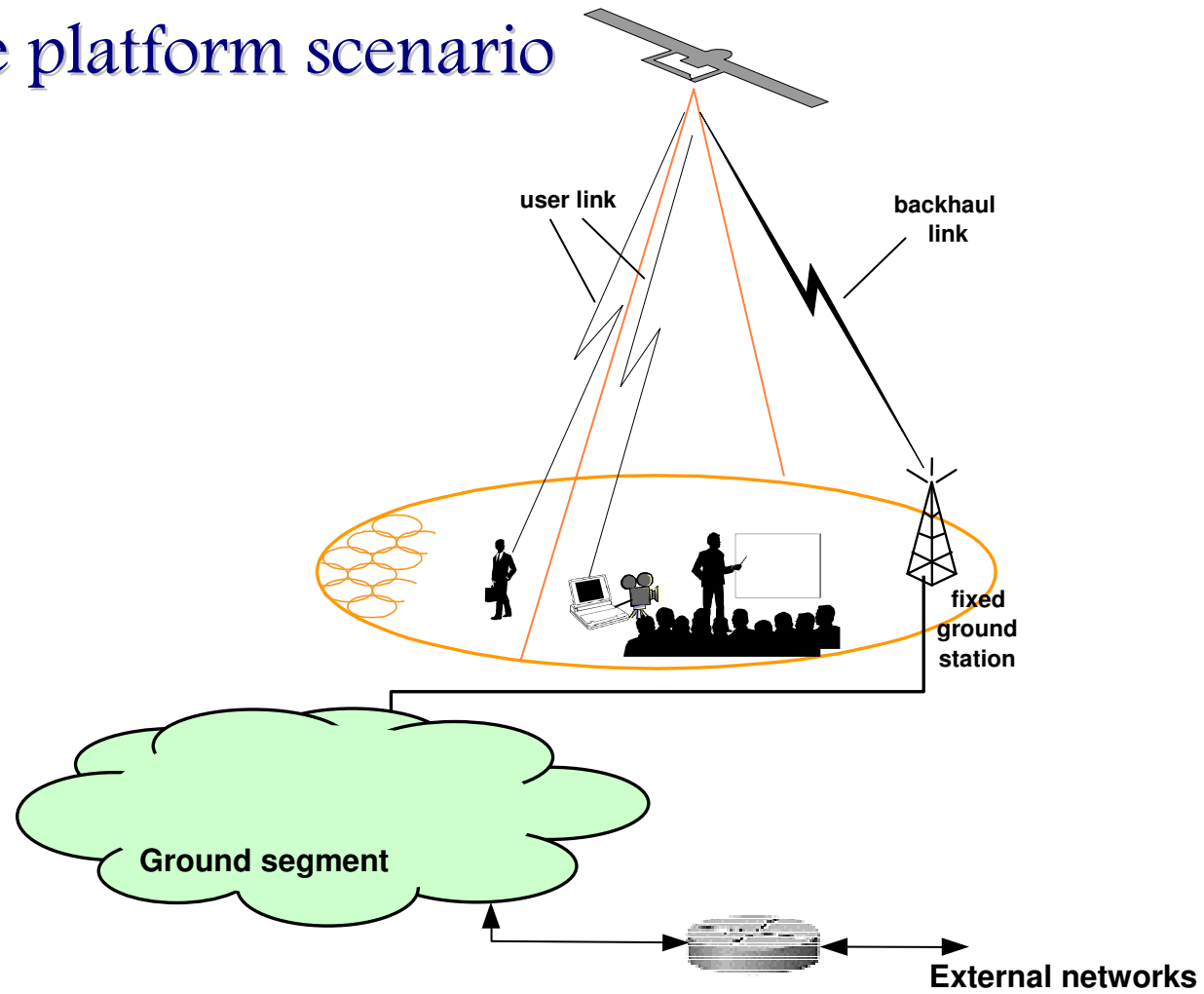


**Helios Sets New World Record!**  
August 13, 2001  
96,863 feet at 1608 HST



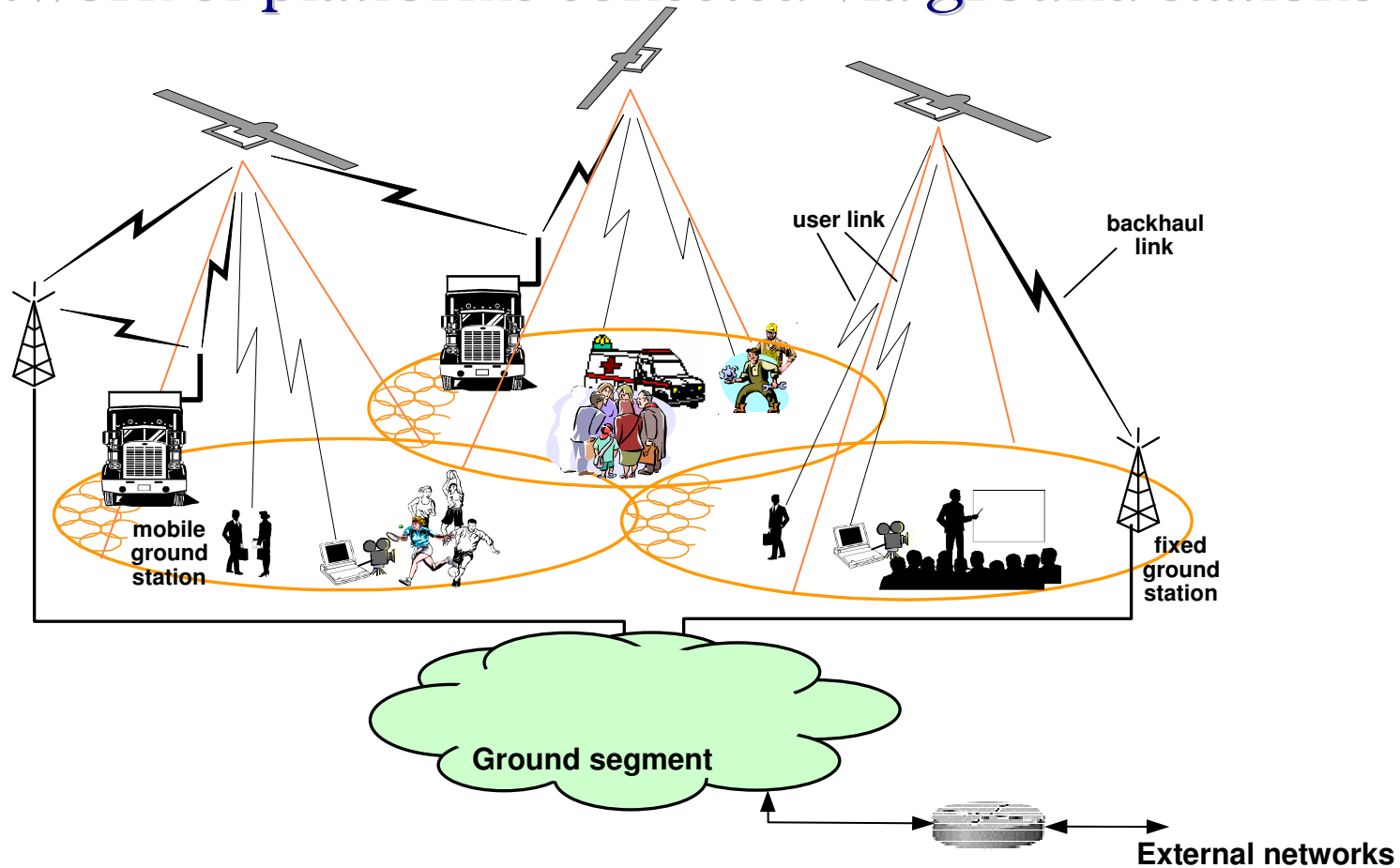
# HAP network architecture

## Standalone platform scenario



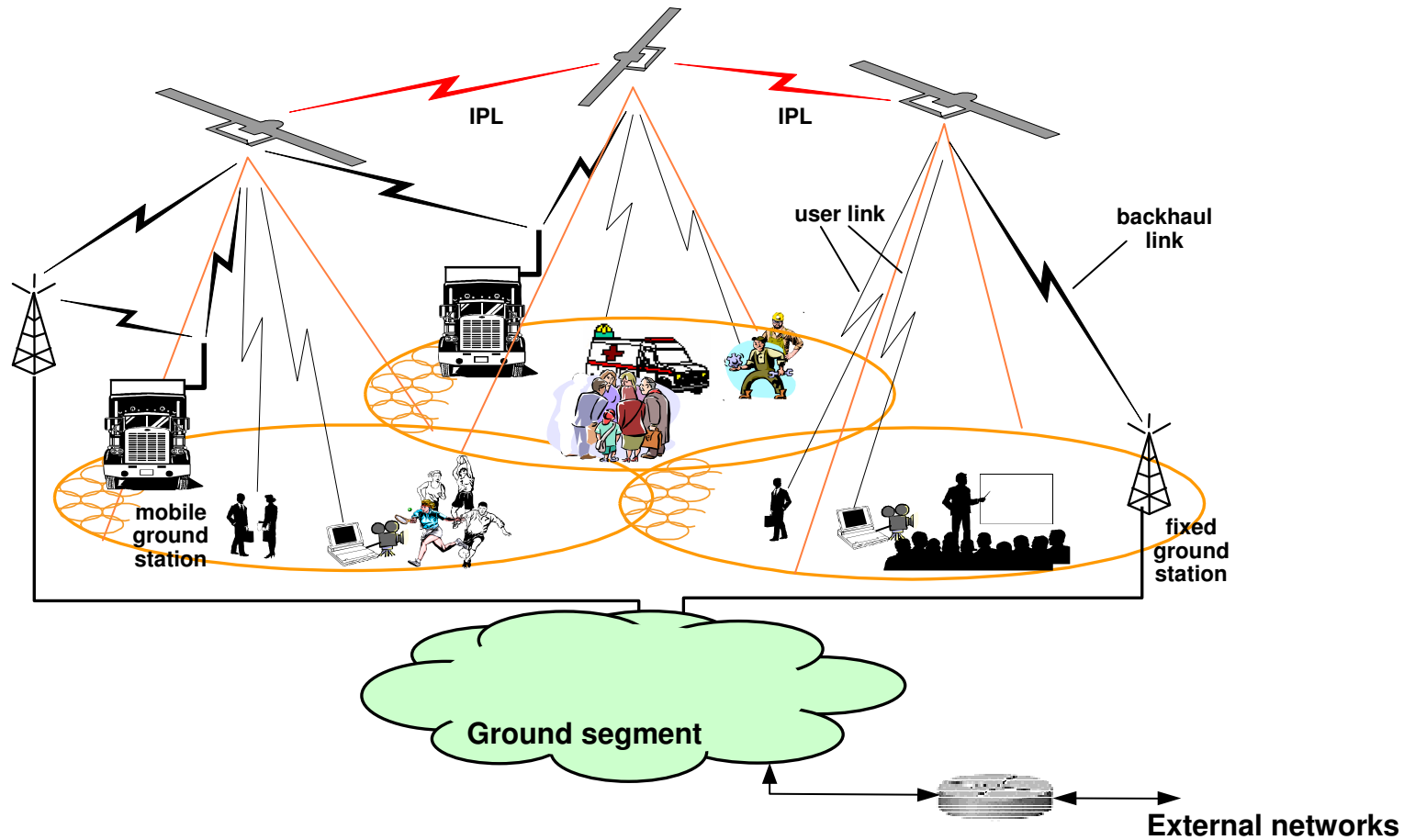
# HAP network architecture

Network of platforms connected via ground stations



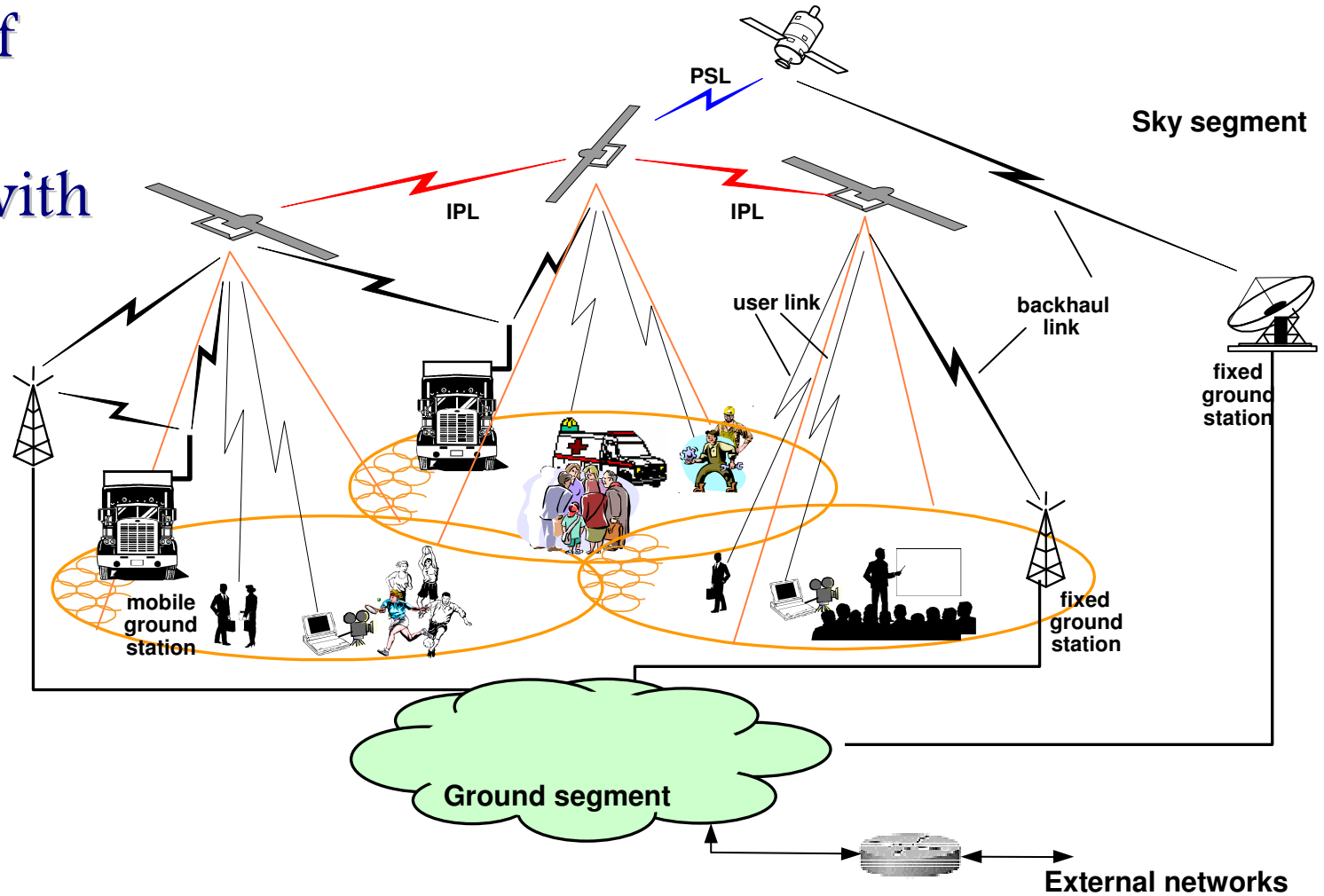
# HAP network architecture

## Network of platforms connected via interplatform links



# HAP network architecture

Network of platforms connected with a satellite

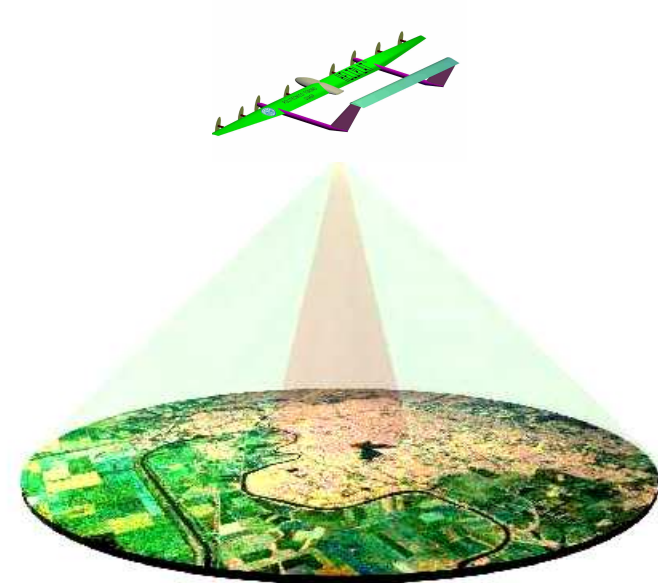


# HAP research activities

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- NiCT and SkyNet Programme in Japan
  - demonstrated the feasibility of 3G mobile communications via HAP
- EU FP5 IST project HeliNet
  - carried out initial phase of study and prototype development  
aeronautics (*solar powered plane with fuel cells*)  
applications (*broadband communications, location/navigation, environmental monitoring*)
  - January 2000 – May 2003
  - Value €4.8M



# HAP research activities



- EU FP6 IST project CAPANINA
  - 13 partners
  - November 2003 – October 2006
  - Value €5.6M
  - 1 overseas collaborator



National Institute of Information and Communications Technology of Japan



	University of York (UK) <ul style="list-style-type: none"><li>- York Electronics Centre</li><li>- Department of Electronics</li></ul>
	Jozef Stefan Institute (SL)
	Politecnico di Torino (I)
	Universitat Politecnica de Catalunya (ES)
	Carlo Gavazzi Space (I)
	Budapest University of Technology & Economics (HU)
	DLR (D)
	BTexact (UK)
	SkyLINC Ltd (UK)
	EuroConcepts Srl (I)
	CSEM (CH)
	Contraves AG (CH)

# The CAPANINA objectives

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- To develop broadband technology from HAPs aimed at providing efficient ubiquitous coverage to users marginalised by:
    - geography,
    - distance from infrastructure,
    - those travelling inside high-speed public transport vehicles
  - To deliver burst data rates of up to 120 Mbit/s to fixed users and to vehicles travelling at up to 300 km/h
  - To consider *mm*-waveband and free-space optical communications technologies
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# The CAPANINA key activities



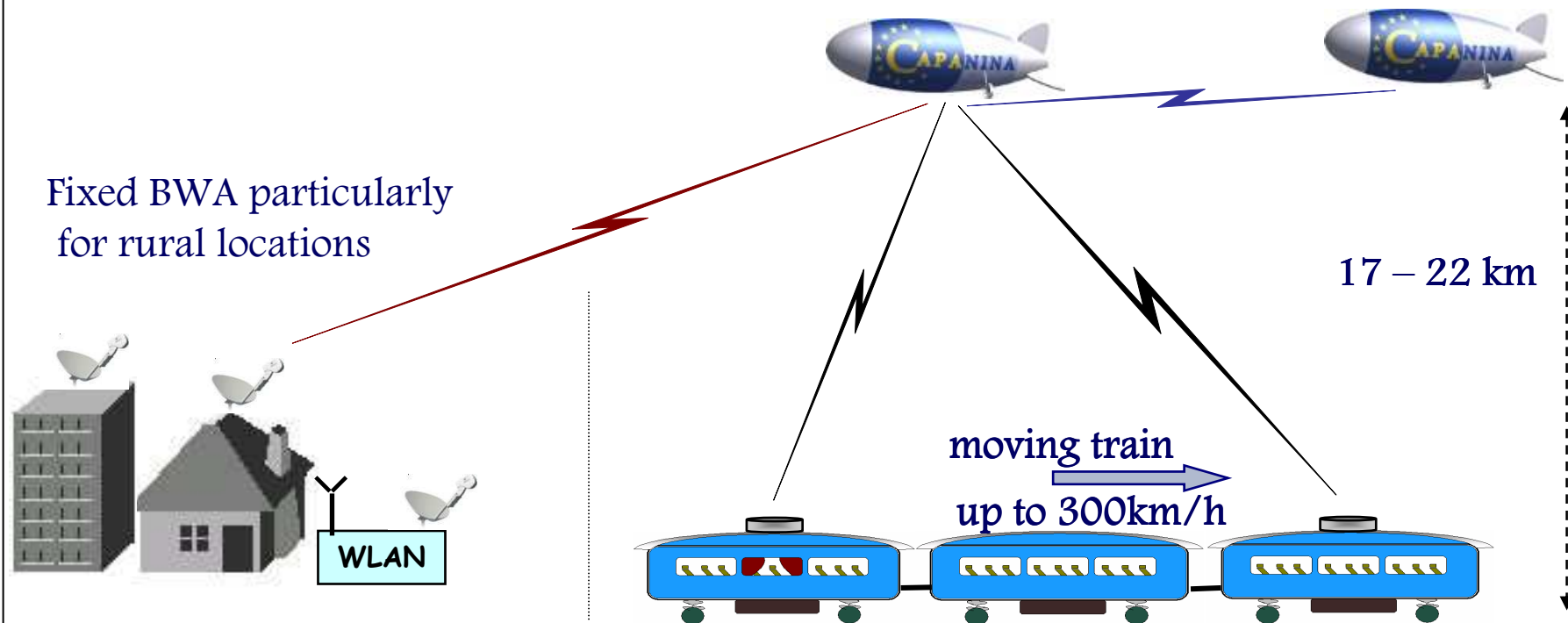
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- Derive business models to ensure low-cost ‘Broadband for All’
  - Develop a system testbed for testing selected broadband services
  - Validate and evaluate services and components on different aerial platform technologies
  - Investigate smart antennas and associated signal processing for advanced beam forming
  - Develop advanced signal processing algorithms
  - Perform *mm*-wave propagation measurements (fixed, moving)
  - Study resource management and spectrum sharing in frequency bands allocated for use with HAPs (47/48 GHz and 28/31 GHz )
  - Demonstrate a high-speed optical backhaul downlink from HAP to a ground station and a free space optical interplatform link
-

# The CAPANINA scenario (i)

§ Up to 120Mbit/s

§ 31/28GHz, (47/48GHz)  
+ optical backhaul & interplatform

Fixed BWA particularly  
for rural locations



# The CAPANINA scenario (ii)

Up to 120 Mbit/s  
(aggregate)

Possible Services:

- ~ High speed Internet
- ~ Video-on-demand
- ~ Corporate Services

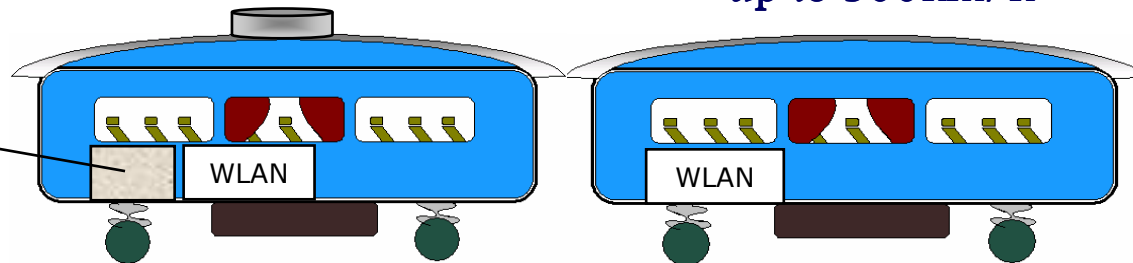
Down conversion,  
signal processing,  
general processing,  
on board caching,  
distribution to  
carriage WLANs

Possible standards:

- ~ IEEE 802 family
- ~ DVB family
- ~ HIPERACCESS

Phased Array,  
Smart Antenna

moving train  
up to 300km/h



# The CAPANINA Trials



- End Yr 1 – ‘Pershore, UK’ Trial
  - 300 m tethered aerostat
  - FWA test + applications
  - Optical communications test
  - Propagation measurements
- End Yr 2 – ‘Kiruna, Sweden’ Trial
  - Stratospheric balloon test
  - Repeat of the above
- End Yr 3 – ‘Japanese’ Trial
  - High Altitude Platform
  - Repeat of the above

## Examples of Previous Trials



- 6FP IST Network of Excellence SatNEx
- Satellite Communications Network of Excellence

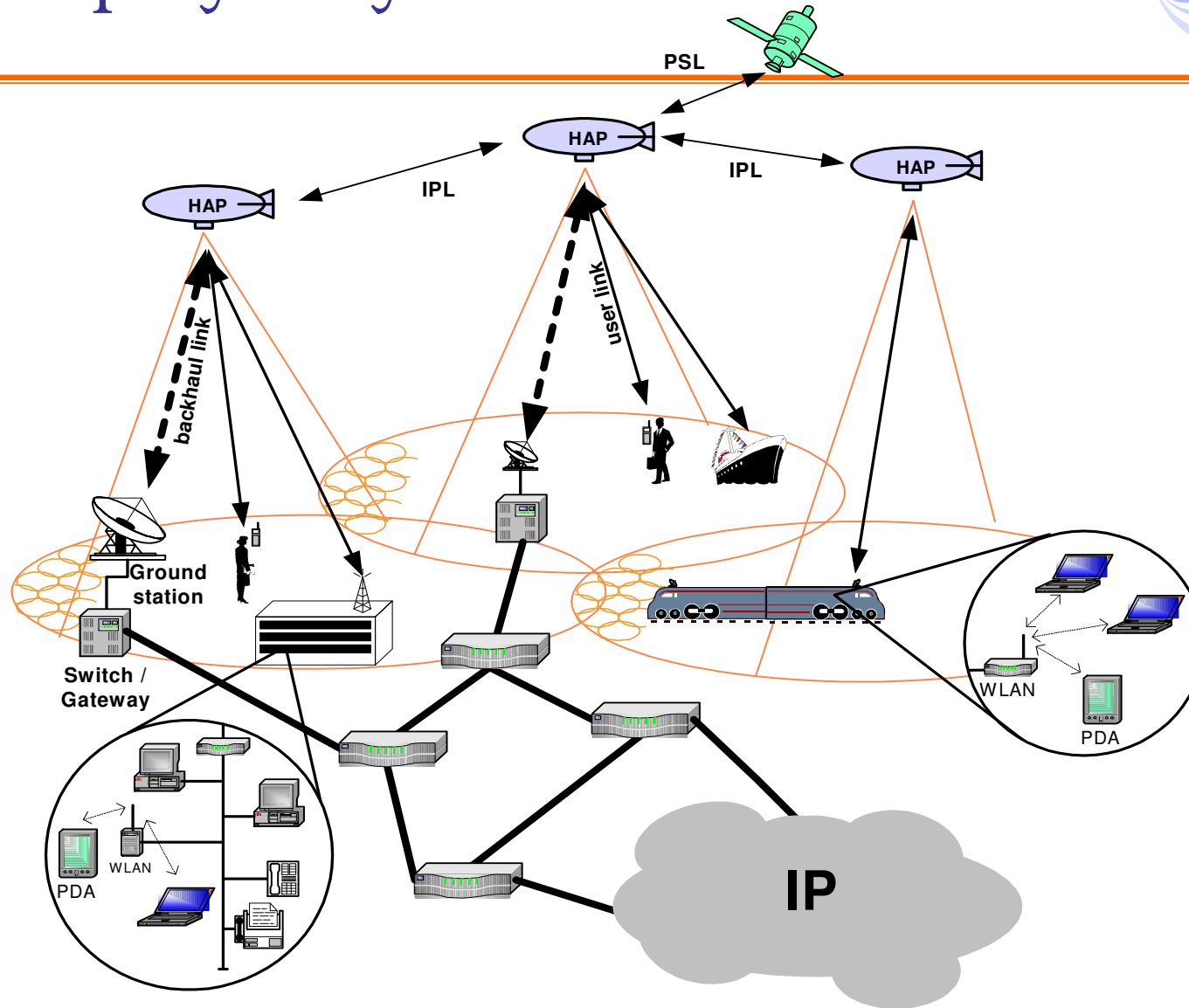


The banner features a central image of a satellite dish with the text "SATNEX SATELLITE COMMUNICATIONS NETWORK OF EXCELLENCE" overlaid. Below the title, a paragraph describes the network's purpose: "Networks of Excellence" have been introduced as a new instrument within the 6th IST framework program. SatNEx is one of the first consortia to implement the new ideas and to overcome the fragmentation of European research. Through co-operation of outstanding universities and research organizations with excellent expertise in satellite communications, SatNEx will build a European virtual centre of excellence in satellite communications and contribute to the realisation of the European Research Area. The website [www.satnex.org](http://www.satnex.org) is listed at the bottom right.

**Logos of participating institutions:**

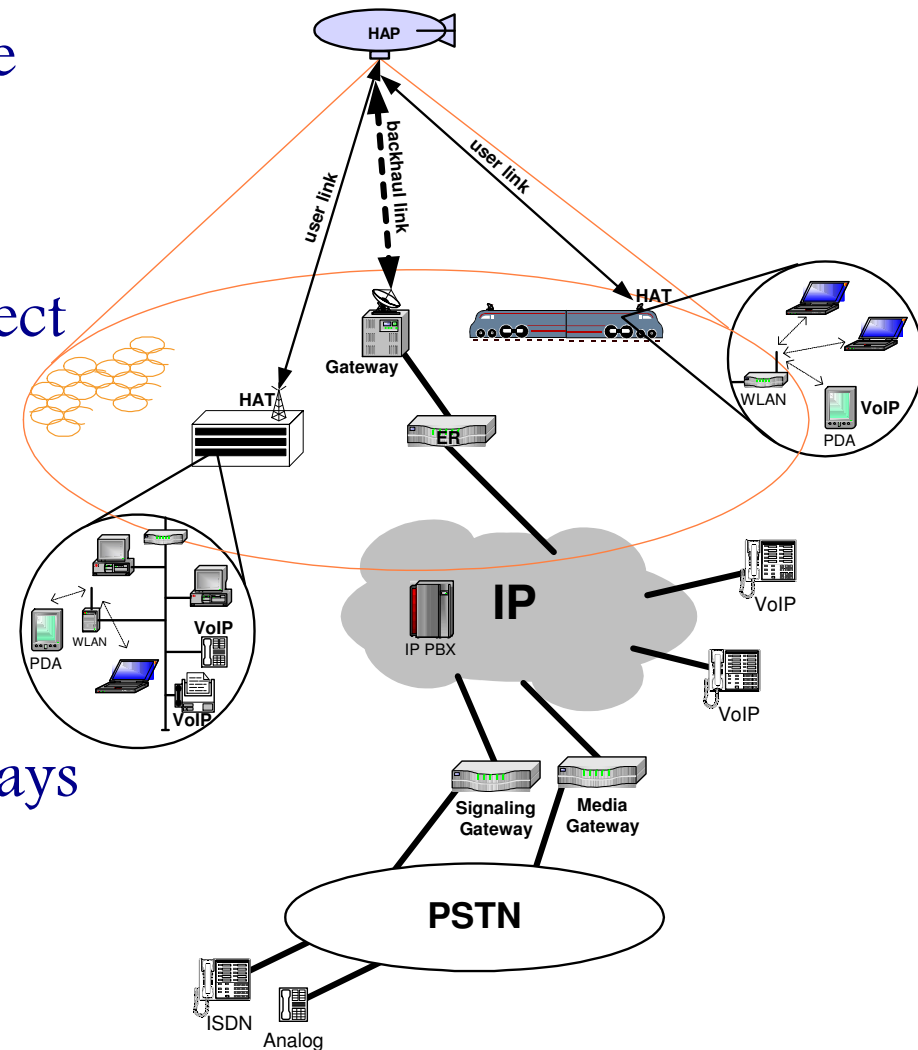
- DLR
- UNIVERSITY OF ABERDEEN
- Budapest University of Technology and Economics
- UNIVERSITY OF BRADFORD
- ONERA
- UniS
- TELECOM PARIS
- RWTH AACHEN UNIVERSITY
- IMEOL
- cnit
- UNIVERSITA' DEGLI STUDI DI ROMA Tor Vergata
- Fraunhofer Institute for Open Communication Systems
- ISTITUTO DI SCIENZA E TECNOLOGIE DELL'INFORMAZIONE "A. FAEDO"
- Other logos include: a cluster of black dots, a blue stylized face, CNES, TUG, a blue stylized 'G', and a circular seal with a portrait.

# Fully deployed system architecture



# VoIP System Architecture for HAP

- HAP network should provide basic VoIP functions
  - Signalling
  - Call Connect and disconnect
  - Database services
  - CODEC operations
- Basic elements
  - soft switch
  - Signalling / Media Gateways
  - User end devices
  - IP network



# Conclusions



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- HAP are suitable for provision of broadband wireless access
  - Particularly suitable for serving remote/hard-to-reach regions, short-term large-scale events and disaster relief missions
  - Alternative network architecture scenarios with different system coverage and platform interconnections
  - Recent research activities demonstrated the feasibility for provision of 3G services and are now focusing on the provision of broadband wireless access to remote fixed users and passengers on trains.
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