

# MEDIAN Service Requirement Study

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**Abstract:** *This paper describes a sequential method to arrive at the user requirements for the MEDIAN broadband wireless LAN demonstrator. Based on an initial identification of applications and application areas, candidate application scenarios have been identified according to predefined selection criteria. An electronic brainstorming and decision tool was applied to further specify and quantify these scenarios. A multi criteria analysis was applied to yield the most representative application scenario, the dynamic office environment, to be demonstrated with the MEDIAN demonstrator. Its quantitative description serves as the basis for the demonstrator technical requirements.*

## Introduction

The MEDIAN broadband wireless LAN demonstrator's final aim is to exhibit the advantage of using broadband wireless LANs for transmission of multimedia information. To meet this goal, detailed insight is required into the communication needs and communication environments of the user. These *user requirements* dictate the *service requirements* which describe at the highest level the necessary system characteristics.

This paper reports the MEDIAN user requirements and the method that was utilised to arrive at these requirements [1], together with intermediate results.

## 1. Potential wireless multimedia applications

As the initial step, interesting potential applications and application areas have been identified, based on literature sources, interviews [2-9] and results from other CEC-projects such as Briteur, MBS, FAIR and Magic WAND [10-12].

For the business/professional area we have identified the applications: hospital bed side imaging, building-to-building communications, wireless studio, manufacturing or repair assistance, dynamic office environment, WLANs at conferences, rapid deployment WLANs, WLANs in exhibition halls, interactive design (CAD/CAM), telelearning/business TV, wireless Virtual Reality. For mainly residential usage: news tablet, wireless TV/audio, teleshopping, home office, videophone have been identified and are considered as components of the 'wireless home'.

To gain insight into the spread of required multimedia services over the above mentioned applications, the applicable services have been identified from a predefined list of multimedia services. These services: videoconferencing, fast data/file transfer, high resolution imaging (still pictures), high quality real time audio & video and file sharing, are generic in nature and mutually complementary.

Table 1 lists more or less generic services versus the potential applications for wireless multimedia. The application areas are both professional and residential. For each application, the required services are ticked. Below table 1, the definitions of the services mentioned are provided.

Table 1: Potential wireless applications and required services

	Videoconferencing	Fast file/data transfer (Internet)	High resolution imaging	Real time audio & video	File sharing
<i>Professional/business applications</i>					
Hospital bed side imaging	•		•		•
Building-to-building	•	•	•	•	•
Wireless studio	•			•	
Manufacturing & repair assistance	•	•	•		•
Dynamic office environment	•	•	•		•
WLANS at conferences	•			•	•
Rapid deployment WLANS	•	•	•		•
Interactive design	•	•	•		•
Telelearning/ Business TV	•	•		•	•
Virtual Reality		•		•	
<i>Residential applications</i>					
News tablet		•		•	
Wireless TV/audio	•	•		•	
Teleshopping		•		•	
Home office	•	•			•
Videophone	•				

Source: TNO-STB/TNO-FEL

- Videoconferencing:* low quality real time voice and moving images of limited size and update rate;
- Fast data/file transfer:* refers to fast file transfer and database access (mainly files such as documents and EDI files; Internet);
- High resolution imaging:* exchange of high quality, possibly large, still pictures ('stills');
- Real time audio & video:* high quality real time voice and moving images (large and high update rate) - includes high resolution imaging;
- File sharing:* simultaneous access to same data file.

## 2. Qualitative application description

After having identified potential multimedia applications for wireless use, all these applications have been described in a qualitative form, focusing on: the environment of use, the user population, the required functionality, critical factors, limiting conditions and on the required services (as shown in tables 2-5). An important intermediate result is that many applications require access to a fixed broadband infrastructure.

This step concluded the investigation effort that yielded a first understanding of the characteristics of the several application and their mutual differences and similarities.

## 3. Scenarios for wireless multimedia

The third step was to reach a certain convergence in the earlier presented applications to arrive at candidate application scenarios. This was necessary to limit the amount of different user requirements and to come to preliminary quantitative input for the system. From the application

descriptions, four have been selected to be elaborated as application scenarios. The following criteria have been used:

1. In the scenarios, the used services should have a more generic character (videoconferencing, file transfer, Internet, etc.), in order to be representative for applications with a high market potential;
2. The set of scenarios should be defined broad enough to link up with diversity in market demand;
3. The scenarios should link up with social-economical trends, such as business process redesign, teleworking, telelearning, etc.;
4. In one or more of the scenarios the system should function as a wireless extension of a fixed ATM infrastructure.

Applying the above mentioned selection criteria, the following scenarios have been identified:

- hospital bed side communications;
- wireless studio;
- dynamic office environment;
- wireless home.

These scenarios are summarised in tables 2-5.

Table 2: Hospital bed side communications

Environment	Medical buildings, indoor use, portable to many rooms
User	Doctors, nurses
Functionality	Wireless access to patient information and medical images, teleconsulting
Critical factors	High quality imaging <ol style="list-style-type: none"> <li>a. adequate resolution of individual imaging</li> <li>b. the ability to compare several (X-ray or echoscopical) images, e.g.: those of the same modality taken on different dates or from different viewangles and those of the same part of the body using different modality;</li> </ol> Reliability (very high) Security
Limiting conditions	Possibly: medium term health aspects of radiation, interference with other medical equipment
Required services	High definition imaging, file sharing, videoconferencing

Table 3: Wireless studio

Environment	TV studios, theatres, congress centres, airport studios, major sport events
User	TV, video and film producers, directors and camera crew
Functionality	Wireless monitors, microphones, cameras and other studio equipment
Critical factors	High resolution video quality, extremely high reliability and availability, continuous wireless channel claim
Limiting conditions	Interference with other equipment, available bandwidth
Required services	High quality real time video and audio, videoconferencing

Table 4: Dynamic office environment

Environment	Offices
User	Employees in business, governmental and other offices
Functionality	Wireless multimedia system with access to the fixed LAN, for collaborative working, database access, video demonstrations
Critical factors	Efficiency, security, different types of traffic and considerable user density
Limiting conditions	Initial investment
Required services	File sharing, desktop videoconferencing, Internet, high resolution imaging

Table 5: Wireless home

Environment	Residential customer premises
User	Family members
Functionality	Wireless TV, teleshopping, wireless newspaper, videophone, teleworking
Critical factors	Price of terminals and services, availability of fibre-to-the-home, social acceptance and accessibility
Limiting conditions	Integratability in home environment
Required services	(HD)TV, audio, videoconferencing, Internet, file sharing

#### 4. User Requirement Maps

In-depth descriptions of the future scenarios of these four applications have been made, applying an electronic brainstorming and decision tool in a user requirement workshop. Experts and representatives of user groups elaborated on the specific circumstances of use of these four selected applications. Results of this workshop have been translated into *quantitative* user requirements, presented in so-called User Requirement Maps (URMs), one for each scenario (table 6). Most of these user requirements already appear as service requirements.

Table 6: User requirement maps (1)

CHARACTERISTICS	EXPLANATORY NOTES	VALUES/ UNITS/ DESCRIPTIONS	USER NEEDS			
			hospital	office	studio	home
traffic	type  update rate symmetry addressing  simultaneous usage	burst/ long packets; continuous real time; frame rate % upstream / % downstream point-to-point (p2p), point-to-multipoint (p2mp), etc. average & maximum # users	cont/burst  25 Hz appl. dep.  p2p  1/4	burst/long  >100 Hz 50/50  all  multiples of 12	long  >100 Hz 60/40  mp2p  8/8	burst/long  >100 Hz 50/50  mp2p / p2mp  1/3
volume per user	capacity per user	average and max. Mbit/s per user (155 Mbit/s)	20/40 teleoperation: 155	2/20	max. 18- 70 (com- pressed)	2/20
multisharing	user density	# users / m <sup>2</sup>	0.01-0.02	0.1	0.03	0.02
delay	setup delay communication delay	seconds or less milliseconds or less	5 s 100 ms (for real time voice/ video)	5 s 0.1µs/ packet	0.1 s audio- video time relation	5 s 100 ms
reliability	correctness availability	normal, high, extremely high  % available in time % av. in space	burst:extr. high; cont.:nor- mal/high >95 % 95 %	high  99 % 75 %	extr. high  99.5 % 85 %	normal  75 % 50 %
security	confidentiality and integrity	integrity, access control, authentication, bulk & end2end encryption	-end2end -integrity -access control -authen- tication	-end2end -access control -authen- tication	-authen- tication -access control	-end2end -possibly access control
range	distance between terminal & base station	min. and max. range in m (at 60 GHz: 1- 100 m)	1 - 50 m	1 - 30 m	indoor: 1 - 60 m outdoor: >1 km	1 - 20 m
resolution	image quality	describe focus by examples or #pixels	high res. TV; X-ray: 4k x 4k	VHS com- parable	high res. TV: 1k x 1.5k	high res. TV: 1k x 1.5k
inter- connection	connection with other infrastructures (fixed, mobile, satellite)	stand alone, closed system (LAN) or open system	closed with con. to expert	open; intercon. of all types	closed; intercon. with studio LAN	open intercon. of all types
additional services	GSM and ISDN-like intelligent services	description of examples	caller id., use of multiple channels, interactive control	caller id. & call queuing	interact. control, tele- metry (to focus, etc.)	caller identifica- tion & call queuing

Table 6: User requirement maps (2)

CHARACTERISTICS	EXPLANATORY NOTES	VALUES/ UNITS/ DESCRIPTIONS	USER NEEDS			
			hospital	office	studio	home
mobility	portability roaming area speed	weight in kg radius in m max. in km/h	< 2 kg < 10 m < 5 km/h	2 kg < 1 m < 1 km/h	< 10 kg < 30 m < 4 km/h	10 kg < 20 m < 2 km/h
installability	flexibility, time to install	in minutes, hours or days	< 5 min.	< 5 min.	hours	days
antenna position	height at which the antenna is installed	in metres from the ground	base 3 m remote 1 m	base 3 m remote 0-3 m	base >3 m remote >1 m	base 0.1-3 m remote 1-3 m
environment	environment of use (propagation aspects)	in- , out-door, close to voluminous objects, such as metal objects, walls, etc.	high, metal objects, but not volu- minous	high objects in centre; metal & other materials	not many large objects in centre	not many large objects in centre
services	type of simultaneous information	combination of: voice, video, text and data	-vid. conf -stills -file sharing	-vid. conf -data transfer -stills -file sharing	-vid. conf -real time audio/ video,	-vid. conf -r. time audio/ video -data tr. -stills -file sh.
added value of wireless	consider only wireless aspect	large, medium, small	large	large	large	medium

Source: TNO-STB/TNO-FEL

The URM for the four scenarios offer sufficient information to fill out URM for the other applications and application areas. This aims to verify the selection of the four scenarios on the basis of quantitative results, using multi criteria analysis (MCA) as a supporting tool. Moreover, it shows which scenario offers the most similarities with the other scenarios and applications, i.e.: a demonstration of wireless multimedia in this scenario is representative for other scenarios. MCA and an associated sensitivity analysis has shown in a convincing way that the dynamic office environment is this representative scenario, showing large overlaps with rapid deployment, telelearning and interactive design.

As the first step of the system requirement investigation, an URM for the demonstrator can be composed, using the dynamic office environment URM as the minimum requirement.

## 5. Conclusions

A sequential method has been successfully applied to arrive at service requirements for broadband wireless LANs. The method consists of four steps:

1. identification of potential wireless multimedia applications from several sources;
2. structural, yet qualitative description of applications found, using common identifiers;
3. selection of applications for elaboration to application scenarios, using predefined criteria;
4. quantification of the application scenarios, filling out the User Requirement Maps and application of the multi criteria analysis, resulting in the identification of the most representative application scenario, the dynamic office environment, to be demonstrated with the MEDIAN broadband wireless LAN demonstrator. Its quantitative description serves as the basis for the demonstrator system technical requirements.

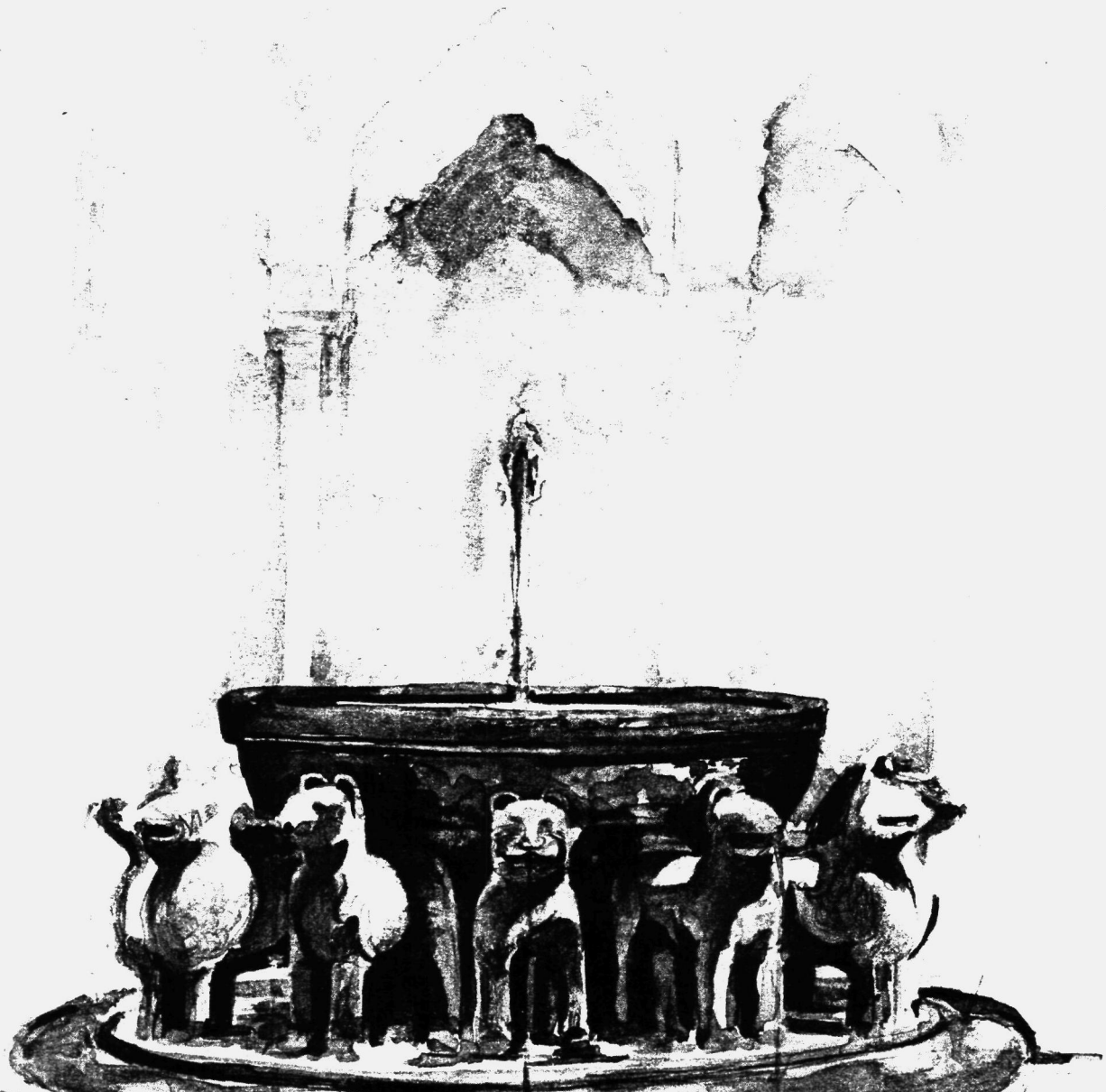
Specifically, for the four selected scenarios we have come to the following conclusions:

- the dynamic office environment shows largest characteristic overlaps for the largest number of applications, i.e. with: rapid deployment, telelearning and interactive design. Also for the broad impact in society and the connection with social-economical trends, it possesses a large market potential. Thus, the dynamic office is considered as the 'leading' application, i.e. the features of this application should be covered by the demonstrator;
- The studio and the hospital applications show user requirement overlaps, in spite of the completely different environments. On the other hand, these applications show minor correlation with the dynamic office environment. For this reason and for their mutually contrasting social functionality, both are interesting to consider as potential wireless broadband applications;
- the MCA has verified that the home application is very different from the studio, hospital and the office application.

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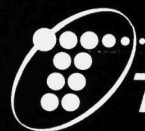
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