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1. Introduction

The main goal of this project is to develop an efficient solution for IPTV operators to provide HD video streams to users which have a limited access bandwidth and to optimize bandwidth usage for IPTV video streaming. WP8 deals with the Live Test Plan and execution

The deliverable D8.2 - Live Test Report describes the execution and the result of Live Test phase of the developed components of the IPTV system for achieving the goal of the OptiBand project of providing multiple HD video streaming solution for limited access bandwidth environments.

2. Live Test

The document describes the subjective tests done at Telecom Italia Lab within all the **Use Cases**. The final target of these tests has been to evaluate video quality, subjectively perceived. This task was planned under Quality of Experience (QoE) modelling activity carried out within the OptiBand Project.

2.1 Test Conditions

All the subsequent definition are already reported in D8.1 but, for reader convenience, we briefly mention them also in this document, in order to have at hand all the technical definition applying to this project.

2.1.1 Content classes

The most important rationale for content class definition was to use genres that viewers could be realistically expected to watch in a typical HD IPTV consumption situation. To support this motivation, Telecom Italia performed own market research and the available popularity ratings were investigated. The results of this survey reflect the sport, film and documentary genre dominance within the available HD channels in Europe. Finally in WP8, we add documentary in order to cover the whole range of most challenging content classes.

We selected the following content classes for focused investigation in OptiBand QoE research (WP2):

- Action movie (CC1)
- Soccer (CC2)
- Documentary (CC3)

For these three content classes HD resolution provides the most significant benefit from the point of view of perceived quality. Action movie, soccer and documentary are classes with different levels of detail, complexity of structures, and movements.



Figure 1: Snapshots of Soccer (left), Action movie (middle) and documentary sequences.

2.1.2 Bandwidth Levels

According to following look up table (LUT), which was defined based on early WP2 QoE results in OptiBand, the PDA will switch between the bandwidth levels (BL):

Look up table for multi-stream AVC				
Level	BL (Mbps)	Soccer (MOS)	Action (MOS)	Documentary (MOS)
L	8.00	4.1	4.3	4.2
L1	6.50	4.02	4.14	4.08
L2	4.95	3.98	4.07	4.025

Table 1: LUT

Patterns of household bandwidth sharing (e.g., how often do users zap, how many TV sets are for how long time used in parallel, etc.)

2.1.3 Use Case

The household is assumed to have a number of TV sets, so that the available bandwidth is stressed and the content test will be audio-visual.

Use cases:

- **Use case 0:**
From the OptiBand project perspective, this use case represents the state-of-the-art (SOTA); only one TV-set is switched, the whole bandwidth is available and no packet-dropping needs to be applied.
 - Sequence with constant bitrate at SOTA Level (L).The available bandwidth considered is: 15Mbps.
 - No zapping
 - This scenario should be tested for the quality rating tests and for all CCs
 - ADSL link alignment on the application layer at 15Mbps
- **Use cases 1:**
This is the most challenging scenario for the OptiBand project, as it involves:
 - Video sequences with changing operation points according to real-world household bandwidth sharing patterns
 - The user is connected to the platform through an ADSL2+ line. The ADSL2+ link is supposed to align at 18 Mbps. The available downstream bandwidth at the application layer is then 15 Mbps.
 - The considered household has 3 active devices, connected to a single AG.
 - The household has 3 TV set
 - 2 patterns for slow zapping
 - 1 pattern for fast zapping
- **Use cases 2:**
For this use case, we assume that only two TV-set is switched on, as it involves:
 - The user is connected to the platform through an ADSL2+ line. The ADSL2+ link is supposed to align at 12 Mbps. The available downstream bandwidth at the application layer is then 10 Mbps.

- The considered household has 2 active devices, connected to a single AG.
 - The household has 2 TV set.
 - 2 patterns for slow zapping
 - 1 pattern for fast zapping
- **Use case 3:**
Only one TV set per household is switched on, as it involves:
 - Sequence with constant bitrate. The ADSL2+ link is supposed to align at 7 Mbps

Sequence length: 2 minutes

2.1.4 Zapping Patterns

It should be pointed out that: during the WP 8, Task 8.1, an important activity, in close collaboration between FTW, INTEROUD and TiS was carried out. The aim was to define different types of "zapping time" to use during the Live test, in order to make the zapping, on the different TV-Set, no relevant for the final evaluation during the various tests

- **Use case 0:**

Zapping time	15	30	45	60	75	90	105	120
1 st TV set	TV set under QoE test for CC1, CC2, CC3							

Table 2: zapping pattern for use case 0

- **Use case 1:**

Zapping time sec.	15	30	45	60	75	90	105	120
1 st TV set	TV set under QoE test for CC1, CC2, CC3							
2 nd TV set	CC1							
				CC2				
							CC3	
3 rd TV set	CC1			CC1			CC1	
		CC2			CC2			CC2
			CC3			CC3		

Table 3: FAST zapping pattern for all CCs with active 3 TV sets

Zapping time	15	30	45	60	75	90	105	120
1 st TV set	TV set under QoE test for CC1, CC2, CC3							
2 nd TV set	CC1							
							CC2	
3 rd TV set								
	CC2							
				CC3				

Table 4: SLOW zapping pattern with 3 active TV sets for all CCs

Zapping time	15	30	45	60	75	90	105	120
1 st TV set	TV set under QoE test for CC1, CC2, CC3							
2 nd TV set	CC1			X	X	X	X	X
				X	X	X	X	X
				X	X	X	X	X
3 rd TV set				X	X			
	CC2			X	X			
				X	X	CC3		

Table 5: SLOW zapping pattern with 1 active TV set under QoE test and connecting and disconnecting 2 TV sets (for all CCs)

- Use case 2:

Zapping time	15	30	45	60	75	90	105	120
1 st TV set	TV set under QoE test for CC1, CC2, CC3							
2 nd TV set	CC1			CC1			CC1	
		CC2			CC2			CC2
			CC3			CC3		

Table 6: FAST zapping scenario for all CCs with active 2 TV sets

Zapping time	15	30	45	60	75	90	105	120
1 st TV set	TV set under QoE test for CC1, CC2, CC3							
2 nd TV set	CC1							
				CC2				
							CC3	

Table 7: SLOW zapping scenario for all CCs with active 2 TV sets

Zapping time	15	30	45	60	75	90	105	120
1 st TV set	TV set under QoE test for CC1, CC2, CC3							
2 nd TV set	CC1	CC1	CC1	X	X	X		
				X	X	X		
				X	X	CC3	CC3	CC3

Table 8: SLOW zapping pattern with 1 active TV set under QoE test and connecting and disconnecting 1 TV sets (for all CCs)

- Use case 3:

Zapping time	15	30	45	60	75	90	105	120
1 st TV set	TV set under QoE test for CC1, CC2, CC3							

Table 9: Zapping pattern for use case 3

2.1.5 How the Use Case Run

- The live encoders will be running in parallel during the tests.
- Use ADSL lines, DSLAM and PDD.
- 9 tests are required (3 contents x 3 use cases).

SOTA for HD video 8Mbps --- SOTA-16% --- SOTA-33%Mbps Soccer & Action & Documentary SOTA video 8Mbps - SOTA-xx%=6.5Mbps - SOTA-xx%=4.95Mbps						
Physical Layer Bitrate	Application Layer Bitrate	N. STB	STB1	STB2	STB3	STB
18Mbps	15Mbps	3	8Mbps	---	---	1
			8Mbps	Mbps6.5	---	2
			4.95Mbps	Mbps4.95	Mbps4.95	3
12Mbps	10Mbps	2	8Mbps	---		1
			4.95Mbps	4.95Mbps		2
8Mbps	7Mbps	1	6.5Mbps	---	---	1

Table 10: Run Use Case

Quality rating test	Use Case 0	Fast zapping (Use Case 1 & 2)	Slow Zapping #1 (Use Case 1 & 2)	Slow Zapping #2 (Use Case 1 & 2)	Use Case 3
OPT	2 (CC1 + CC2)	4 (CC1 + CC2)	4 (CC1 + CC2)	4 (CC1 + CC2)	2 (CC1 - + CC2)
TVN	1 (CC3)	2 (CC3)	2 (CC3)	2 (CC3)	1 (CC3)
Total	3	6	6	6	3

Table 11: Quality Rating test overview

Number of quality rating test: 24

2.1.6 Quality Rating Test

Quality rating tests will be performed according to ITU-R Recommendation BT.500

- MOS scale: 1 to 5 (5 grades)
- Acceptability: simple binary answer [yes/no]
- The target is to check that packet dropping up to 33% keeps an acceptable QoE

2.1.7 Definition of User panel

A selection of users from a stable TI panel of users will be invited to the trial, they are characterised by different and complementary profiles, in terms of attitude towards new technologies and socio-demographic features.

The evaluation campaign is planned under the supervision of professional ergonomists certified by CREE (Centre for Registration of European Ergonomists). These Ergonomists are Telecom Italia personnel from TI LAB (Turin).

2.1.8 Test Rooms and Equipment

Every test was performed in one of our Residential Room in the User Experience Lab

- During the tests we used:
 - ✓ 1 TV of 40" located at 2.2 meters from the experimenter,
 - ✓ 1 TV to manage the test,
 - ✓ 2 set top boxes,
 - ✓ 1 ADSL Access Gateway.

2.2 Live Tests: Phase 1 – Use Case 0 & Use Case 3

This section describes the subjective tests done at Telecom Italia Lab about **Use Case 0** and **Use Case 3**. The final target of these tests has been to evaluate video quality, subjectively perceived.

This task was planned under Quality of Experience (QoE) modelling activity led by OptiBand Project. These first tests was applied only to 18 persons: however it retains very valuable qualitative indications for the following tasks (phase 2) and was a very useful opportunity to tune methodology and tools to be adopted in the next planned activity

Subjective tests done in a residential room in the Telecom Italia Lab User Experience Lab. 18 people (Telecom Italia colleagues) on the base of the following variables: Gender (female/man) and Age (over 40, under 40).

2.2.1 Methodology

We respected the policy of changing the content vision to avoid the presentation order effect. In this experimental test we adopt the **within-subjects** method: all participants are exposed to every condition.

In order to maintain an high attention level, we provide clips with a duration of 1,5 minutes. In our experience 1,5 minutes is enough to evaluate the overall quality and at the end of every sequence, the participant had to fill in a questionnaire to evaluate his/her video quality perception.

2.2.2 Sample Size and Characteristics

For experimental tests we recruited 18 colleagues according to the following variables:

- Gender (female/male);
- Age (over 40, under 40).

Sample Size					
Experimenters	Male	Female	Under 40	< 40 >	Over 40
18	10	8	3	5	10

Table 12: Sample Size Table

2.2.3 Test Setting

The encoded content is composed of:

- The video elementary stream encoded at 8 Mbit/s for each channel.
- The audio elementary stream (audio channel encoded AC3 at 128 Kbit/s each).
- No subtitles.

User's sequence:

User 1	User 2	User 3	User 4	User 5	User 6	User 7	User 8	User 9	User 10
Uc3: 7mb	Uc3: 7mb	Uc3: 7mb	Uc0: 15mb	Uc0: 15mb	Uc0: 15mb	Uc3: 7mb	Uc3: 7mb	Uc3: 7mb	Uc0: 15mb
1) Action	1) Soccer	1) Docum.	1) Action	1) Soccer	1) Soccer	1) Action	1) Soccer	1) Docum.	1) Action
2) Soccer	2) Docum.	2) Action	2) Soccer	2) Docum.	2) Docum.	2) Soccer	2) Docum.	2) Action	2) Soccer
3) Docum.	3) Action	3) Soccer	3) Docum.	3) Action	3) Action	3) Docum.	3) Action	3) Soccer	3) Docum.
Uc0: 15mb	Uc0: 15mb	Uc0: 15mb	Uc3: 7mb	Uc3: 7mb	Uc3: 7mb	Uc0: 15mb	Uc0: 15mb	Uc0: 15mb	Uc3: 7mb
4) Action	4) Soccer	4) Docum.	4) Action	4) Soccer	4) Docum.	4) Action	4) Soccer	4) Docum.	4) Action
5) Soccer	5) Docum.	5) Action	5) Soccer	5) Docum.	5) Action	5) Soccer	5) Docum.	5) Action	5) Soccer
5) Docum.	6) Action	6) Soccer	5) Docum.	6) Action	6) Soccer	5) Docum.	6) Action	6) Soccer	5) Docum.

User 11	User 12	User 13	User 14	User 15	User 16	User 17	User 18
Uc0: 15mb	Uc0: 15mb	Uc3: 7mb	Uc3: 7mb	Uc3: 7mb	Uc0: 15mb	Uc0: 15mb	Uc0: 15mb
1) Soccer	1) Soccer	1) Action	1) Soccer	1) Docum.	1) Action	1) Soccer	1) Soccer
2) Docum.	2) Docum.	2) Soccer	2) Docum.	2) Action	2) Soccer	2) Docum.	2) Docum.
3) Action	3) Action	3) Docum.	3) Action	3) Soccer	3) Docum.	3) Action	3) Action
Uc3: 7mb	Uc3: 7mb	Uc0: 15mb	Uc0: 15mb	Uc0: 15mb	Uc3: 7mb	Uc3: 7mb	Uc3: 7mb
4) Soccer	4) Docum.	4) Action	4) Soccer	4) Docum.	4) Action	4) Soccer	4) Docum.
5) Docum.	5) Action	5) Soccer	5) Docum.	5) Action	5) Soccer	5) Docum.	5) Action
6) Action	6) Soccer	5) Docum.	6) Action	6) Soccer	5) Docum.	6) Action	6) Soccer

Table 13: Users Sequences Table

2.2.4 Use Case 0 & Use Case 3: Gathered Results

MOS --- Action: Content Average Rating

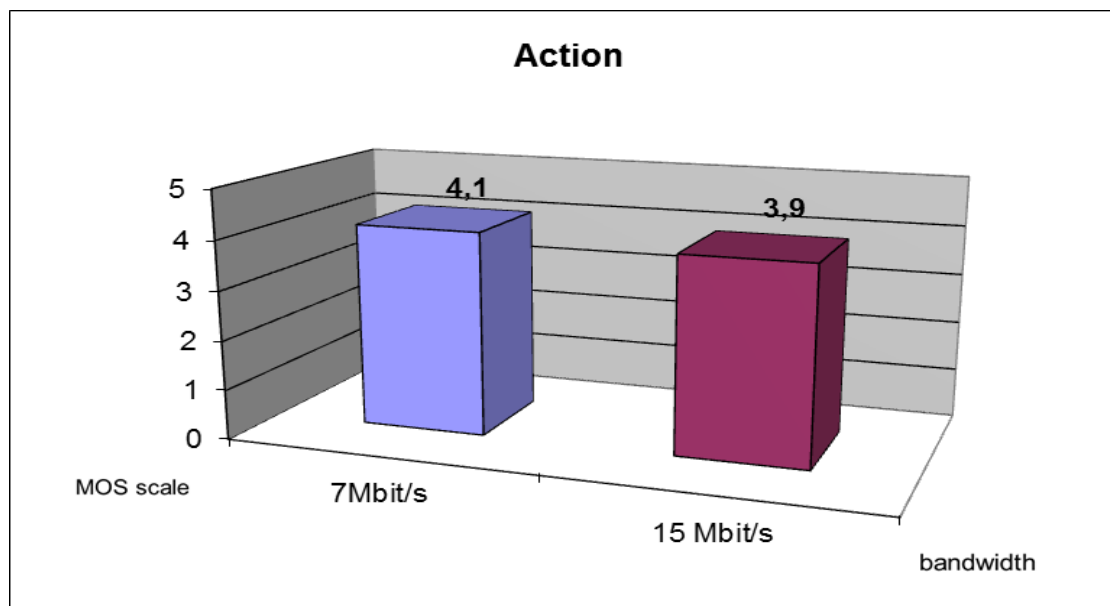


Figure 2: Action Average Rating

Average rating for ACTION is: 4.

At 15 Mbit/s of bandwidth perceived video quality is **slightly worse**.

MOS --- Soccer: Content Average Rating

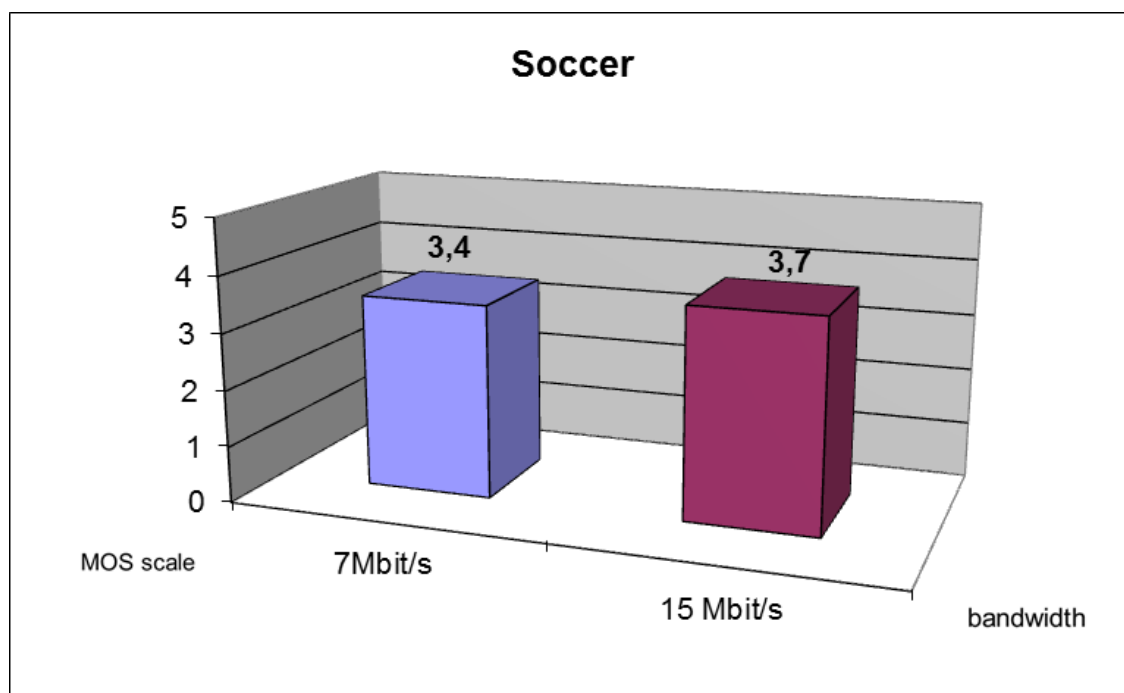


Figure 3: Soccer Average Rating

Average rating for SOCCER is: 3,58.

At 15 Mbit/s of bandwidth the perceived video quality is **slightly better**.

MOS --- Documentary: Content Average Rating

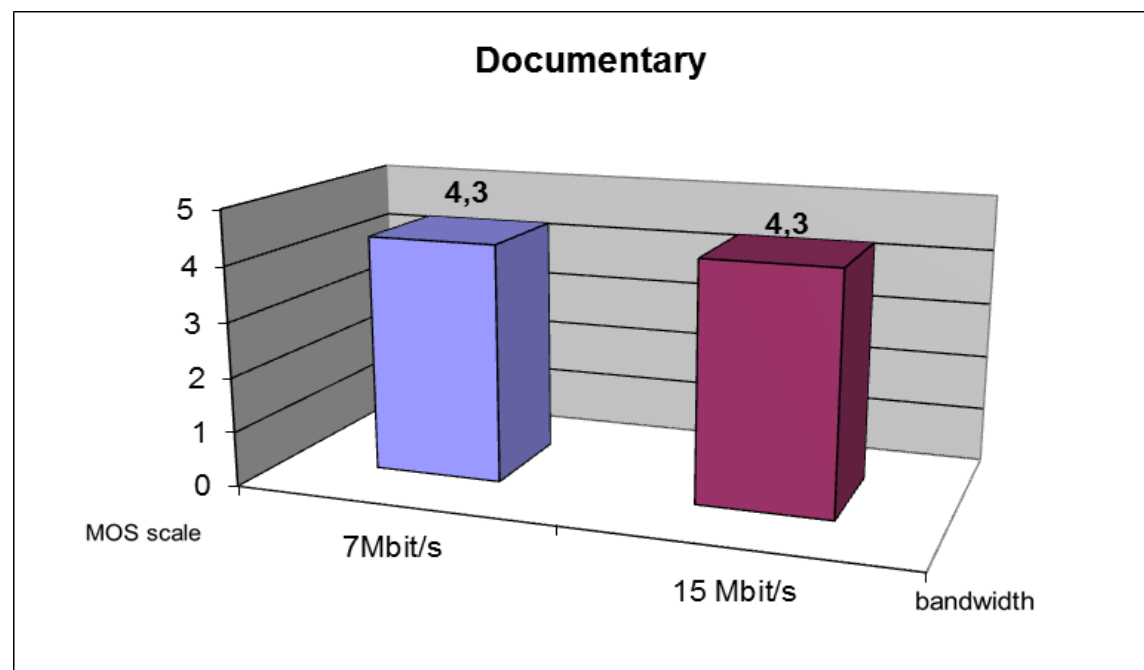


Figure 4: Documentary Average Rating

Average rating for DOCUMENTARY is: 4,3.

There are no differences about perceived video quality between different bandwidths.

MOS --- Overall: Average Rating

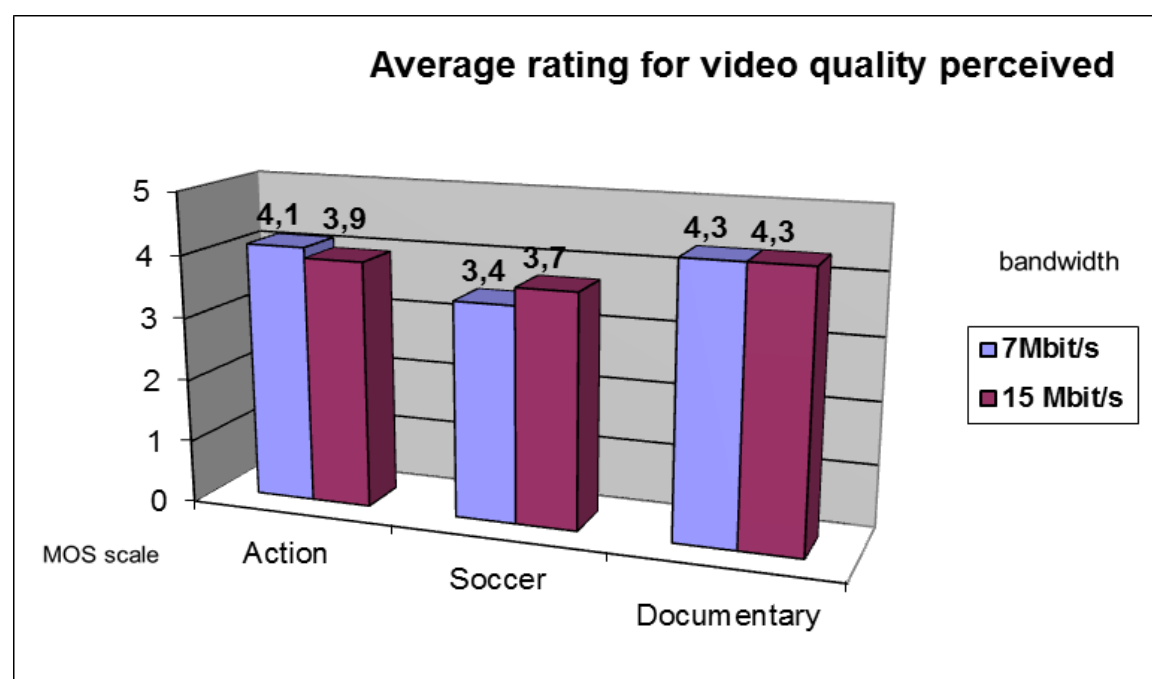


Figure 5: Overall Average Rating

Average rating for bandwidth at 15 Mbit/s is: 3,97.

- Relative to this bandwidth the content that has been perceived with the better video quality is DOCUMENTARY.

Average rating for bandwidth at 7 Mbit/s is: 3,93.

- Relative to this bandwidth the content that was perceived with the better video quality was the DOCUMENTARY

2.3 Live Tests: Phase 2 – Use Case 1 & Use Case 2

The document describes the subjective tests done at Telecom Italia Lab about **Use Case 1** and **Use Case 2**.

The final target of these tests has been to evaluate:

- 1) video quality, subjectively perceived
- 2) acceptability quality, subjectively perceived

This task was planned under Quality of Experience (QoE) modelling activity led by OptiBand Project. These tests have a statistical value because they applied to 30 persons. Subjective tests done in a Residential room in the Telecom Italia Lab User Experience Lab. 30 people (Telecom Italia colleagues) on the base of the following variables: Gender (female/male) and Age (over 40, under 40).

2.3.1 Methodology

We respected the policy of changing the content vision to avoid the presentation order effect. In these experimental tests we adopt the **between-subjects** method.

All crossings of the variables:

- clip content,
- use case,
- different levels of zapping, would produce a very high number of combinations.
- We divided the sample in three different groups: the first evaluate the cc1 + cc2, the second cc2+cc3 and the third cc1+cc3.
- In this experimental design each user tested and evaluated twelve different combinations (maximum number of combinations to be provided during a single test)
- In order to maintain a high attention level, we provide clips with a duration of 2 minutes.
- At the end of every sequence, the participant had to fill in a questionnaire to evaluate:
 1. Acceptability Quality: yes/no
 2. His/her video quality perception using the MOS scale: 1 to 5 (1=bad,....5=excellent).

2.3.2 Sample Size Characteristics

For experimental tests we recruited 30 colleagues according to the following variables:

- ✓ Gender (female/male);
- ✓ Age (over 40, under 40).

Sample Size					
Experimenters	Male	Female	Under 40	< 40 >	Over 40
30	15	15	10	---	20

Table 14: Sample Size Table

2.3.3 Test Setting

The encoded content is composed of:

- The video elementary stream encoded at 8 Mbit/s for each channel.
- The audio elementary stream (audio channel encoded AC3 at 128 Kbit/s each).

- No subtitles.

User's sequence:

	User1	User2	User3	User4	User5	User6	User7	User8	User9	User10	User11	User12	User13	User14	User15
	Uc1	Uc1	Uc1	Uc2	Uc2	Uc2	Uc1	Uc1	Uc1	Uc2	Uc2	Uc2	Uc1	Uc1	Uc1
Use Case	Video	Video	Video	Video	Video	Video	Video	Video	Video	Video	Video	Video	Video	Video	Video
Content	Action	Soccer	Docum	Action	Soccer	Docum	Action	Soccer	Docum	Action	Soccer	Docum	Action	Soccer	Docum
Movie: 1	Fast Zapping	Slow Zapping1	Slow Zapping2	Fast Zapping	Slow Zapping1	Slow Zapping2	Slow Zapping1	Slow Zapping2	Fast Zapping	Slow Zapping1	Slow Zapping2	Slow Zapping1	Slow Zapping2	Fast Zapping	Slow Zapping1
Movie: 2	Slow Zapping1	Slow Zapping2	Fast Zapping	Slow Zapping1	Slow Zapping2	Fast Zapping	Slow Zapping1	Slow Zapping2	Fast Zapping	Slow Zapping1	Slow Zapping2	Slow Zapping1	Slow Zapping2	Fast Zapping	Slow Zapping1
Movie: 3	Slow Zapping2	Fast Zapping	Slow Zapping1	Slow Zapping2	Fast Zapping	Slow Zapping1	Fast Zapping	Slow Zapping1	Slow Zapping2	Fast Zapping	Slow Zapping1	Slow Zapping2	Slow Zapping1	Slow Zapping2	Fast Zapping
Use Case	Uc2	Uc2	Uc2	Uc1	Uc1	Uc1	Uc2	Uc2	Uc2	Uc1	Uc1	Uc1	Uc2	Uc2	Uc2
Content	Video	Video	Video	Video	Video	Video	Video	Video	Video	Video	Video	Video	Video	Video	Video
Movie: 4	Soccer	Docum	Action	Soccer	Docum	Action	Soccer	Docum	Action	Soccer	Docum	Action	Soccer	Docum	Action
Movie: 5	Fast Zapping	Slow Zapping1	Slow Zapping2	Fast Zapping	Slow Zapping1	Slow Zapping2	Slow Zapping1	Slow Zapping2	Fast Zapping	Slow Zapping1	Slow Zapping2	Slow Zapping1	Slow Zapping2	Fast Zapping	Slow Zapping1
Movie: 6	Slow Zapping1	Slow Zapping2	Fast Zapping	Slow Zapping1	Slow Zapping2	Fast Zapping	Slow Zapping1	Slow Zapping2	Fast Zapping	Slow Zapping1	Slow Zapping2	Slow Zapping1	Slow Zapping2	Fast Zapping	Slow Zapping1
Movie: 7	Slow Zapping2	Fast Zapping	Slow Zapping1	Slow Zapping2	Fast Zapping	Slow Zapping1	Fast Zapping	Slow Zapping1	Slow Zapping2	Fast Zapping	Slow Zapping1	Slow Zapping2	Slow Zapping1	Slow Zapping2	Fast Zapping
Content	Video	Video	Video	Video	Video	Video	Video	Video	Video	Video	Video	Video	Video	Video	Video
Movie: 8	Action	Soccer	Docum	Action	Soccer	Docum	Action	Soccer	Docum	Action	Soccer	Docum	Action	Soccer	Docum
Movie: 9	Fast Zapping	Slow Zapping1	Slow Zapping2	Fast Zapping	Slow Zapping1	Slow Zapping2	Slow Zapping1	Slow Zapping2	Fast Zapping	Slow Zapping1	Slow Zapping2	Slow Zapping1	Slow Zapping2	Fast Zapping	Slow Zapping1
Use Case	Uc1	Uc1	Uc1	Uc2	Uc2	Uc2	Uc1	Uc1	Uc1	Uc2	Uc2	Uc2	Uc1	Uc1	Uc1
Content	Video	Video	Video	Video	Video	Video	Video	Video	Video	Video	Video	Video	Video	Video	Video
Movie: 10	Soccer	Docum	Action	Soccer	Docum	Action	Soccer	Docum	Action	Soccer	Docum	Action	Soccer	Docum	Action
Movie: 11	Fast Zapping	Slow Zapping1	Slow Zapping2	Fast Zapping	Slow Zapping1	Slow Zapping2	Slow Zapping1	Slow Zapping2	Fast Zapping	Slow Zapping1	Slow Zapping2	Slow Zapping1	Slow Zapping2	Fast Zapping	Slow Zapping1
Movie: 12	Slow Zapping2	Fast Zapping	Slow Zapping1	Slow Zapping2	Fast Zapping	Slow Zapping1	Fast Zapping	Slow Zapping1	Slow Zapping2	Fast Zapping	Slow Zapping1	Slow Zapping2	Slow Zapping1	Slow Zapping2	Fast Zapping

Table 15: UC1- UC2 Users Sequences Table 1/2

	User16	User17	User18	User19	User20	User21	User22	User23	User24	User25	User26	User27	User28	User29	User30
Use Case	Uc2	Uc2	Uc2	Uc1	Uc1	Uc1	Uc2	Uc2	Uc2	Uc1	Uc1	Uc1	Uc2	Uc2	Uc2
Content	Video Action	Video Soccer	Video Docum	Video Action	Video Soccer	Video Docum	Video Action	Video Soccer	Video Docum	Video Action	Video Soccer	Video Docum	Video Action	Video Soccer	Video Docum
Movie: 1	Slow Zapping2	Fast Zapping	Slow Zapping1	Fast Zapping	Slow Zapping1	Slow Zapping2	Fast Zapping	Slow Zapping1	Slow Zapping2	Slow Zapping2	Slow Zapping2	Fast Zapping	Slow Zapping1	Slow Zapping2	Fast Zapping
Movie: 2	Fast Zapping	Slow Zapping1	Slow Zapping2	Slow Zapping1	Slow Zapping2	Fast Zapping	Slow Zapping1	Slow Zapping2	Fast Zapping	Slow Zapping2	Fast Zapping	Slow Zapping1	Slow Zapping2	Fast Zapping	Slow Zapping1
Movie: 3	Slow Zapping1	Slow Zapping2	Fast Zapping	Slow Zapping2	Fast Zapping	Slow Zapping1	Slow Zapping2	Fast Zapping	Slow Zapping1	Fast Zapping	Slow Zapping1	Slow Zapping2	Fast Zapping	Slow Zapping1	Slow Zapping2
Use Case	Uc1	Uc1	Uc1	Uc2	Uc2	Uc2	Uc1	Uc1	Uc1	Uc2	Uc2	Uc2	Uc1	Uc1	Uc1
Content	Video Soccer	Video Docum	Video Action	Video Soccer	Video Docum	Video Action	Video Soccer	Video Docum	Video Action	Video Soccer	Video Docum	Video Action	Video Soccer	Video Docum	Video Action
Movie: 4	Slow Zapping2	Fast Zapping	Slow Zapping1	Fast Zapping	Slow Zapping1	Slow Zapping2	Fast Zapping	Slow Zapping1	Slow Zapping2	Slow Zapping1	Slow Zapping2	Fast Zapping	Slow Zapping1	Slow Zapping2	Fast Zapping
Movie: 5	Fast Zapping	Slow Zapping1	Slow Zapping2	Slow Zapping1	Slow Zapping2	Fast Zapping	Slow Zapping1	Slow Zapping2	Fast Zapping	Slow Zapping2	Fast Zapping	Slow Zapping1	Slow Zapping2	Fast Zapping	Slow Zapping1
Movie: 6	Slow Zapping1	Slow Zapping2	Fast Zapping	Slow Zapping2	Fast Zapping	Slow Zapping1	Slow Zapping2	Fast Zapping	Slow Zapping1	Fast Zapping	Slow Zapping1	Slow Zapping2	Fast Zapping	Slow Zapping1	Slow Zapping2
Content	Video Action	Video Soccer	Video Docum	Video Action	Video Soccer	Video Docum	Video Action	Video Soccer	Video Docum	Video Action	Video Soccer	Video Docum	Video Action	Video Soccer	Video Docum
Movie: 7	Slow Zapping2	Fast Zapping	Slow Zapping1	Fast Zapping	Slow Zapping1	Slow Zapping2	Fast Zapping	Slow Zapping1	Slow Zapping2	Slow Zapping1	Slow Zapping2	Fast Zapping	Slow Zapping1	Slow Zapping2	Fast Zapping
Movie: 8	Fast Zapping	Slow Zapping1	Slow Zapping2	Slow Zapping1	Slow Zapping2	Fast Zapping	Slow Zapping1	Slow Zapping2	Fast Zapping	Slow Zapping2	Fast Zapping	Slow Zapping1	Slow Zapping2	Fast Zapping	Slow Zapping1
Movie: 9	Slow Zapping1	Slow Zapping2	Fast Zapping	Slow Zapping2	Fast Zapping2	Slow Zapping1	Slow Zapping2	Fast Zapping	Slow Zapping1	Fast Zapping	Slow Zapping1	Slow Zapping2	Fast Zapping	Slow Zapping1	Slow Zapping2
Use Case	Uc2	Uc2	Uc2	Uc1	Uc1	Uc1	Uc2	Uc2	Uc2	Uc1	Uc1	Uc1	Uc2	Uc2	Uc2
Content	Video Soccer	Video Docum	Video Action	Video Soccer	Video Docum	Video Action	Video Soccer	Video Docum	Video Action	Video Soccer	Video Docum	Video Action	Video Soccer	Video Docum	Video Action
Movie: 10	Slow Zapping2	Fast Zapping	Slow Zapping1	Fast Zapping	Slow Zapping1	Slow Zapping2	Fast Zapping	Slow Zapping1	Slow Zapping2	Slow Zapping1	Slow Zapping2	Fast Zapping	Slow Zapping1	Slow Zapping2	Fast Zapping
Movie: 11	Fast Zapping	Slow Zapping1	Slow Zapping2	Slow Zapping1	Slow Zapping2	Fast Zapping	Slow Zapping1	Slow Zapping2	Fast Zapping	Slow Zapping2	Fast Zapping	Slow Zapping1	Slow Zapping2	Fast Zapping	Slow Zapping1
Movie: 12	Slow Zapping1	Slow Zapping2	Fast Zapping	Slow Zapping2	Fast Zapping	Slow Zapping1	Slow Zapping2	Fast Zapping	Slow Zapping1	Fast Zapping	Slow Zapping1	Slow Zapping2	Fast Zapping	Slow Zapping1	Slow Zapping2

Table 16: UC1- UC2 Users Sequences Table 2/2

2.3.4 Use Case 1 & Use Case 2: Gathered Results

MOS --- Action: Content Average Rating

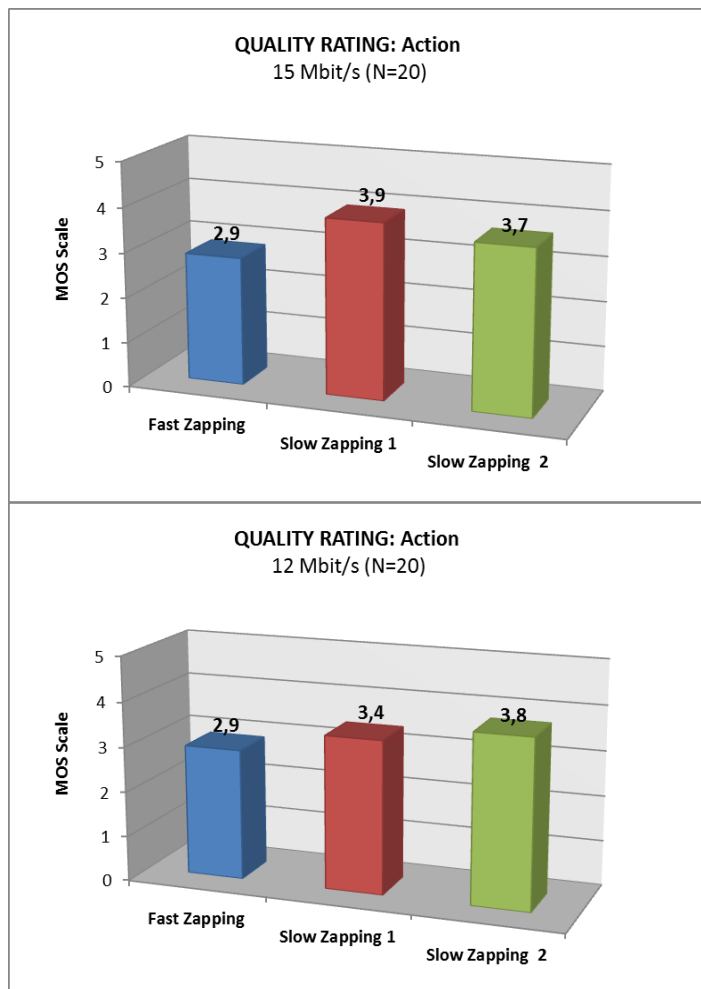
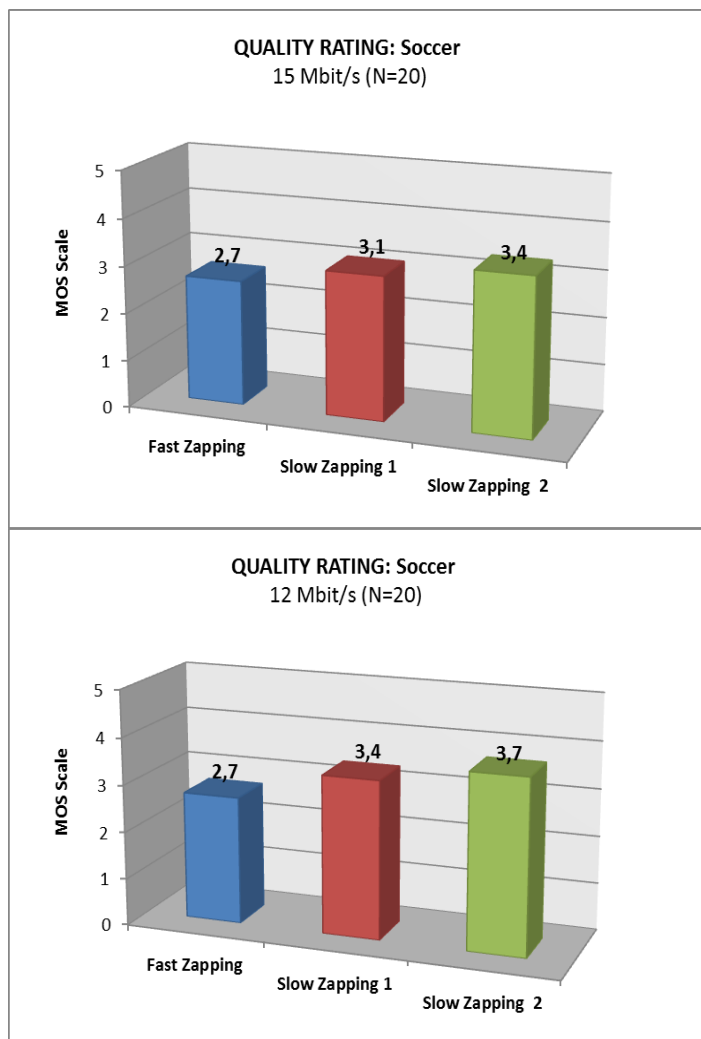


Figure 6: Action Average Rating for UC2 and UC2

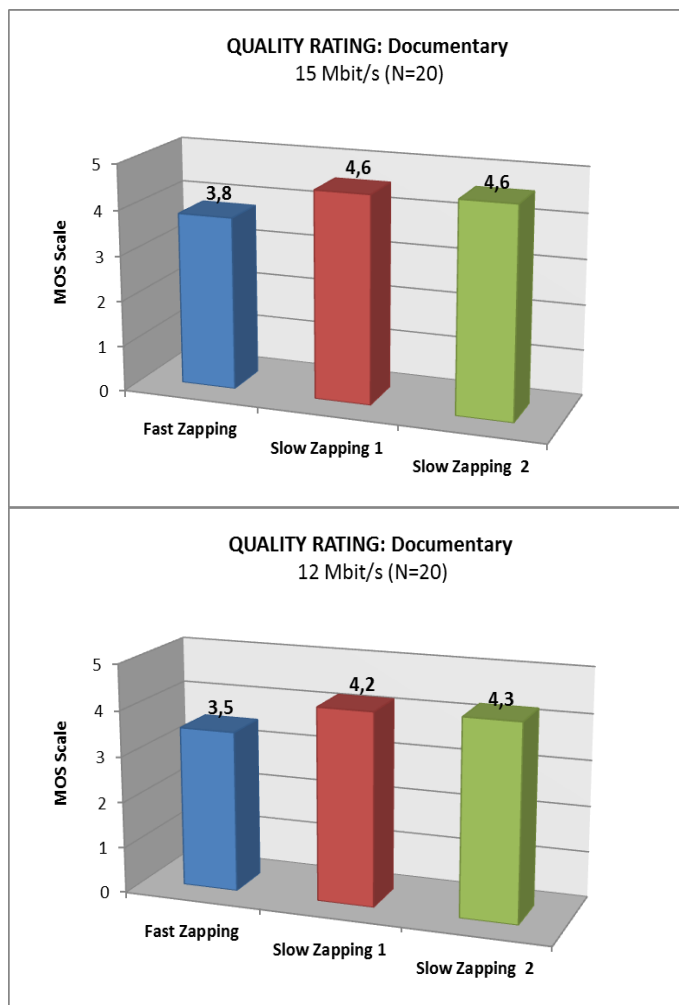
The best quality rating for action content, has been for UC1 (15 Mbit/s) with slow zapping 1. The worst quality rating has been with fast zapping for both Use Cases.

MOS --- Soccer: Content Average Rating

**Figure 7: Soccer Average Rating for UC1 and UC2**

Soccer has been the content that, overall, got the worst quality rating. The best quality rating for soccer content, has been for UC2 (12 Mbit/s) with slow zapping 2. The worst quality rating has been with fast zapping for both Use Cases.

MOS --- Documentary: Content Average Rating

**Figure 8: Documentary Average Rating for UC1 and UC2**

Documentary has been the content that, overall, got the best quality rating. The best quality rating for documentary content, has been for UC1 (15 Mbit/s) with slow zapping. The worst quality rating has been for UC2 (12 Mbit/s) with fast zapping.

MOS --- Overall: Average Rating

30 experimenters evaluated sequentially: 6 movies UC1 (15Mbit/s) and 6 movies UC2 (12Mbit/s)

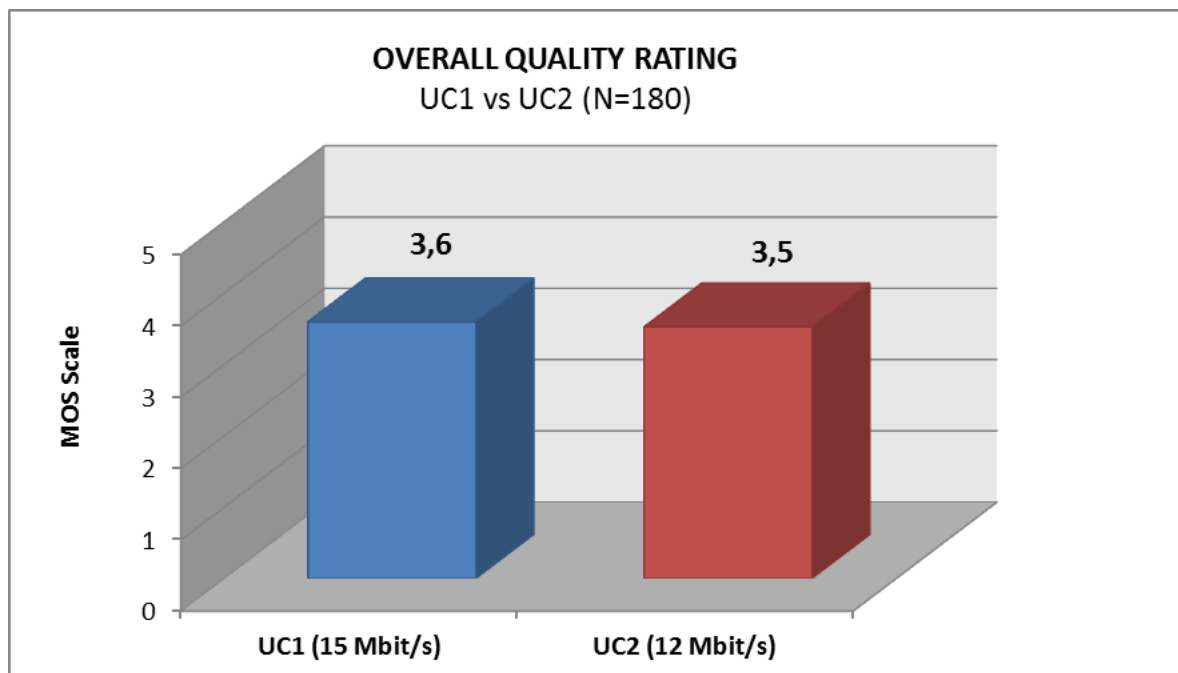


Figure 9: Overall Average Rating UC1 vs. UC2

On average, the testers evaluated similarly UC1 and UC2 quality rating

30 experimenters evaluated sequentially: 6 movies UC1 (15Mbit/s) and 6 movies UC2 (12Mbit/s)

Every three movies the zapping has been changed.

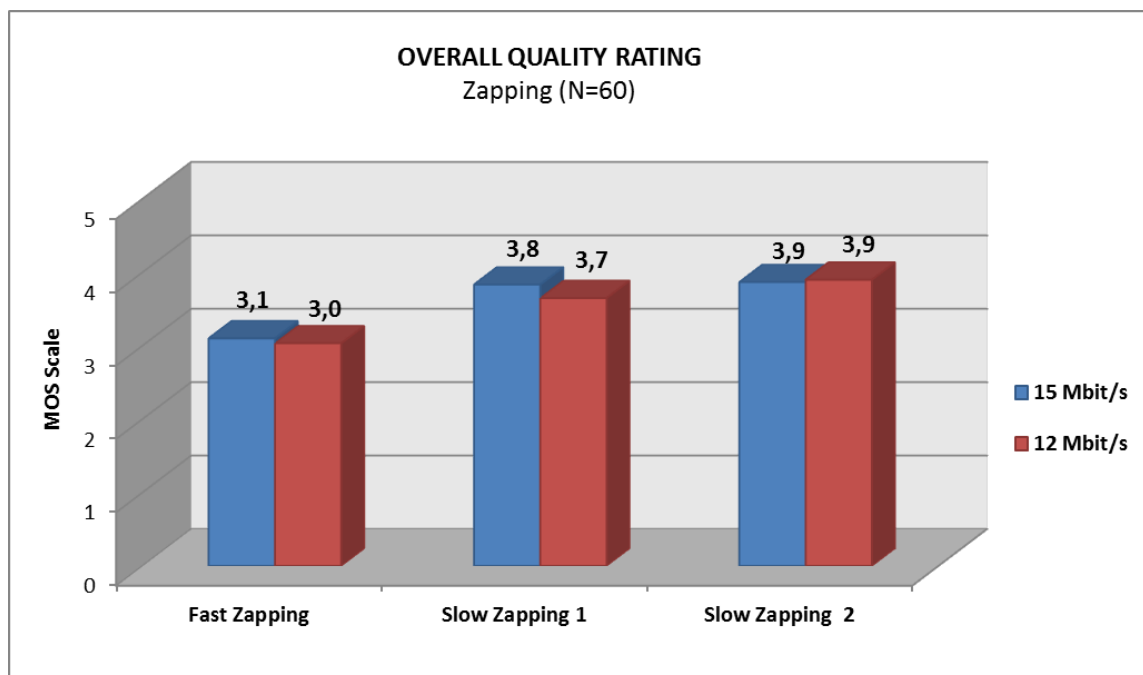


Figure 10: Overall Average Rating – Zapping Type

On average, only with “fast zapping” the quality rating perceived degraded. With “slow zapping 1 and 2” the quality rating perceived increases a little bit.

Acceptability --- Action: Content Average Rating

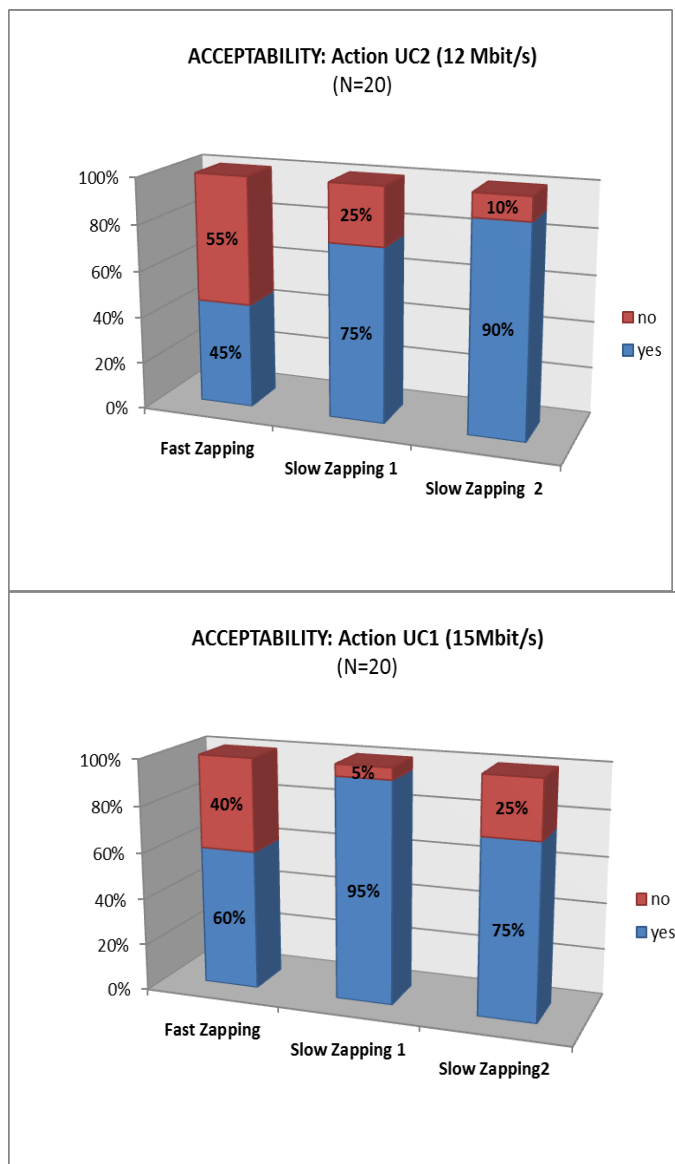


Figure 11: Acceptability → Action Average Rating for UC1 and UC2

The best acceptability video for action content has been for UC1 (15 Mbit/s) with slow zapping 1, and for UC2 (12 Mbit/s) with slow zapping 2. With fast zapping the acceptability video, for each Use Case, has never been over 60%.

Acceptability --- Soccer: Content Average Rating

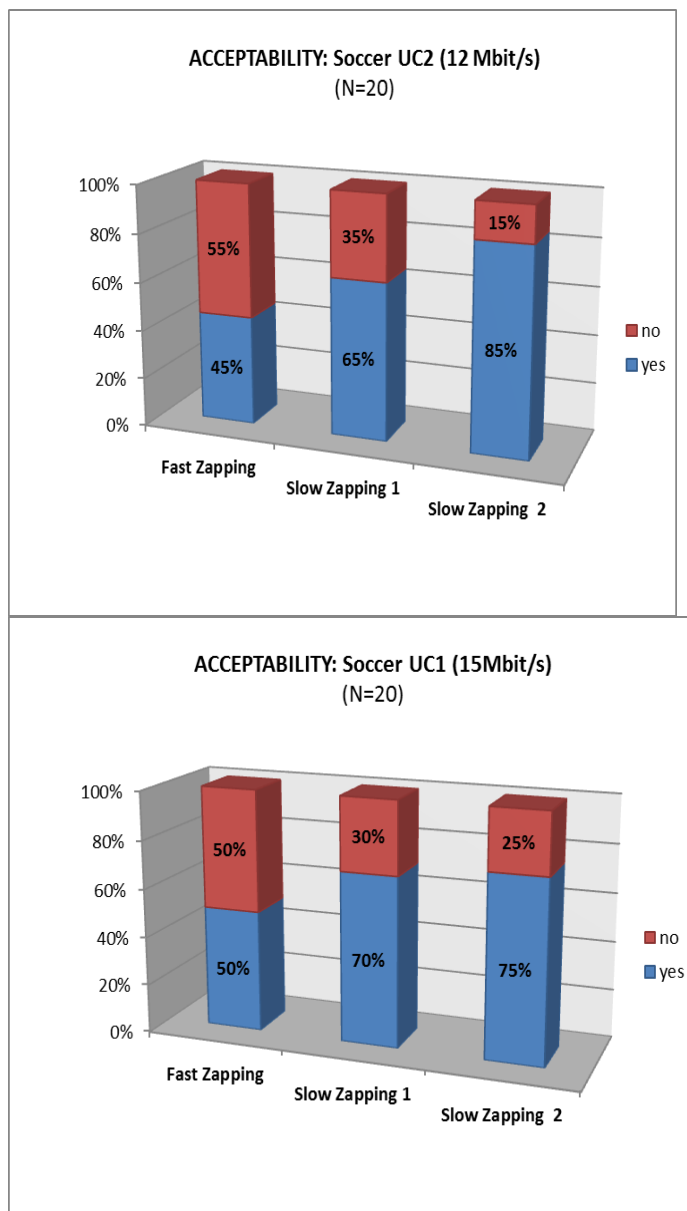


Figure 12: Acceptability → Soccer Average Rating for UC1 and UC2

Soccer has been the content that, overall, was considered less acceptable. With fast zapping the acceptability video, for each Use case, has never been over 50%.

Acceptability --- Documentary: Content Average Rating

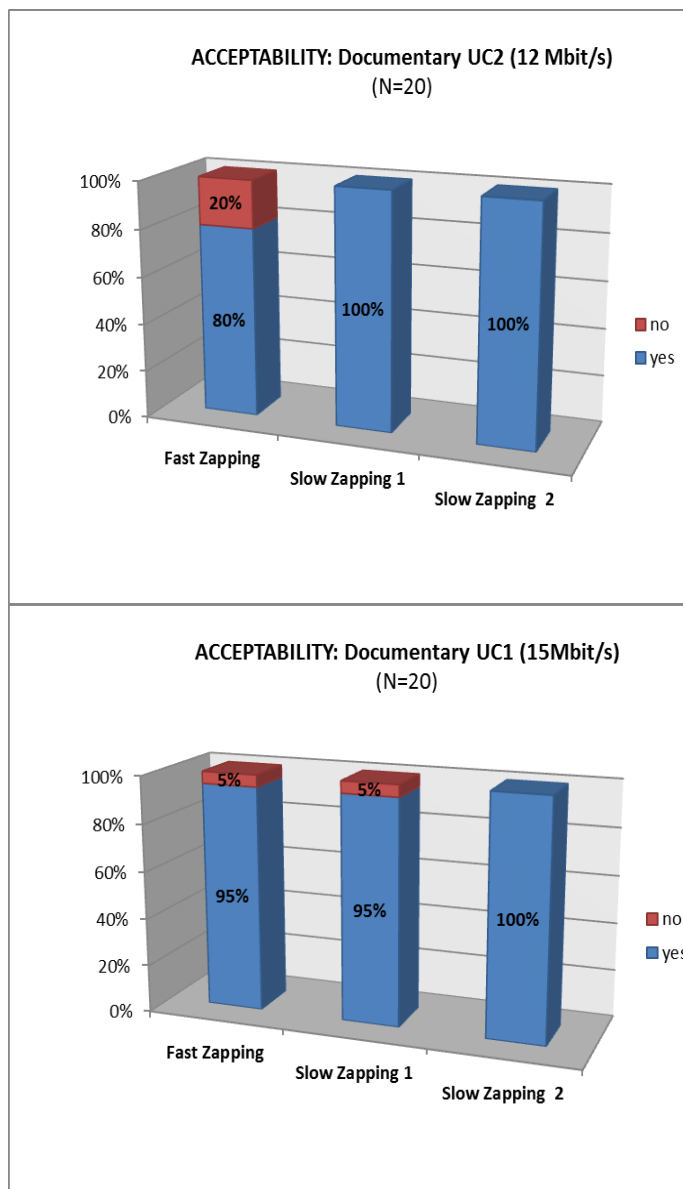


Figure 13: Acceptability → Documentary Average Rating for UC1 and UC2

Documentary has been the content that, overall, has resulted more acceptable. With UC2 (12 Mbit/s) all testers have considered acceptable the clip with slow zapping (1&2) and only 20% have evaluated no-acceptable the clip with fast zapping. With UC1 (15 Mbit/s) almost all testers have considered acceptable the clips.

ACCEPTABILITY --- Overall: Average Rating

30 experimenters evaluated sequentially 6 movies UC1 (15Mbit/s) and 6 movies UC2 (12Mbit/s)

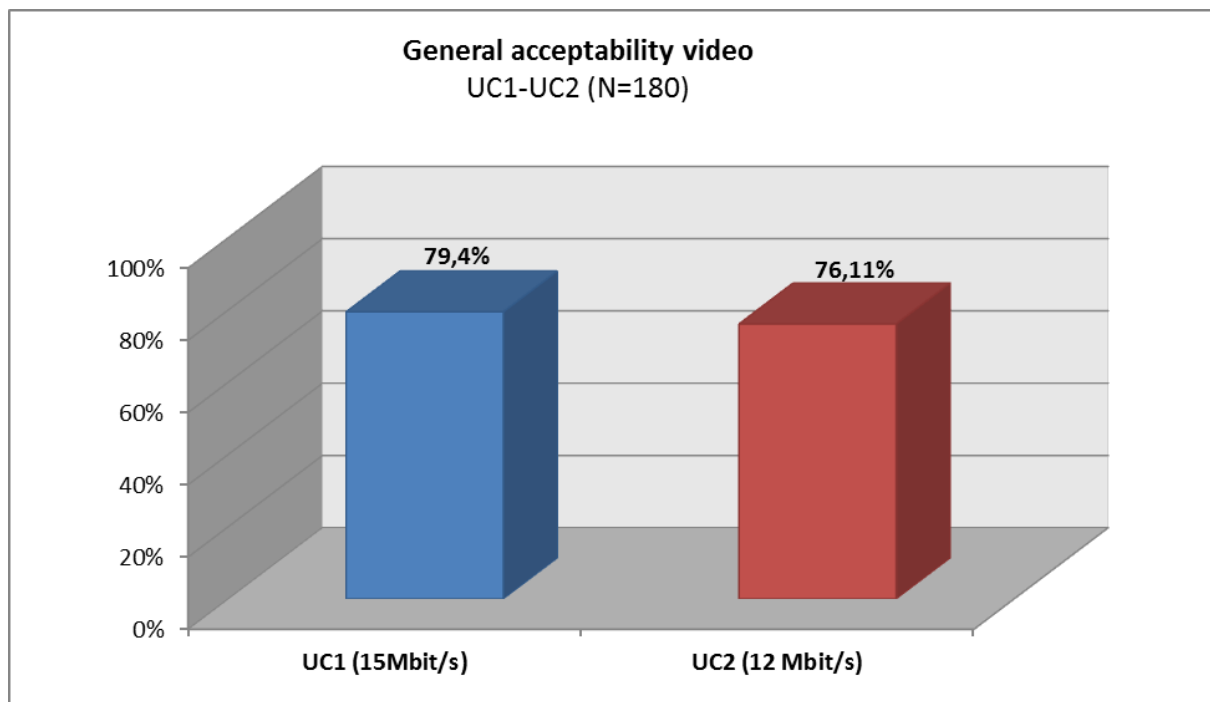


Figure 14: Acceptability → Overall Average Rating UC1 vs. UC2

On average, the testers evaluated a little bit less acceptable UC2 than UC1. In general the acceptability exceeded 75%.

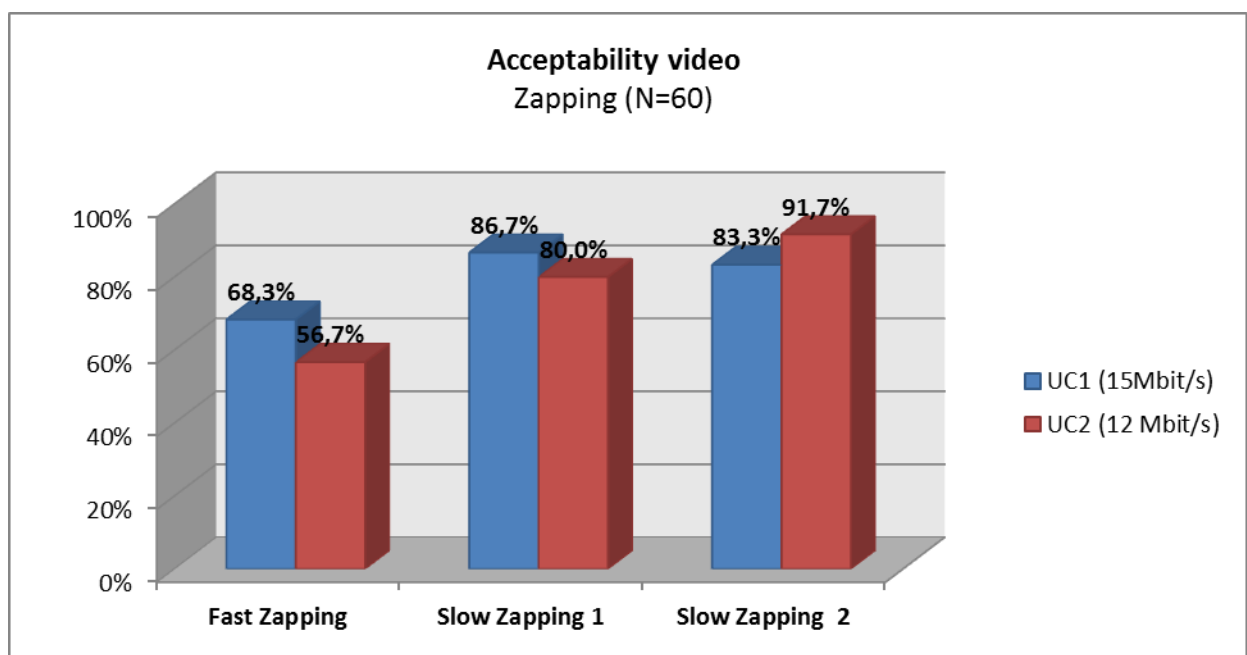


Figure 15: Acceptability → Overall Average Rating UC1 vs. UC2. Zapping Type

On average, with “fast zapping” the acceptability video degraded clearly. The best has been “slow zapping 2” with UC2.

2.4 End Users Characteristics in Live Tests: Phase 1 and Phase 2

2.4.1 End Users Characteristics Phase1 - Use Case 0 & Use Case 3

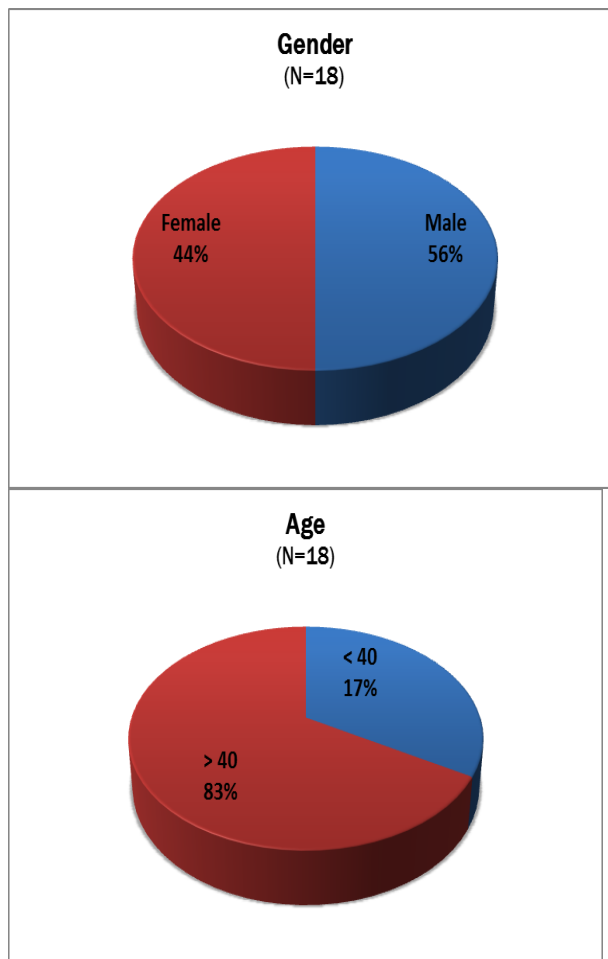


Figure 16: Users → Male vs. Female

There are 2 males more than females.
forty-years old.

Age → Users Age

More than 80% experimenters are over

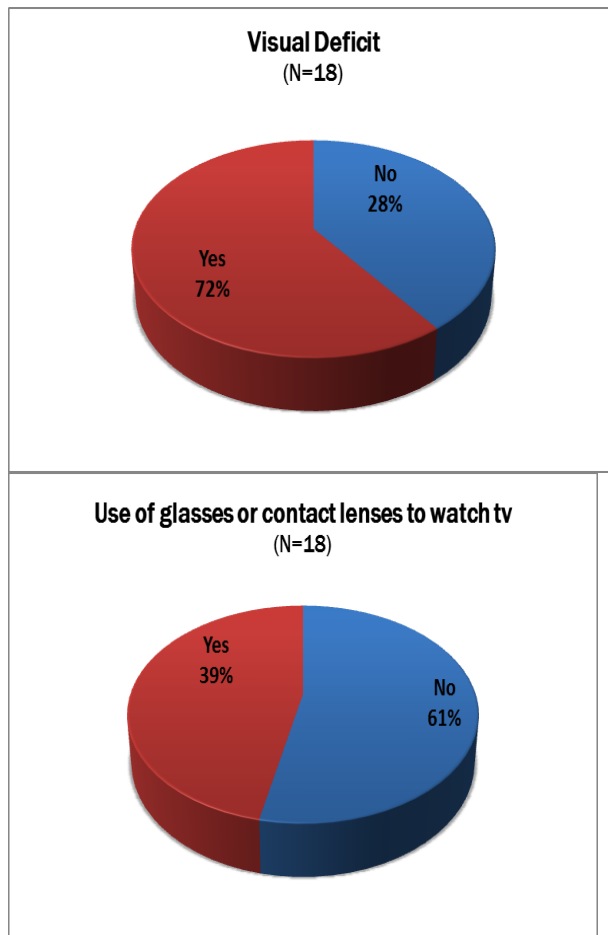


Figure 17: Do you have visual deficit? (Yes/No)
Do you use glasses or contact lenses to watch TV? (Yes/No)

More than 70% testers have some visual deficit (myopia, astigmatism, etc.).
About 60% use glasses or contact lenses to watch TV

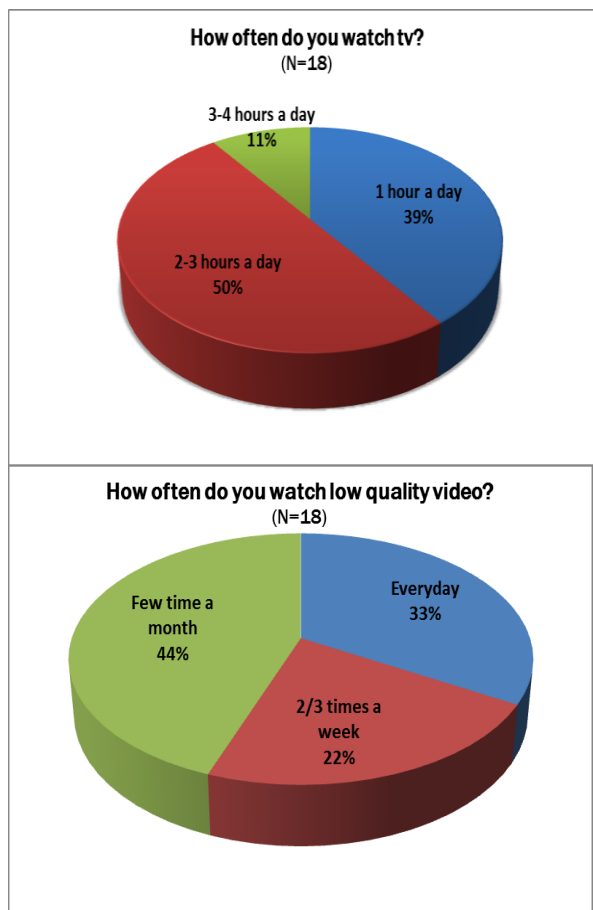


Figure 18: How often do you watch TV?: How often do you watch low quality video?
(1h a day – 2/3h a day – 3/4h a day – >4h a day) (every day – 2/3 times a week sometime a month – never)

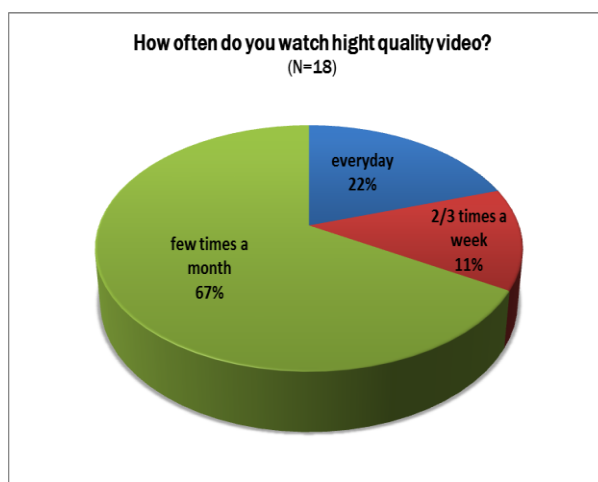


Figure 19: How often do you watch high quality (every day – 2/3 times a week - sometime a month – never)

An half of our sample size says that they watch TV 2-3 hours a day meanwhile 39% only 1 hour a day.

More than 55% say that watch low quality video every day or 2/3 times a week

The most of our Sample Size (67%) use to watch high quality video only few times a month.

Optiband: Live Tests – Phase 1

Experimenters' words

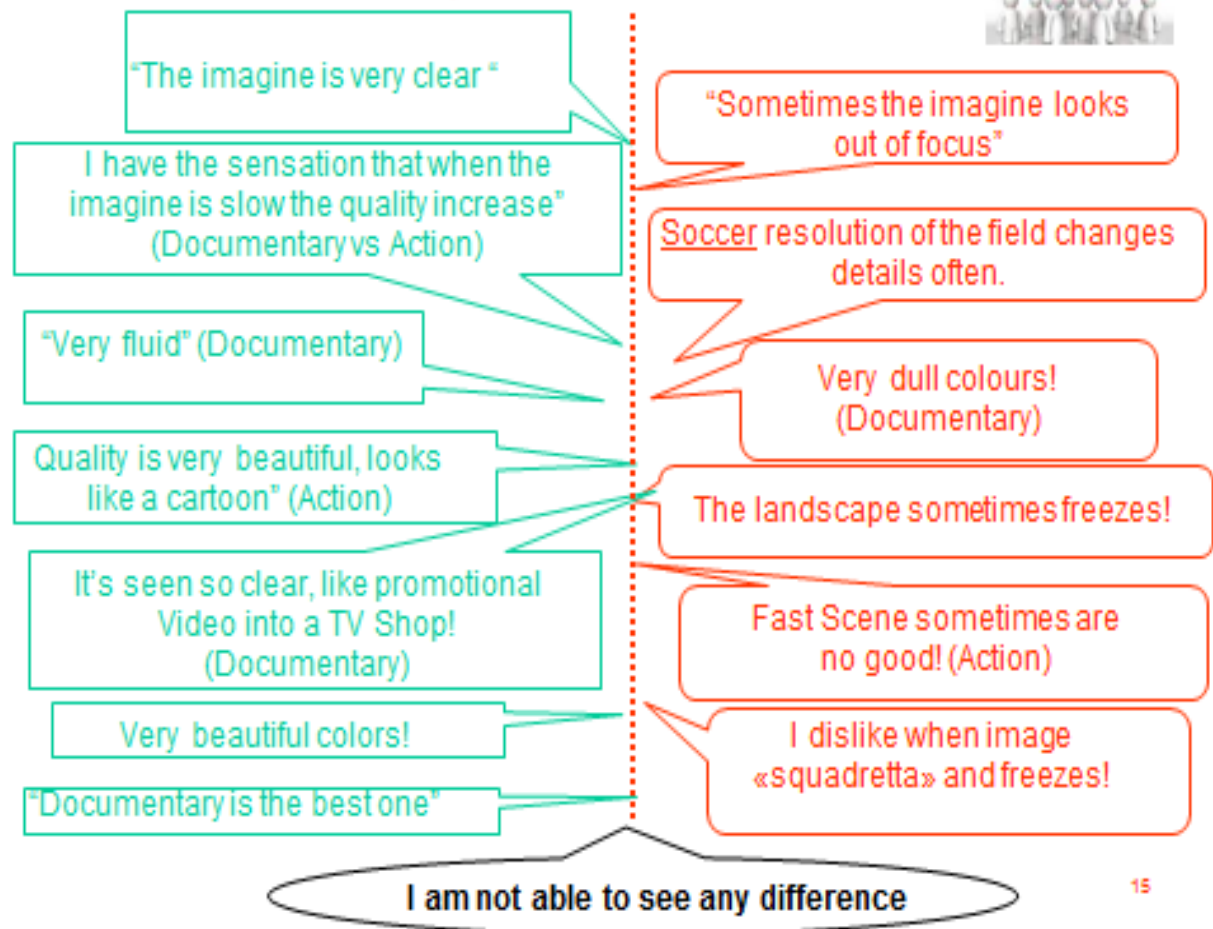


Figure 20 Some Users Comments

2.4.2 End Users Characteristics Phase2 - Use Case 1 & Use Case 2

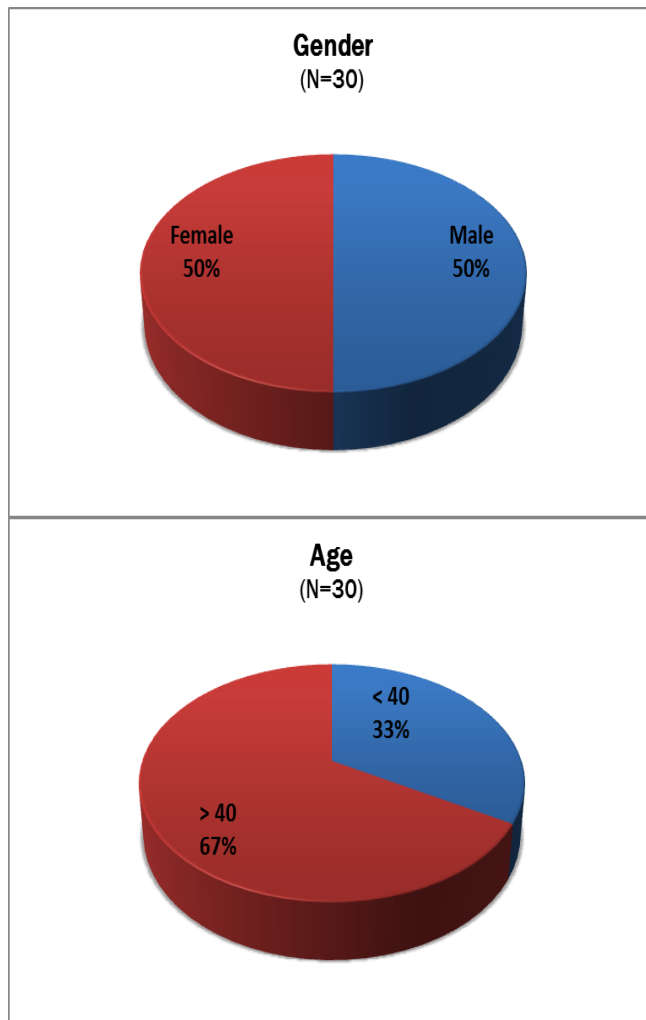


Figure 21: Users → Male vs. Female

Females and males are equally represented.

Age → Users Age

In this Sample Size, 67% testers

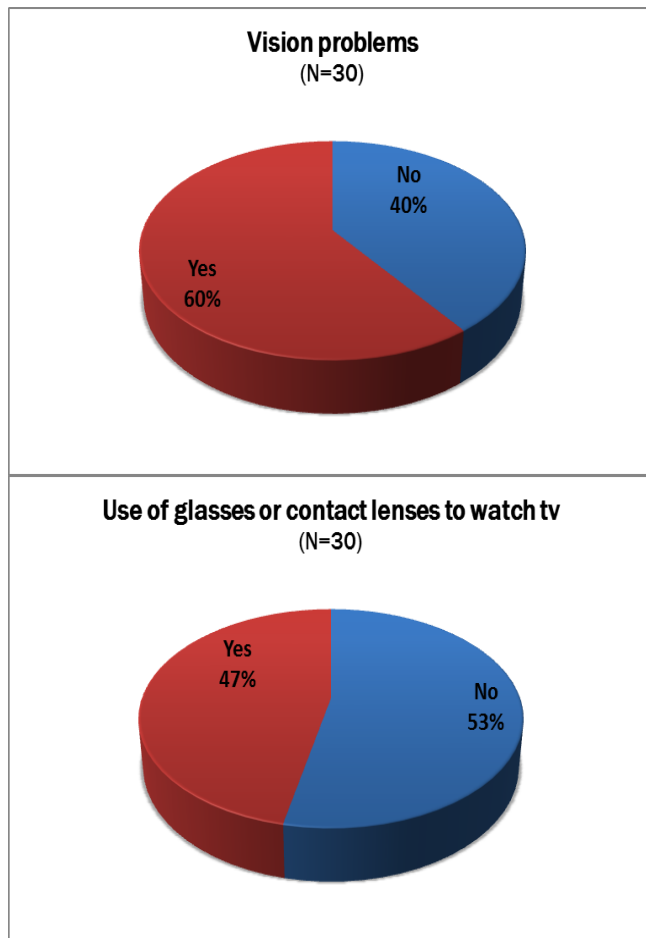


Figure 22: Do you have visual problem? (Yes/No)
Do you use glasses or contact lenses to watch TV? (Yes/No)

In this Sample Size, 60% testers have some visual deficit (myopia, astigmatism, etc.).
In this Sample Size, less than 50% use glasses or contact lenses to watch TV.

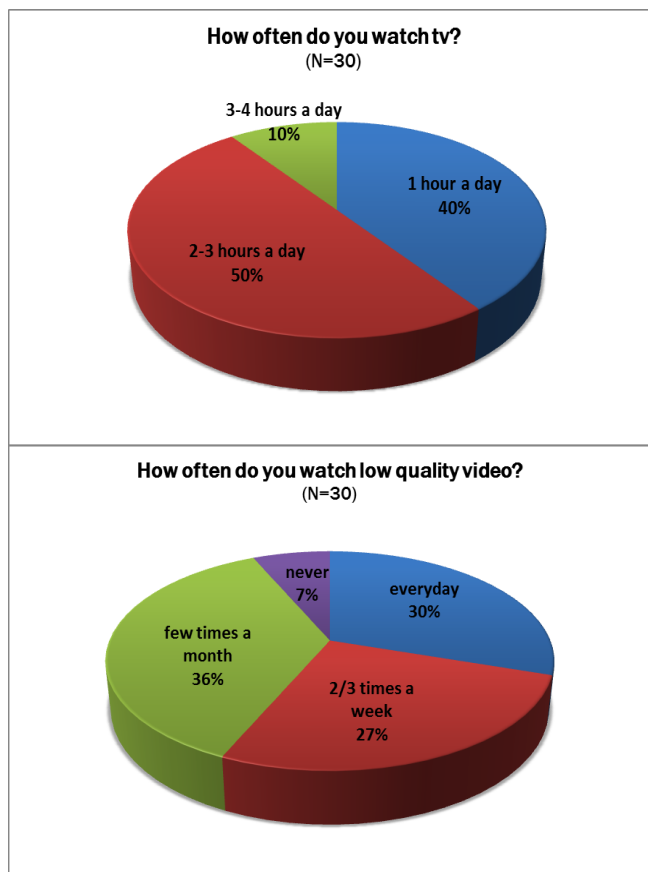


Figure 23: How often do you watch TV?: How often do you watch low quality video?
(1h a day – 2/3h a day – 3/4h a day - >4h a day) (every day – 2/3 times a week sometime a month – never)

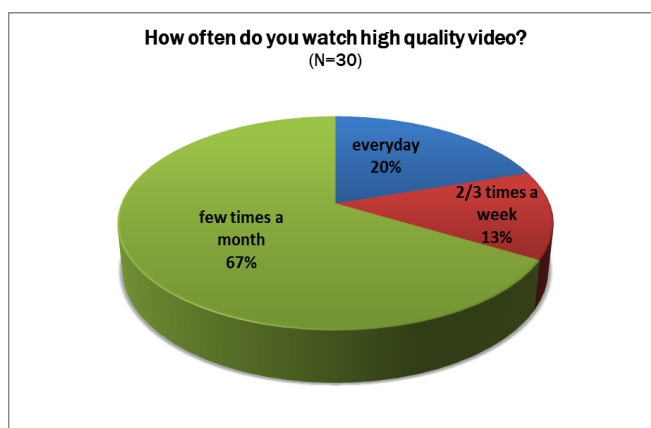


Figure 24: How often do you watch high quality?
(every day – 2/3 times a week - sometime a month – never)

A half of our sample size says that they watch TV 2-3 hours a day meanwhile 39% only 1 hour a day.
More than 55% say that watch low quality video every day or 2/3 times a week
The most of our Sample Size (67%) use to watch high quality video only few times a month.

Optiband: Live Tests – Phase 2

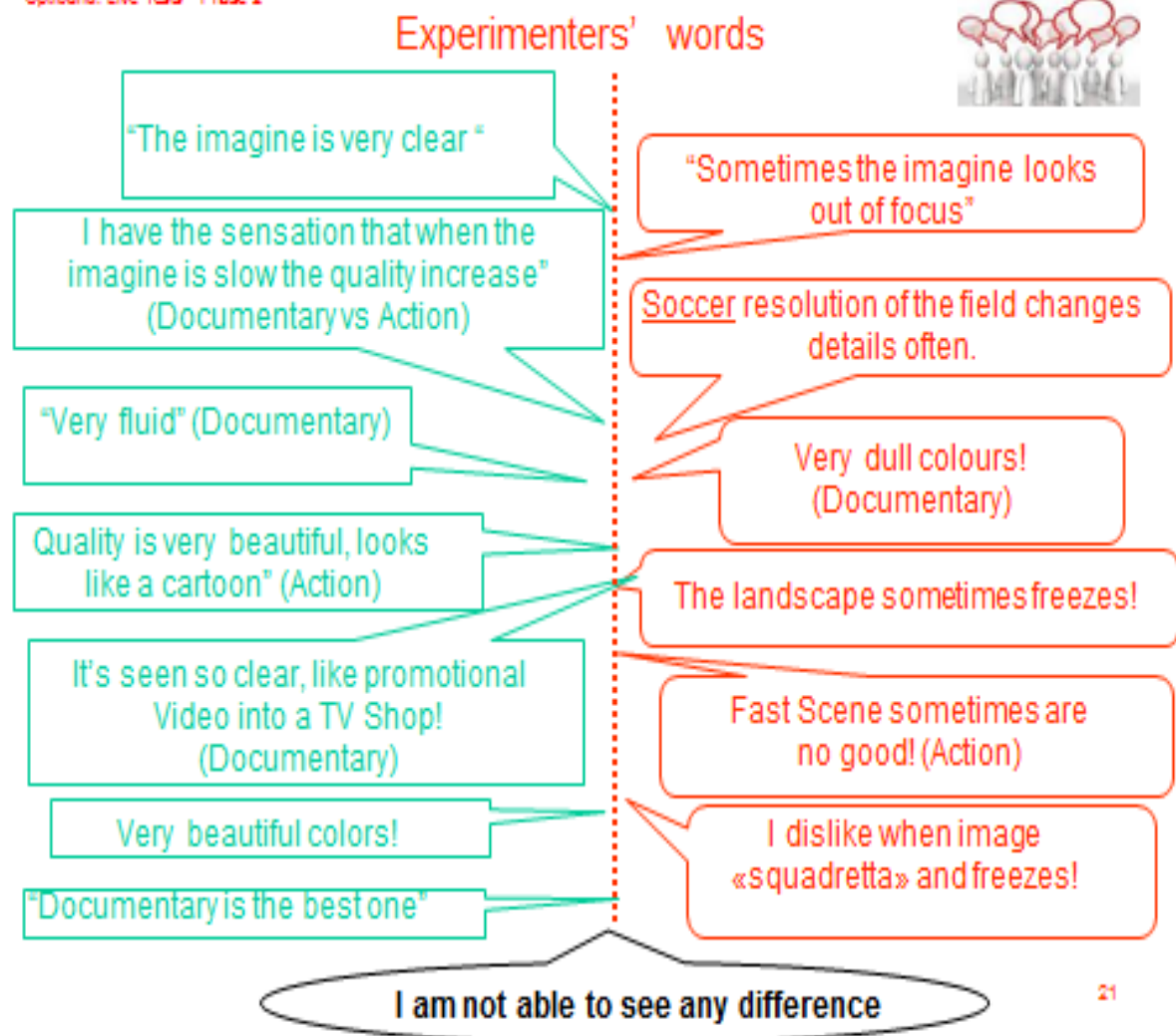


Figure 25 Some Users Comments

2.5 Live Tests: Phase 1 and Phase 2 – End Result

Action



Soccer



Documentary

Figure 26 Used Contents for Live Tests in Phase 1 and Phase 2

Live Tests: Phase 1

As detailed in the chapter: Live Tests: Phase 1 – Use Case 0 & Use Case 3, the perceived video quality was satisfying for all Contents and for the two bitrates:

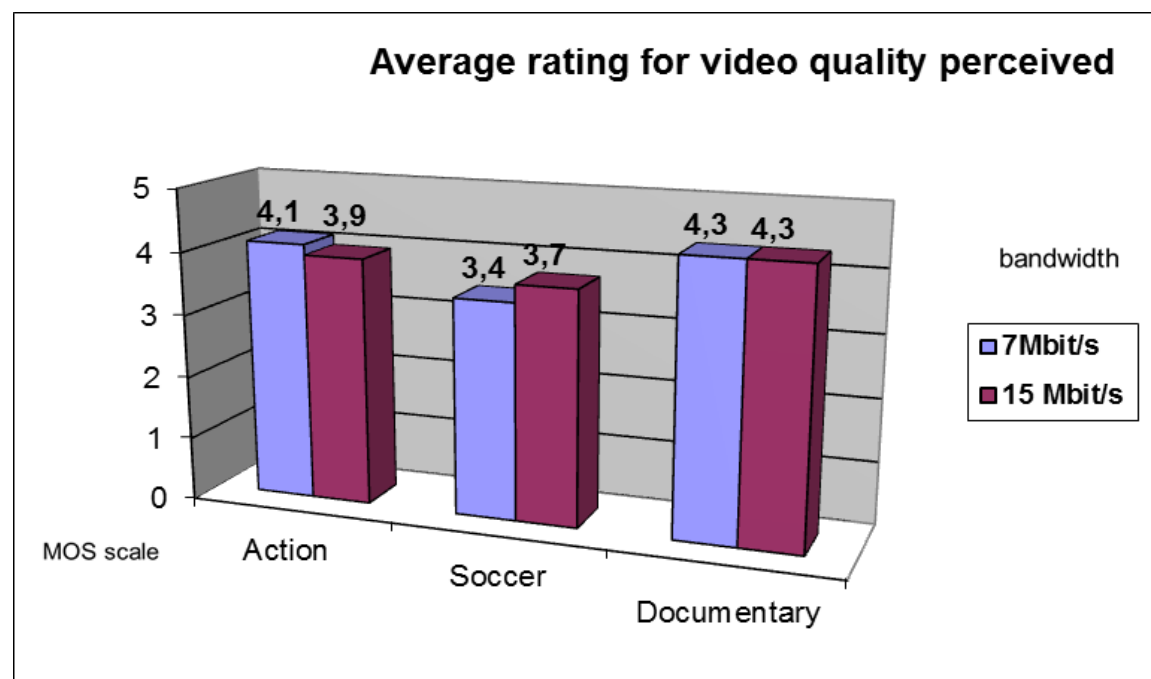


Figure 27: Live Test Phase1 MOS Overall Average Rating

Average rating for bandwidth at 15 Mbit/s is: 3,97.

- Relative to this bandwidth the content that has been perceived with the better video quality is DOCUMENTARY.

Average rating for bandwidth at 7 Mbit/s is: 3,93.

- Relative to this bandwidth the content that was perceived with the better video quality was the DOCUMENTARY

A slight preference for the Documentary was expressed as far as the high definition.

Live Tests: Phase 2

30 experimenters evaluated sequentially 6 movies UC1 (15Mbit/s) and 6 movies UC2 (12Mbit/s)

As detailed in the chapter: Live Tests: Phase 2 – Use Case 1 & Use Case 2, the overall perceived video quality was 3,5 - 3,6 (MOS scale: 1 to 5).

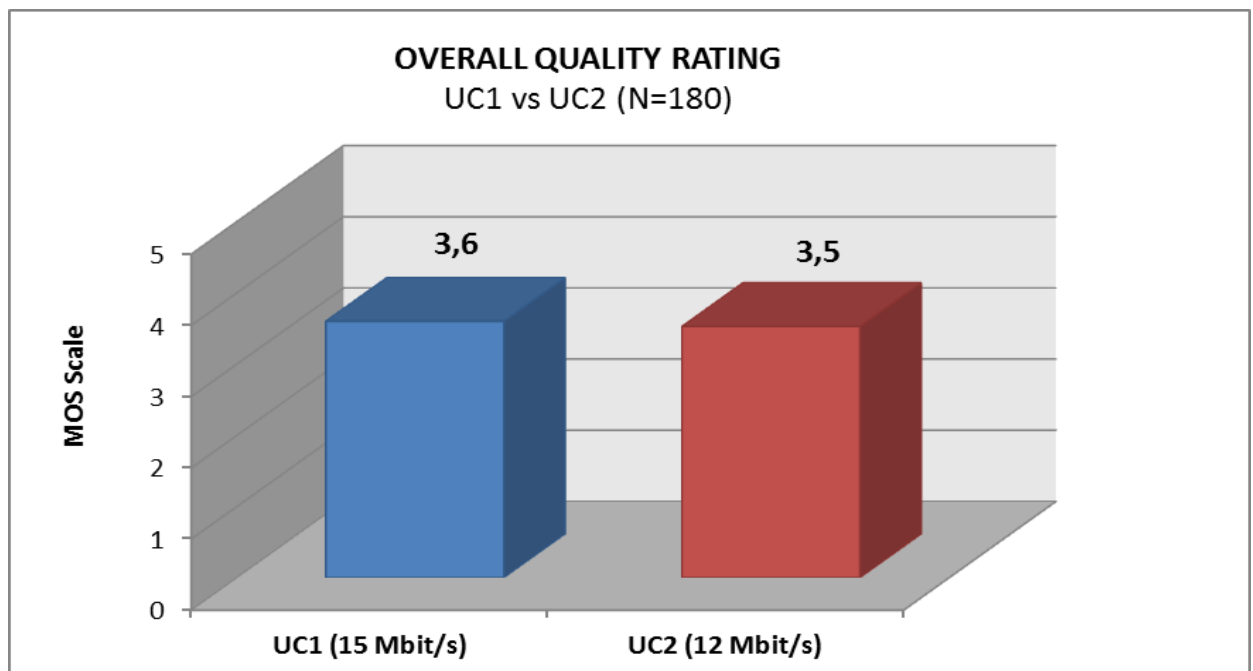


Figure 28: Overall Average Rating UC1 vs. UC2

Between the three zapping typology, the worst evaluated has resulted fast zapping (in every scenarios).

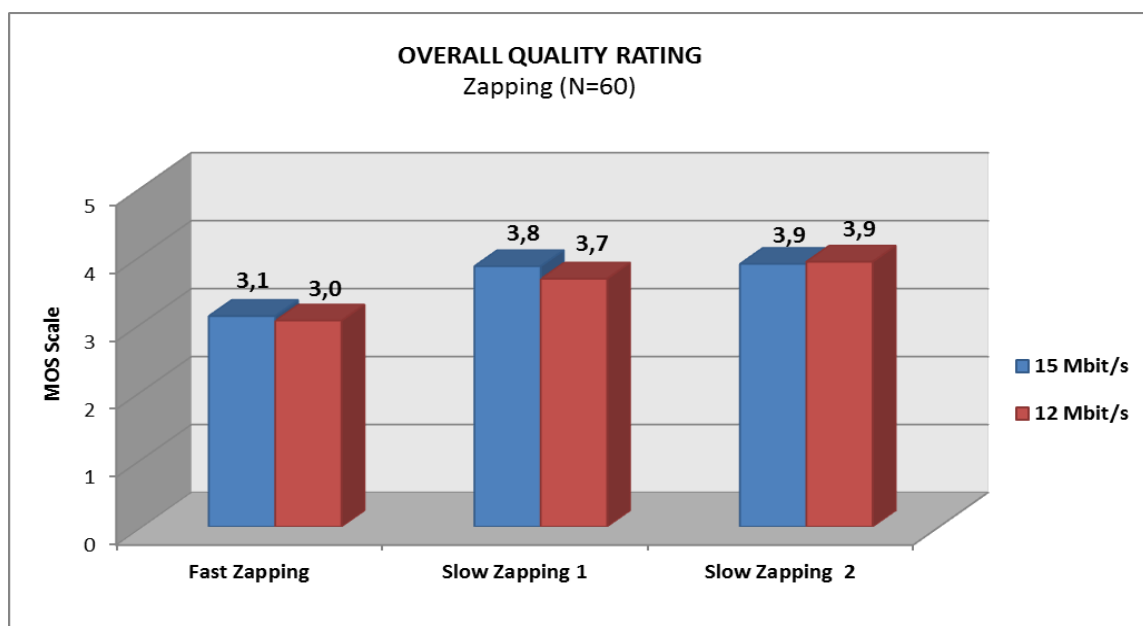


Figure 29: Overall Average Rating – Zapping Type

The less acceptable performance is related to Fast Zapping.
With “slow zapping 1 and 2” the quality rating perceived increases a little bit.
Documentary has been the Content that has been evaluated more acceptable.

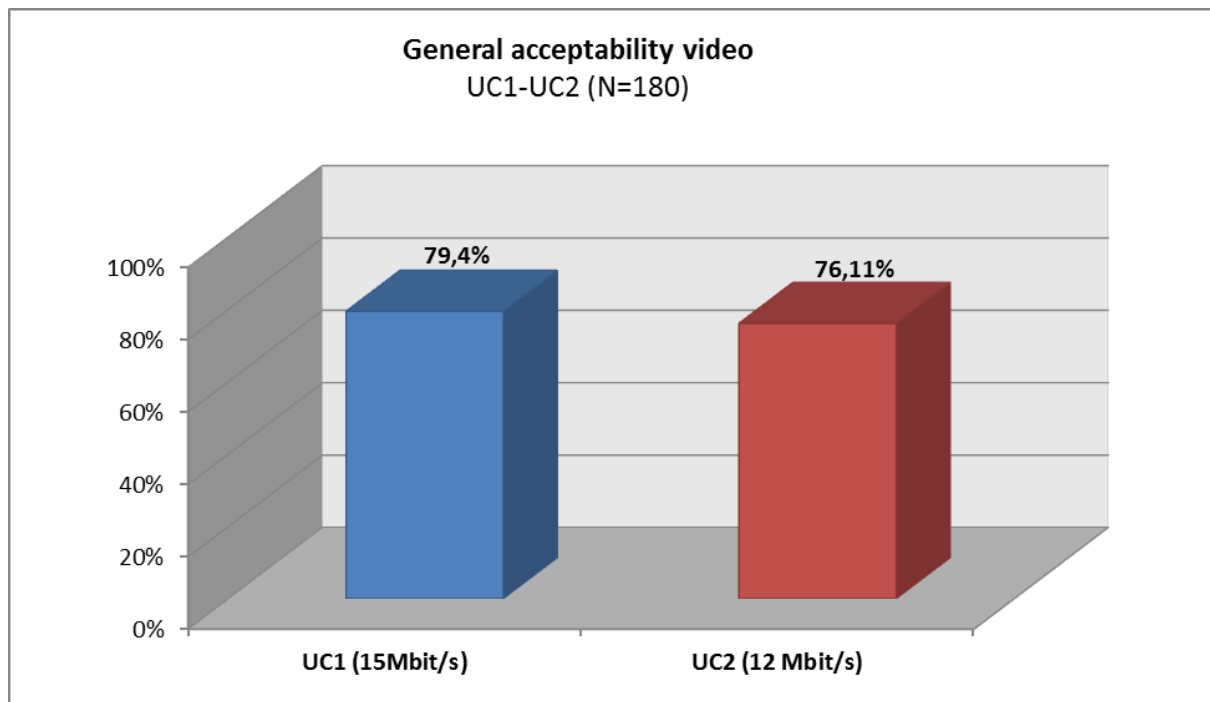


Figure 30: Acceptability → Overall Average Rating UC1 vs. UC2

On average, the users evaluated a little bit less acceptable UC2 than UC1

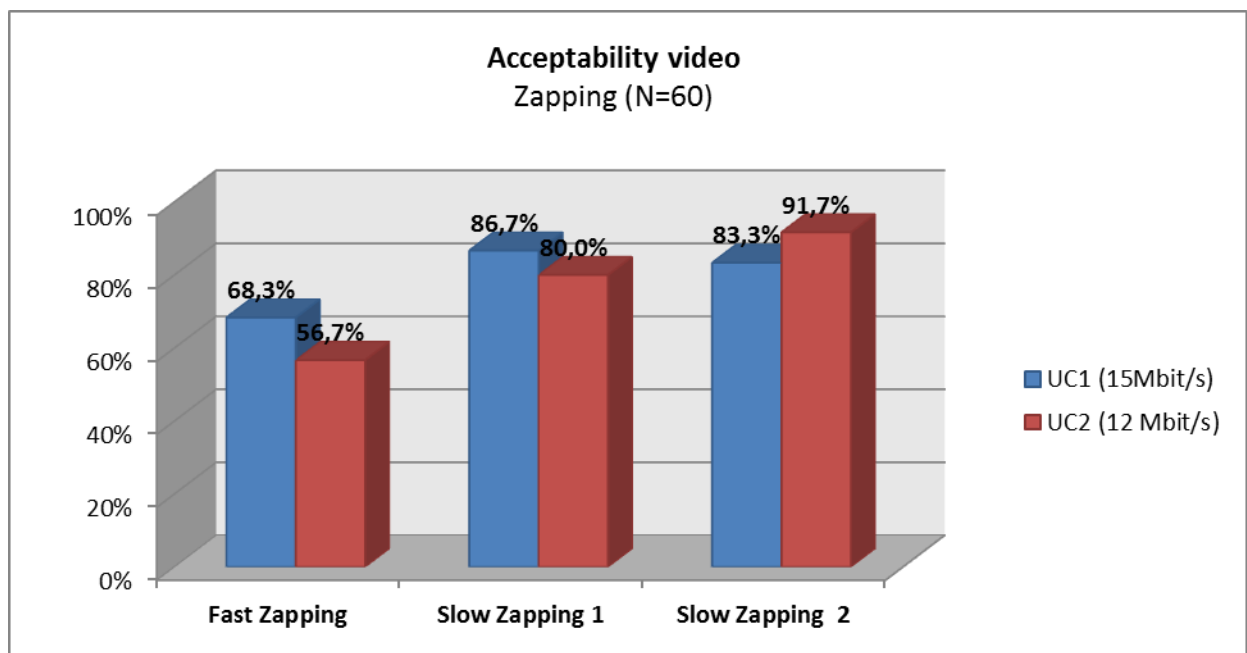


Figure 31: Acceptability → Overall Average Rating UC1 vs. UC2. Zapping Type

On average, with the “fast zapping” the acceptability of the video degraded clearly.
The best has been “slow zapping 2” with UC2.

3. Remark

The delay experienced by the project (two months) during the previous activities, especially during the set-up and integration of the equipment in the test lab in TI, had an heavy impact on the duration and quantity of the test set. For all defined Use Case two types of tests were initially planned: Acceptability and MOS, but due to the delay and following the consortium decision, we were forced to reduce the number and type of live tests.

This delay is partly justified by the need to find the best configuration of the equipment to be used during the test, in particular: optimize the encoder configuration for the selected contents, define the best configuration of the PDD and define the zapping behaviour the STBs.

As regards transcoding, we were forced to perform it, as an additional activity, because the content was provided in a format which was not compatible with our environment; in particular the provided codecs were not compatible with the tools we were using to feed the encoders (Adobe Premiere CS3 and Final CUT).

The result of the transcoding process has been shown to all partners during the Project Meeting in Turin (March 2012), including to the OptiBand reviewers and were found as good quality.

The encoder configuration activity was performed in a close collaboration with TVN and OPTEC who provided the encoders to the project as well as with CSL for video analysis, and this has ensured that the encoding parameters were the most suitable to guarantee a good quality to each content and minimize the presence of artefacts during the use of the contents for the testing activity. The selected encoding parameters, for the encoders, have been reported in D7.2.

Regarding the integration of PDD, TiS and CSL performed an optimization of the behaviour of the PDD during the delivery of the content, with the purpose to minimize the presence of artefacts during the test.

It is important to note that although intensive efforts and time were invested to eliminate the artefacts, some artefacts were still presented from time to time, mainly during zapping events

The integration of the STB included activities to verify the firmware on the STBs and the control software installed on Middleware (script) to ensure that the defined zapping patterns were executed as expected and with minimal introduction of artefacts.

During every step (encoder configuration, PDD integration and STB integration), the video output quality was checked and validated within TI, by a group of video coding experts, and always considered good.

3.1 Success criteria for the Live Test

According to the test description, the maximum IP packet loss that will be experienced will be about 33%. We expect that under this condition the QoE remains acceptable. As a success criteria check that:

- **MOS scale: positive values → equal or above 3.7**

- **Acceptability: we consider satisfying a value around 80%**

So considering all the Use Cases and for all the analysed contents the mean value of MOS is 3.77

It should also note that the worst value of MOS was found for Soccer: MOS= 2.7 and Action: MOS= 2.9 for both UC1 and UC2 in the Fast Zapping test.

It also should be noted that the content that achieved, in all the Use Case the high value is the high **Documentary**; with an overall average of **MOS= 4.2**

Regards the Acceptability Tests, initially were provided for all the Use Cases, but the approaching of the expiration date of the project Ti in collaboration with the other partners participant in the WP decided to give priority to the tests required for Use Case 1 and Use Case 2.

So, as of now, we can say that this deadline of the project has affected the amount of testing that could be done with the different Use Case.

So for all the Use Cases and for all the Contents analysed the average value of "Acceptability" exceed the 75% and for both the Use Case (1 - 2) the mean value is very close to the value that we considered as "success criteria value" of 80%. It should also note that the worst value of "Acceptability" was found for Soccer and Action for both Use Case 1 and Use Case 2 in the Fast Zapping test with an average value of UC1 68.3% and UC2 56.7%.

Must be said also that for both the Use Case and for both Slow Zapping type, the mean value of Acceptability exceeds the value of 80%:

Use Case1: Slow Zapping 1=86.7% --- Slow Zapping 2=83.3%

Use Case2: Slow Zapping 1=80.0% --- Slow Zapping 2=91.7%

It also should be noted that the content that achieved, in all the Use Case the high value is the Documentary.

3.2 Reference to D2.5

Looking at what reported in D2.5; the two following points must to be considered:

- The 18-person panel (instead of 30) and the lack of acceptance rating were due, as already stated elsewhere, to lack of time, as the previous activities have been 2 months late

The encoding of all contents was performed using state-of-the-art technology, so the achieved MOS can be considered a warning that encoding High Definition soccer content at 8 Mbit/s.