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VISUALISE: Enhancing the Spectator Experience

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Abstract-- VISUALISE aims to enhance the spectator experience at temporally and spatially dispersed public events by providing real-time access to unfolding events via wireless IP enabled mobile phones and personal digital assistants. The VISUALISE project enhanced coverage of the World Rally Championships in South Wales (UK) in December 2007. Using consumer handheld devices, wireless technology was deployed to enable spectators to access live video feeds (including in-car footage), live timing data and live GPS information. Live multi-channel video was streamed to mobile terminals using a broadcast WiFi protocol. While this allowed many terminals to receive the service, enhanced IP encapsulation and robust video playback (including loss concealment) was required at the server and client respectively. The VISUALSIE project also developed a novel location based approach for intelligent, automatic and personalised video-feed selection.

I. INTRODUCTION

There is growing public interest in the field of multimedia distribution. Quality of Service (QoS) is vital when streaming video over wireless networks [1][2][3]. In this paper we present a practical implementation of an advanced and robust wireless audiovisual system. The VISUALISE project [4] aims to create a radically enhanced spectator experience at live public events. Using hand-held consumer terminals, such as mobile phones and Personal Digital Assistants (PDAs), the project provides access to personalised information and video feeds by combining advanced wireless connectivity with network optimised video transport and playback. Large scale public events are common place, with high profile examples including motor sports, athletics, and music festivals. Although these events are media-centric, spectators often have a very restricted viewing experience that is location and information limited and lacks personalised content. The VISUALISE project makes spatially and/or temporally shifted information (including video feeds) available to the spectator together with archive material and live statistics. Standard off-the-shelf consumer electronic equipment is used, including mobile phones, PDAs and wireless access points (APs). H.264 video compression is used together with IP encapsulation and error concealment to support reliable transmission over wireless broadband networks. Existing video feeds can be integrated into the VISUALISE network, and where appropriate fixed and mobile cameras can be used to provide additional content.

II. WRC 2007 TRIALS

The World Rally Championship (WRC, ISC owns the media rights of WRC) in South Wales was chosen to showcase of VISUALISE technology in motorsport. Using

wireless handheld mobile phones and PDAs, spectators were able to access trackside and in-car video feeds, live WRC timing and leader board information, and GPS tracking data for each driver. Building on an earlier technology trial, the 2007 WRC event demonstrated real-time audio-visual acquisition and distribution (locally) using WiFi with omni-directional and directional antennas. Live in-car audio and video was also distributed from a selected rally car. The location of each vehicle was determined using in-car GPS. This information was collected every 5 seconds and made available to VISUALISE via an Internet connection. This allowed the real-time position of the cars to be displayed on a dynamic map. The use of GPS meta-data in the video feeds allowed intelligent, automatic and personalised video selection.

III. ARCHITECTURE

The system architecture is shown in Figure 1. This was built on a proprietary H.264 video encoder (ProVu). The resulting Network Abstraction Layer (NAL) units were encapsulated into IP packets. In remote locations the video IP stream was sent over a satellite link using an Inmarsat BGAN terminal. For local spectator distribution the system made use of standard network components (routers, PDAs and WiFi APs).

1) Video Acquisition: Two fixed cameras were placed at the trackside; each equipped with a ProVu unit to compress the live video (Video 1 and Video 2) locally into an H.264 compliant 256 kb/s IP stream. These streams were relayed back to the main spectator area using 2.4GHz and 5.2 GHz fixed WiFi links. A live in-car link (video 3) was also produced at 128kb/s and sent wirelessly (at 2.4GHz) to the spectator area via a relay mounted on fixed camera 2. Other than the in-car unit, all the other APs used a fixed directional antenna. The directional antenna on camera 2 was used to track the rally car to improve the acquisition of the in-car video. Figure 2 shows a number of views from the live in-car feed. The black dot represents the location of camera 2. The bold sections in black represent regions where the in-car link was lost. These were the result of poor camera tracking and weak signal levels. The video acquisition links operated over TCP. A fourth video feed was produced locally using pre-recorded highlights from the WRC 2006 event.

2) Video Distribution: The public multicast IP feeds were distributed using 802.11b to mobile phones and PDAs in the immediate vicinity. Figure 3 shows the mobile Graphical User Interface (GUI) and the range of offered services. The flash-based user interface and the VISUALISE error-resilient video player ran under Windows Mobile 5/6. Content for display on a large remote public screen was generated and distributed via a UHF video relay. The public screen was used to show
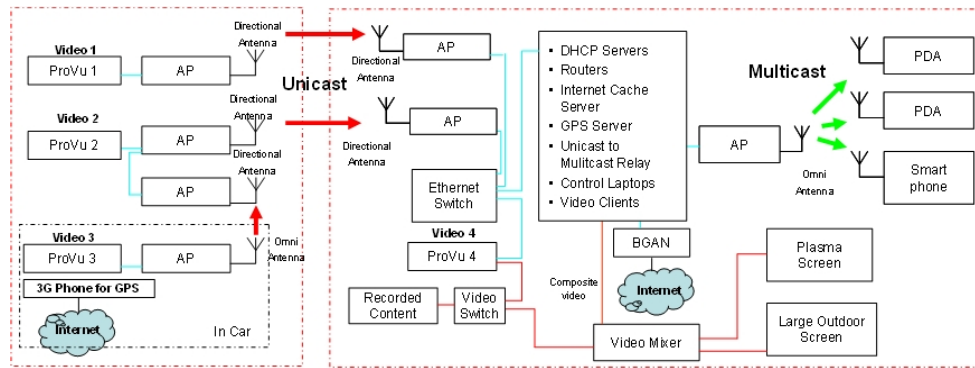
Figure 1: VISUALISE Architecture for WRC 07

Figure 2: Views from in-car camera as seen by users

Figure 3: VISUALISE User Interface

selected live video streams together with timing and GPS data. Plasma screens were placed to display this public content.

IV. GPS DATA ACQUISITION AND DISTRIBUTION

1) GPS database and in-car acquisition: A system based on a mobile phone with integrated GPS was installed in a selected rally car. This unit was used to regularly send location data back over the standard mobile network to a local GPS database. This architecture facilitates the storage (and subsequent viewing) of live GPS data. Furthermore, via collaboration with ISC, access to live GPS location data was made available using their safety critical in-car data links. This system sends real-time data back to the organizers from each car using a radio relay mounted on an overhead aircraft.

2) PC-based Internet GPS distribution: A Java Applet embedded into a web browser was used to display the GPS tracking information. Live and pre-recorded head-to-head GPS displays were made available. The application allowed the user to select the stage and driver(s) to view. Using KML scripts, the location of the driver was displayed in Google Earth. Figure 4 shows a typical display from the PC client.

3) PDA/Mobile device GPS distribution: A Java application was developed to display GPS data on spectator phones. The interface was device independent and easily installed onto mobile devices. This application differed from the PC version in that car overlay icons were placed onto a static map, with the same functionality. On the day of the rally this system enabled spectators to view live and personalized GPS data and historical data from previous rallies on their mobile devices.

Figure 4: PC mapping display

V. CONCLUSION

This paper has given an overview of the VISUALISE demonstration system as deployed at the 2007 World Rally Championship in South Wales. Video from fixed trackside cameras was fused with live in-car audio-video streams and sent to spectators using WiFi technology. Subsequently, the project has also been demonstrated over HSDPA and WiMAX technologies. Personalised video feed selection was achieved at the spectators' terminal by combining user-defined preferences with video embedded GPS meta-data.

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