CHIRPVISION

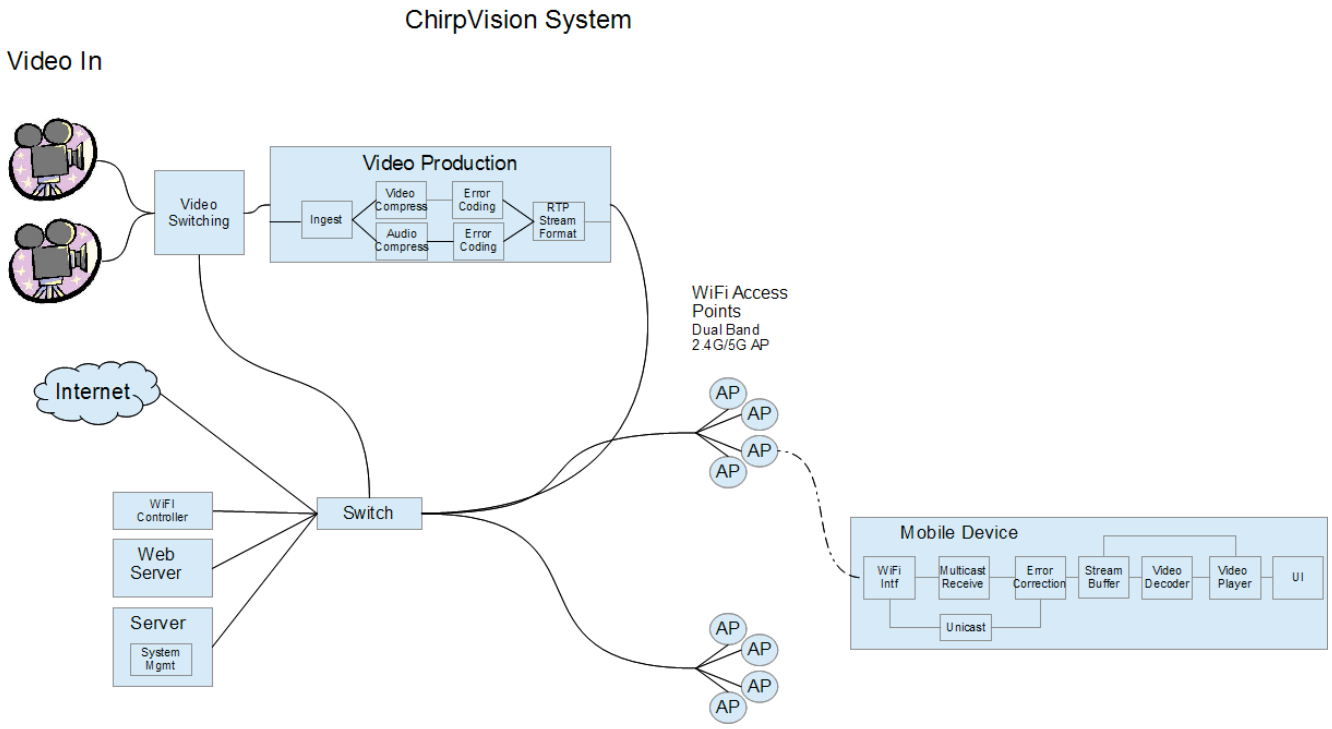
DELIVERING LIVE, INTERACTIVE EVENT CASTING TO SMART PHONES

WHITEPAPER CHIRPVISION TECHNOLOGY FOR BROADCAST-TO-MOBILE

ChirpVision is a revolutionary system for streaming live video direct to smartphones and mobile devices in stadiums, music festivals, and other dense crowd environments. It reaches every fan at the event using WiFi and new technologies for live video streaming, at a fraction of the cost of competing technologies.

SYSTEM OVERVIEW

The technology in ChirpVision broadcasts to mobile devices over WiFi using robust video streams created from camera and video sources. The video and audio, typically from HD digital sources, frames are ingested and then compressed.



The compressed video and audio streams are created by adding error codes and timestamps. The error codes and timestamps are used as part of the Forward Error Correction (FEC) performed on the mobile device, providing means to detect and correct data errors inflicted during transmission. Streams are formed into standard Ethernet packets that are optimized to match the data format of the compressed stream.

The broadcast to the mobile devices uses multicast, a network broadcasting technique. Any device on the network can receive the broadcast, without requiring a unique connection. Other network functions required for communications.

The ChirpVision application on the mobile device receives the streams over the WiFi, performs error correction, and displays the video. The app is able to detect data stream errors using the error codes and corrects the data whenever possible. User controls for the video for replay, pause, and play

MOBILE DEVICES	iOS, Android
WIFI	802.11a/g/n compatible
PICTURE SIZE	768x432 pixels
FRAME RATE	24 frames/sec
AUDIO	48kHz, 24 bit, AAC+ encoding
VIDEO FEATURES	DVR playback controls with 10 minute replay, slow-motion , 30-sec jump
OTHER	Push notifications, video and interactive advertising

KEY TECHNOLOGIES

KEY TECHNOLOGIES IN CHIRPVISION

- multicast WiFi
- Fault-tolerant video streams
- Forward ErrorCorrection (FEC)

MULTICAST

ChirpVision is multicast over WiFi, essentially a broadcast to everyone on the local network. Each user receives same live video streams without requiring a separate connectionfor each user. With three live video streams, ChirpVision uses 8% of the available WiFi capacity on 802.11g is WiFi no matter how many users are watching ChirpVision – in other words, 1000 users consume the same bandwidth as 100000 users. By contrast, ordinary unicast (one-to-one connection) WiFi requires a stream for each user connected to the access point. This means in practical terms that ChirpVision can accommodate 5-10 times more users access point than ordinary unicast WiFi, resulting in significantly lower cost.

The WiFi connection is used for both multicast and interactive features for the user. A special format video stream for each live channel includes audio, error codes and other control information. The stream is completely compatible with standard protocols, allowing the network to be for other services such as internet and messaging. Other low-bandwidth event information such as the leaderboard for golf or schedule for music festival, is also multicast to the mobile clients. Interactive features use the remaining WiFi channel capacity to support social media, photo sharing and other applications.

FAULT-TOLERANT VIDEO CODEC

ChirpVision features a video CODEC similar to those used in digital cinema that delivers a high quality picture and is also fault-tolerant. This breakthrough technology in video processing has been developed by Chirp and perfected to run on mobile devices where computing power and memory limitations until now were impossible. Like digital cinema, the CODEC is a wavelet technique that features frame-by-frame encoding and progressive resolution, providing the highest picture quality.

To understand how ChirpVision is different, first consider some details of the standard H.264 video CODEC. As one of its techniques, H.264 uses multiple frames (inter-frame coding) to encode the video. The group of frames start with a "key" frame, followed by differences from the key frame. The key

frame is typically sent every 5-30 seconds. Compression is achieved through tracking the differences from the key frame and just sending those differences. This method is very efficient, but not very fault-tolerant because dependency of frames to others. If any frame in a group is lost, then all subsequent frames in the group are corrupted. The data loss results in picture corruption lasting 5-30 seconds.

ChirpVision CODEC, contrasted to H.264, does not use inter-frame compression and data loss results either in a lost frame or a lower quality picture. If the data loss cannot be recovered by the FEC, then a lower quality picture is rendered if possible, or at worst a frame is skipped. At 24 frames per second, one lost frame is rarely noticed by viewers and acceptable video can even be rendered at 12 frames per second.

FORWARD ERROR CORRECTION

Multicast is challenging to implement in WiFi because of packet loss due to interference and noise is often 5-20% over the air. This is especially true in dense crowds, where the mobile devices add to the chatter on the air and signal attenuation is severe. Each human body adsorbs some of the WiFi signal, making transmission into the crowd challenging,

To overcome these challenges with WiFi multicast where the data is only sent once, ChirpVision implement Forward Error Correction
methods to make the system more resilient to errors. Checksum codes are used to identify the damaged portion of video frames so that data packets lost or damaged in transmission are replaced. The progressive resolution inherent to the CODEC is used to advantage by protecting the most important data with stronger FEC than the less important data, resulting in robust but slim streams that are typically <600kbps each.

WIFI VERSUS OTHER TECHNOLOGIES

WiFi is the key technology used to deliver live video to smartphones. Compared to competing technologies of 4G (LTE) cellular and traditional television, WiFi has advantages in responsiveness, interactivity, and cost.

- Low-latency delivery for live streaming of < 300 ms.
- Interactive mobile application combines internet with live video streaming
- Lower cost than 4G (LTE) cellular: no data charges and less capital investment.

	WIFI	4G (LTE) CELLULAR	TELEVISION
Responsive, Live Viewing	●		●
Interactivity	●	●	
Operating Cost	$	$$$	$
Capital Cost	$$	$$$	$

A particular problem many stadiums is that cellular services frequently do not work well because they are overwhelmed by the number of users. Increasing the capacity means adding more cellular sites to service a group of users – an expensive upgrade – to overcome the limited capacity of the cellular radio bands shared amongst all the users. While carriers tout the use of broadcast modes in 4G, these remain expensive alternatives to customers who must have the latest mobile phone and frequently pay data plan charges.

ADVANCED WIFI TECHNIQUES

ChirpVision also benefits from many of the advanced features in modern WiFi systems such as load balancing, traffic controls, and adaptive antennas. This is important because 2.4 GHz devices account for about 75% of all devices at most events (as of June 2013) and there are only 3 non-overlapping channels in the 2.4GHz band.

The WiFi system makes optimal use of the available channels by dispersing the client devices both spatially amongst the access points, but also by pushing the 5 GHz capable devices up to the lesser used bands. This balances the access point loading to achieve highest utilization.

New advances in adaptive antenna technology for WiFi is also important to reaching the dense crowd. The antennas are able to focus their signal on an area using "beam steering" methods that were first perfected for RADAR applications. The antenna rejects adjacent channels and background noise resulting in significant improvements in the dense crowd environment.

SUMMARY

Advanced technology in ChirpVision makes WiFi to mobile broadcasting a new way to connect to fans at stadiums, music festivals and other large events. The robust video streams featuring error-correcting codes, coupled with a new fault-tolerant CODEC, are key to reaching high density crowds with a high quality video stream at the lowest cost over WiFi. This technology enables a new "second screen" , a new and engaging way to reach fans at events.