Building a wireless camera from FOSS components

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Wireless Camera?
Wireless Camera?

€7000 – out of reach for most
Wireless broadcast Camera?

€20000 – out of reach for most
Background Tech

• DVB-T COFDM modulation in both licensed and unlicensed spectrum (1.9-2.7 GHz).
  – Essentially a Vislink wireless transmitter used in news reporting
  – 100m to 1-2km

• Not the same as a “streaming” camera
  – Much lower latency (~100s ms vs ~1-2s)
Well just use WiFi?

• Similar(ish) technology (COFDM)

BUT

• As soon as device and AP lose association no signal – “digital cliff”
  – Association and de-association repeatedly
Wifibroadcast Project

• Makes WiFi more analogue!
  – Transmits irrespective of receiver using packet injection
  – Aided by Atheros Open Source WiFi firmware
  – Accept corrupt (but possibly useful) packets
  – A ton of FEC

• Allows you to have multiple receivers for diversity

• Started by befinitiv for First Person Video (FPV)
First Person Video

• Flying drones remotely
The “pro” world – Le Tour
Buy these wifi dongles very easily!
Things we’d like to have

• General
  – Low-latency
  – High quality
  – Telemetry feed

• “Pro”
  – Some kind of intercom for control room to talk to cameraman
  – Tally
  – Data (CCU control camera)
Raspberry Pi encoding

Picamera (Csi) > RPI(a,b+,2) > wifibroadcast > atheros wifi chipset (usb)

Latency ~100ms (end to end from TX to RX)
Picamera (1280x720 30fps)

- Sensor to GPU: 33ms
- Rolling shutter (clear from first line to the last): 20ms
- ISP processing (stab off): 10ms
- Fec encoding + transmission + reception + fec decoding + display: 50ms to 100ms

TOTAL = ~ 110ms to 160ms
Getting pictures from a camera

- Mini-PCle boards – supported in V4L2
Encoding

• Can use hardware-encoding. Get what you’re given basically

• x264 has “intra-refresh” mode – better error resilience
  – Beefy but low-power and portable x86 motherboards
    • Gigabyte Brix, Intel NUC etc
Realistic future

• Wifibroadcast uses a custom protocol
  – Move this all to plain RTP
  – Have diverse receivers connected over ethernet (and perhaps cellular).
  – Receiver (e.g VLC) can detect duplicate and out of order packets

• Multiple channels

• 5GHz (with Dynamic Frequency Selection)

• Less WiFi bandwidth (5mhz or 10mhz)

• 900MHz WiFi for non line of sight applications
Crazy future

Fleet of relay drones carrying RPIs – (perhaps 4G aided)
Trying it for real!
Trying it for real!
Live demo

• Capturing from SDI camera, encoding with OBE into MPEG-TS, diversity receive and playback with MPlayer.

(Sorry can’t do this)