"This is so cool! I'm flying this thing completely on my Palm pilot!"

# AccessGrid-to-Go : Providing AccessGrid access on Personal Digital Assistants

Michael Thorson[1], Jason Leigh[1], Gabriel Maajid[2],
Kyoung Park[1], Atul Nayak[1], Paul Salva[2], Shirley Berry[2]

1-Electronic Visualization Laboratory (EVL),
University of Illinois at Chicago

2-Chicago Public Schools- Medill Technical and Professional Development Center


The Collaborative Continuum
5Ghz 40Mbps 802.11a
Wireless mobile
Plasma Touch screen
Persistent flip notes
Camera array for image based panorama
Passive stereo
VR display
Wireless tablet PCs +
cameras velcroed to wall
for private video or
persistent postits
Tiled display
(LCD tiles for high resolution,
or plasma screens)

# Problem

How does one display dozens of Access Grid video streams on a small screen, over a low bandwidth wireless network, with a small amount of processing power

# Implementation

- Hardware
  - Compaq IPaq 3765 (206MHz)
  - HP Jornada 548 (133MHz)
  - PC
- Software
  - Microsoft Embedded Visual Tools 3.0
    - Provides Visual Studio interface for PocketPC development
    - Embedded Visual BASIC
    - Embedded Visual C++
  - GAPI (Game API)

# Implementation

- 2 pieces of software developed:
  - VVP – Vic Video for PocketPC
  - VVP Proxy – Filter Vic streams to reduce traffic to PPC
- 2 possible modes of operation:
  - 1 to 1 : direct Unix/Windows VIC to VVP
  - N to 1 : multicast Unix/Windows VIC to proxy to VVP

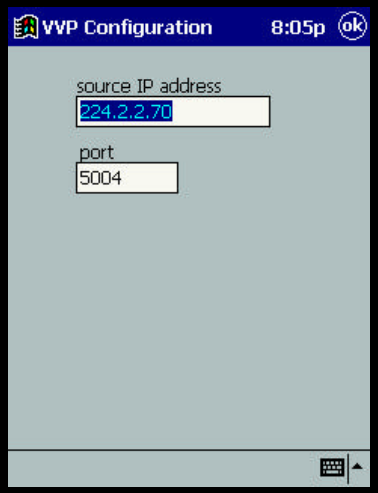
# VVP

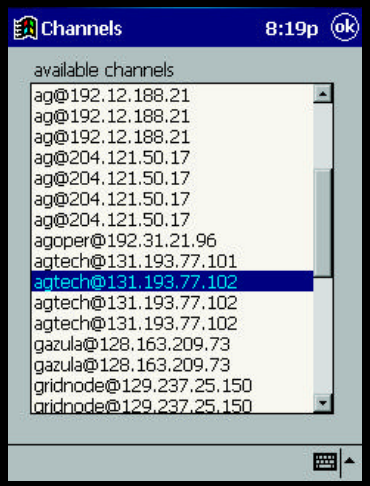
Specify VVP Proxy or unicast Vic Address

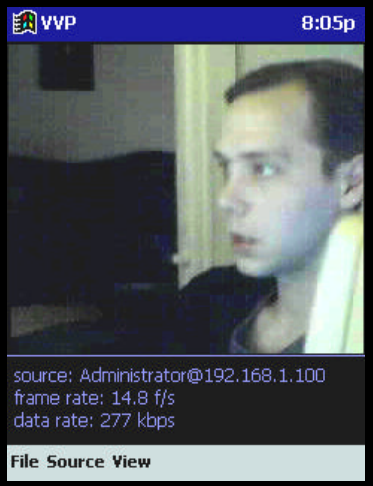
Select from a list of available Vic streams

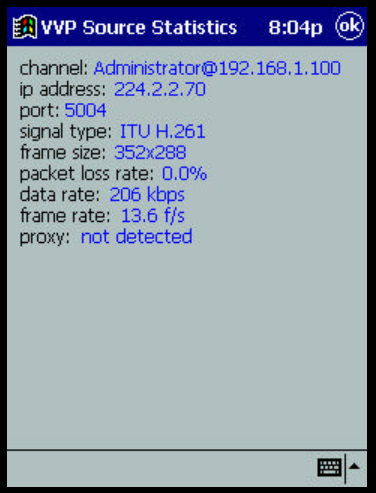
Video

Stats

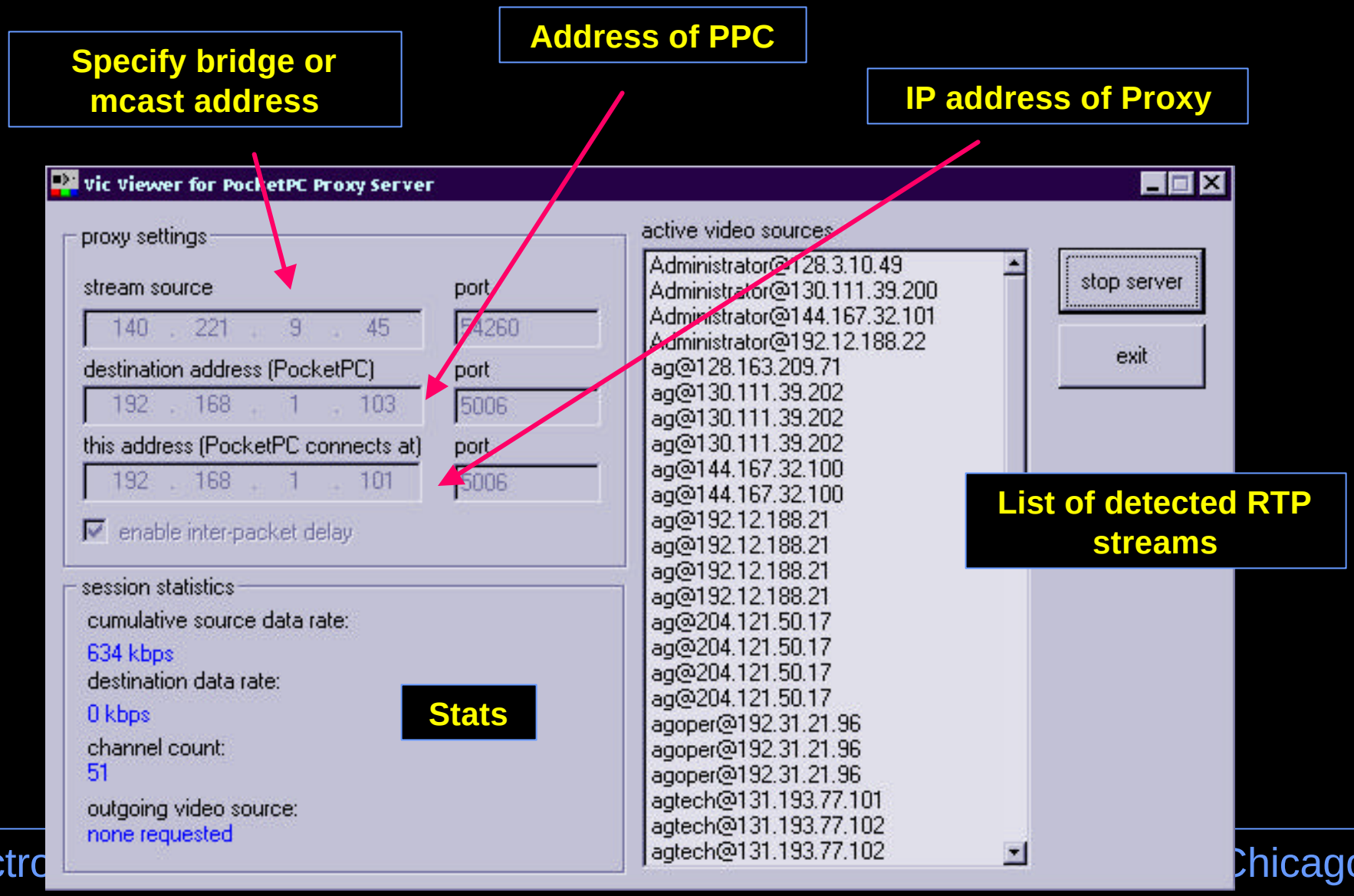


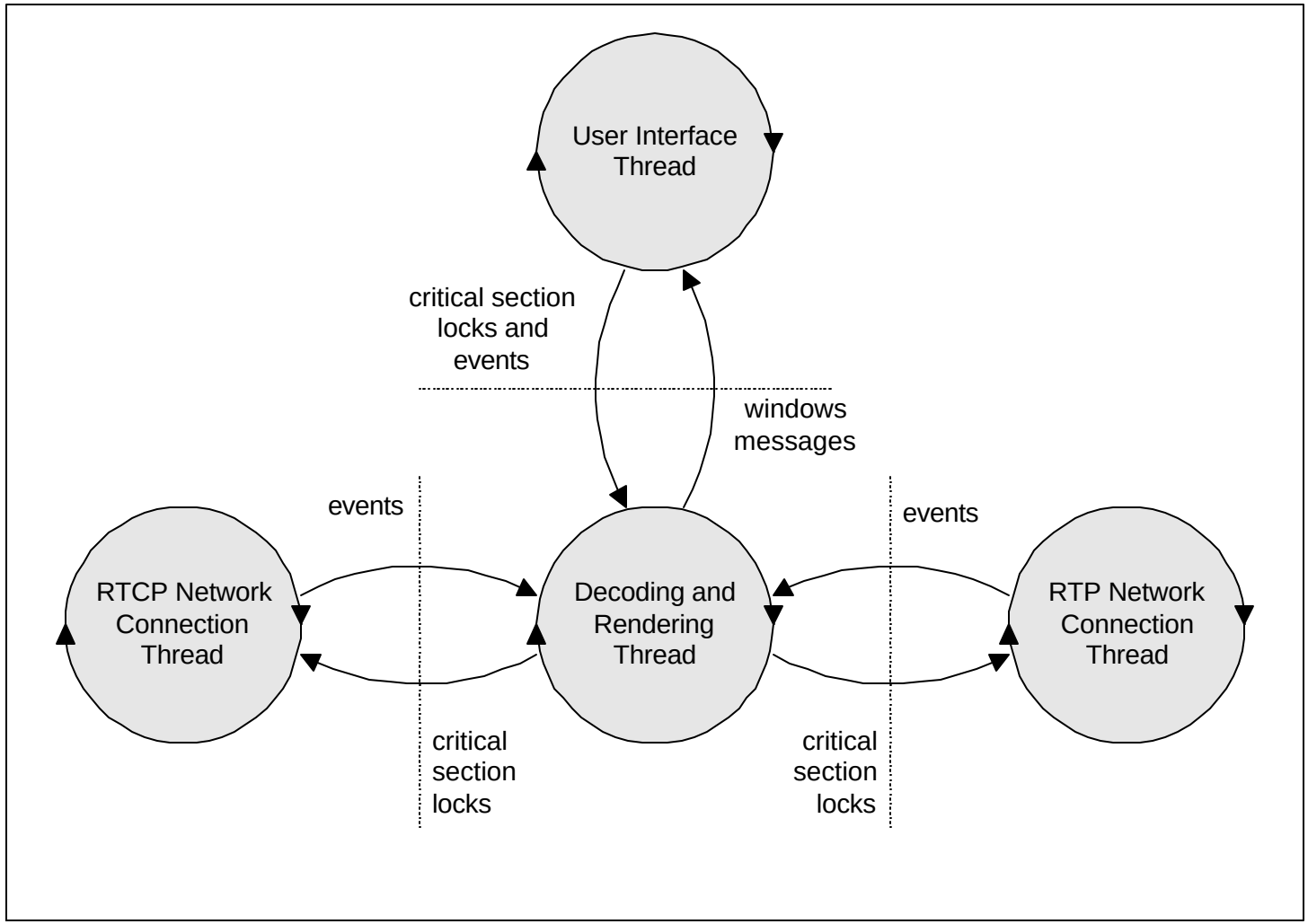



# VVP Proxy


Specify bridge or mcast address
Address of PPC
IP address of Proxy
Vic Viewer for PocketPC Proxy Server
proxy settings
stream source
140 . 221 . 9 . 45
port
destination address (PocketPC)
192 . 168 . 1 . 103
port
5006
this address (PocketPC connects at)
192 . 168 . 1 . 101
port
5006
enable inter-packet delay
session statistics
cumulative source data rate:
634 kbps
destination data rate:
0 kbps
channel count:
51
outgoing video source:
none requested
Stats
active video sources
Administrator@128.3.10.49
Administrator@130.111.39.200
Administrator@144.167.32.101
Administrator@192.12.188.22
ag@128.163.209.71
ag@130.111.39.202
ag@130.111.39.202
ag@130.111.39.202
ag@144.167.32.100
ag@144.167.32.100
ag@192.12.188.21
ag@192.12.188.21
ag@192.12.188.21
ag@192.12.188.21
ag@204.121.50.17
ag@204.121.50.17
ag@204.121.50.17
ag@204.121.50.17
agoper@192.31.21.96
agoper@192.31.21.96
agoper@192.31.21.96
agtech@131.193.77.101
agtech@131.193.77.102
agtech@131.193.77.102
stop server
exit
List of detected RTP streams

# VVP Processing Threads



# User Interface

- PPC API for interface development very similar to Windows development
- Need to consider aspect ratio of PPC- portrait for PPC vs landscape for Windows
- VVP provides viewing in both portrait & landscape mode.
- Landscape mode supports full 320x200
- Portait mode- crop 320x200 to 238x206

# Network Interface

- 2 threads – 1 for RTP, 1 for RTCP
- RTP thread captures data into a shadow buffer which decoding thread can use when ready
- RTCP's Source Descriptor used by Proxy to build video list
- PPC network API similar to Winsock API similar to Berkeley sockets
- Important differences:
  - PPC API does not provide asynchronous socket events like in Winsock – simulate this with threading and synchronous calls
  - PPC API does not allow enlarging of socket buffers - locked at 4K bytes- enough for 3 to 4 RTP packets depending on codec.
  - For high quality Mjpeg (quality setting > 30 in Vic) more than 4K buffers are needed.
  - 4K buffer means it can't tolerate traffic bursts.
  - Solution was to apply traffic shaping at the proxy- ie add 1ms sleep between packet transmissions to smooth out bursts.

# Video Decoding

Implemented codecs (by borrowing code from Vic directly):

- Xerox Parc Network Video (NV)
- Motion JPEG
- ITU h.261
- Sun Microsystems Cell B
- BVC

# Video Rendering

- Use Microsoft's Game API (GAPI)- freely downloadable from www.pocketpc.com
- Alternative is Graphics Device Interface (GDI)
- GAPI provides direct access to graphics memory on PPC.
- Frame rendering is reduced by 50% using GDI vs GAPI.

# Performance

| Source Configuration | HP Jornada | Compaq iPaq |
|---|---|---|
| H.261 video<br>Native frame size 352x288<br>VVP Proxy<br>VIC source quality setting 10 (default) | 9 fps<br><br>260 kbps | 15 fps<br><br>500 kbps |
| Motion jpeg video<br>Native frame size 320x240<br>VVP Proxy<br>VIC source quality setting 30 (default) | 8 fps<br><br>260 kbps | 11 fps<br><br>400 kbps |

| Display Configuration | HP Jornada | Compaq iPaq |
|---|---|---|
| Full screen transposed<br>320 x 240 pixels | 142 ms | 43 ms |
| Windowed portrait<br>238 x 206 pixels | 75 ms | 30 ms |

# ToDos / Hurdles

- Improve Proxy to handle multiple VVP clients
- Provide audio streaming
- Providing bi-directional video or audio
- Possible uses:
  - Video not necessarily for seeing faces but to convey what's in the real world
  - Remote monitoring – of experiments, medical patients, etc.
  - Real time in-the-field data gathering especially when coupled with GPS, e.g. for emergency response
- Hurdles:
  - How to get more wireless bandwidth while out in the field
  - Upcoming faster CPUs: 400MHz Intel chip (Spring 2002)
- Thanks to Microsoft Corporation, HP Corporation, Medill Technical and Professional Development Center and the Illinois State Board of Education Learning Technology Center 7
- www.evl.uic.edu/cavern/continuum