The Impact of Video Surveillance Technology on Future Video Coding Standards

Dr. Michael J. Horowitz
Office of the CTO
CoVi Technologies
Talk Overview

ITU-T

Background
- Evolution of video surveillance
- System overview
- Video coding standards in surveillance

Video feature requirements

System cost considerations

Concluding remarks
ITUT VICA Workshop
22-23 July 2005, ITU Headquarter, Geneva

Evolution of Video Surveillance

<table>
<thead>
<tr>
<th>Imaging</th>
<th>Transport</th>
<th>Storage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vidicon (B&amp;W)</td>
<td>Coax</td>
<td>VCR</td>
</tr>
<tr>
<td>CCD</td>
<td>Fiber</td>
<td>Digital Multiplex</td>
</tr>
<tr>
<td>Megapixel IP Cameras</td>
<td>RF UTP</td>
<td>DVR</td>
</tr>
<tr>
<td>NVR</td>
<td>IP/Ethernet</td>
<td></td>
</tr>
</tbody>
</table>

Evolution of Video Surveillance

Analog Video to DVR
(NTSC with CIF Encoding)

Megapixel IP Camera
(1280x720)
Video System Overview

Centralized IP Video

Distributed IP Video
Video Coding Standards in Surveillance

- Simplifies exchange of video information
  - Component-to-component
  - Manufacturer-to-manufacturer
- Compatible with feature requirements
- Reasonable impact on system cost
Video Feature Requirements

- Temporal scalability (active JVT topic)
  - Graceful degradation of archive video
  - Heterogeneous environments
    - Guard on patrol
    - Central monitoring station
    - Forensic analysis

- Error resilience ✔

- Flexible source formats ✔
Feature Requirements (continued)

- Spatial scalability (active JVT topic)
  - Graceful degradation of archive video
  - Heterogeneous environments
  - Selectively code regions of interest
Feature Requirements (continued)

- Low latency (<350ms one-way delay)
  - Real-time viewing
  - Remote camera control

- Trick modes for archival playback
  - Intra-pictures
  - SI and SP pictures (H.264)

- Content retrieval from archive
  - Time stamp-based
  - Alarm event-based (meta data)
Feature Requirements (continued)

- Video data integrity ↔
  - Error detection
  - Tamper resistance

- Alarm events from video content ×
  - Motion detection
  - Object tracking
  - Face recognition
System Cost Considerations

- Computational complexity ×
  - Encoding at camera
    - Hardware cost
    - Power dissipation ⇒ Heat
      - Increased sensor noise
      - Increased mechanical cost
  - Multiple simultaneous decoders

- Coding efficiency ⇔
  - Video transport: cost per kilobits / second
  - Video storage: cost per megabyte
Concluding Remarks

- Existing & emerging video coding standards meet most needs

- Recommended future enhancements
  - Reduced computational complexity
  - Enhanced tools for video data integrity
  - Tools to facilitate video event generation
  - Improved coding efficiency