

THE

*source*

for

JPEG2000

May, 2002



# Corporate Overview

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- Founded in 1986
- Roots in wavelet mathematics, data compression and telecom modulation
- In 1993, focused efforts on telecom and image compression products
- IPO in 1996 raised \$36M
- 140 employees



Bedford, MA Corporate Office



# Business Model

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- Aware develops and licenses telecom and compression technology
  - ▢ Software packages
  - ▢ System models
  - ▢ Reference designs



# Aware Compression Achievements

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- First to commercialize wavelet compression
- Early hardware implementation of wavelet compression
- Contributed to development of WSQ fingerprint compression standard
- Co-developed ADV601 wavelet video chip with Analog Devices
- Participation in JPEG2000 Standard Development
- Strong Patent Portfolio



# Aware Compression Products

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## Standards based products

JPEG2000

WSQ: FBI fingerprint  
compression

AccuPrint

NISTPack

CJISWeb

## Proprietary products

Accupress: wavelet based still  
image codec

Motionwavelets: video codec

Seispact: seismic data  
compression

AccuFace: specialized facial  
compression

AccuRad: medical images

Products available as DLL's, ActiveX controls, SDK's, and plug-ins for web browsers and Adobe Photoshop.



# Wavelet Scalar Quantization (WSQ)

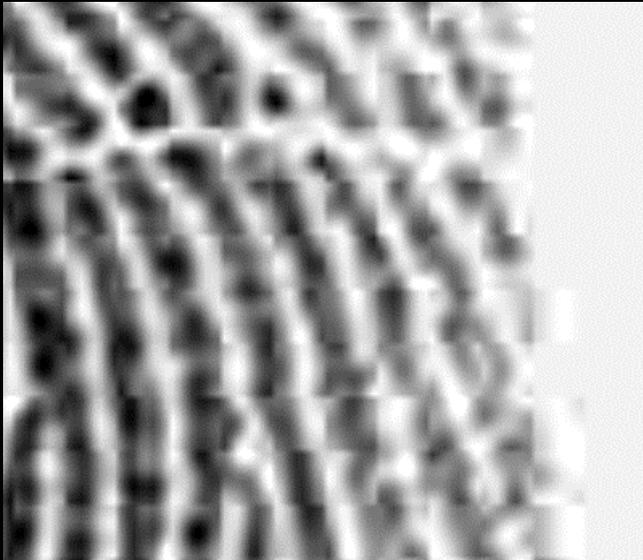
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- A non proprietary standard defined by the FBI
- Based on a class of compression algorithms called wavelets
- Wavelet compression does not introduce the block artifact inherent in JPEG compression
- Wavelet compression enables more robust visual and automatic recognition of fingerprint images

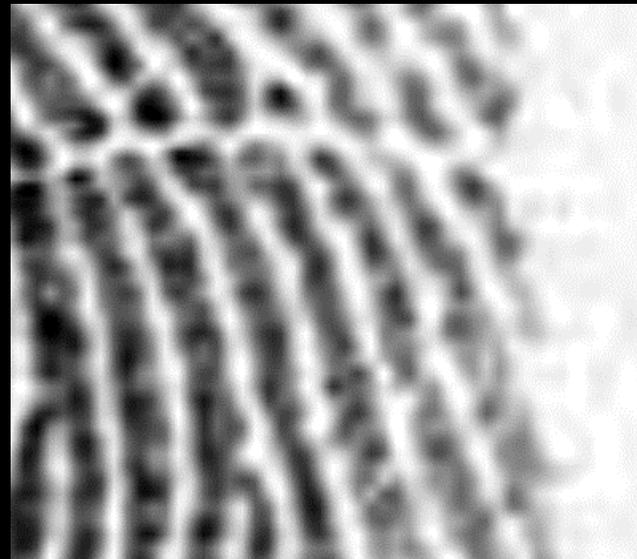


# JPEG versus WSQ

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JPEG compressed: note  
block artifacts



WSQ compressed

FBI stipulates WSQ as a requirement for compression. All states, AFIS and live scan vendors follow suit.



# Aware Experience Relevant to NIMA

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- Extensive Involvement with the Federal Government
- US DOJ Digital Fingerprint Systems- IAFIS, Booking Stations, Latent Print Work Stations
- All use Standard Compliant Software components by Aware
  - ⇒ Image compression (fingerprints, mug shots, scanned documents)
  - ⇒ Compliant File Formatting
  - ⇒ FBI Certified ten-print card printing



# Aware & JPEG2000

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- Active contributor to standard
  - ▢ US & International meetings
  - ▢ contributed several compliance test images (part IV)
- Optimized JPEG2000 software implementation
  - ▢ Based on extensive experience providing commercial wavelet-based compression solutions
- Expertise on best practices to deploy JPEG2000
- Roadmap to provide value-added layers
  - ▢ Enhanced viewers, profiles, example code, DSP implementations, C Model



# Professionally Developed JPEG2000 API

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- COTS product design is based on years of commercial experience
- Emphasis on...
  - ⇒ ease of use and debug
  - ⇒ ease of portability
  - ⇒ memory to memory compression/decompression
  - ⇒ file conversion
  - ⇒ thread safe and optimized
  - ⇒ tools and “value add” options
  - ⇒ continual maintenance and support



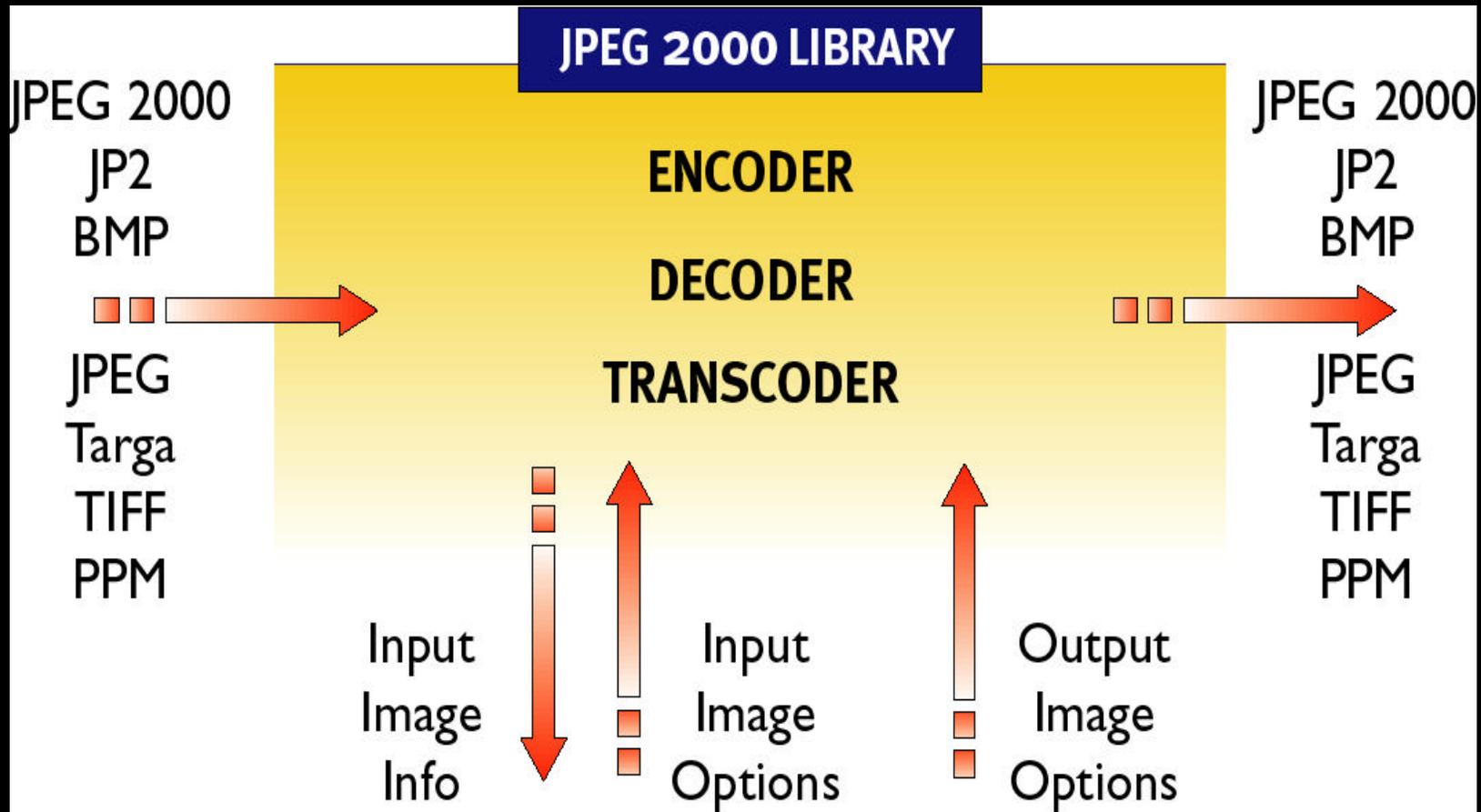
# The Aware Professional API

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- All libraries written in ANSI C
  - ▢ API source code can easily be compiled for different operating systems
  - ▢ C++ wrappers can be built by user
- Java Classes available
- Object based design



# The Aware “Image Object”



# Aware JPEG2000 and NIMA Profile

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- The Aware J2K library provides full support for this profile
  - ▢ 1k square tiles, 5 levels of transform, layer progressive with at least 19 layers, etc.
- Each NIMA encode parameter can be set individually or via one high level function
- We provide a working demo with source code
- The “Tile From Disk” Demo
  - ▢ encodes large images from disk to memory
  - ▢ provides decode/display by resolution and quality



# Aware J2K NIMA profile viewer (1)

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- Is Designed to support encode/decode and display of large tiled images
- For compression: Reads TIF or BMP files in tiles from disk, compresses, writes to memory
- For decompression/viewing
  - ▢ reads entire NIMA J2K file into memory
  - ▢ images encoded by quality (first), resolution (second)
  - ▢ lowest resolution displayed first, quality layers decoded incrementally
  - ▢ only decodes what is necessary for display



# Aware J2K NIMA profile viewer (2)

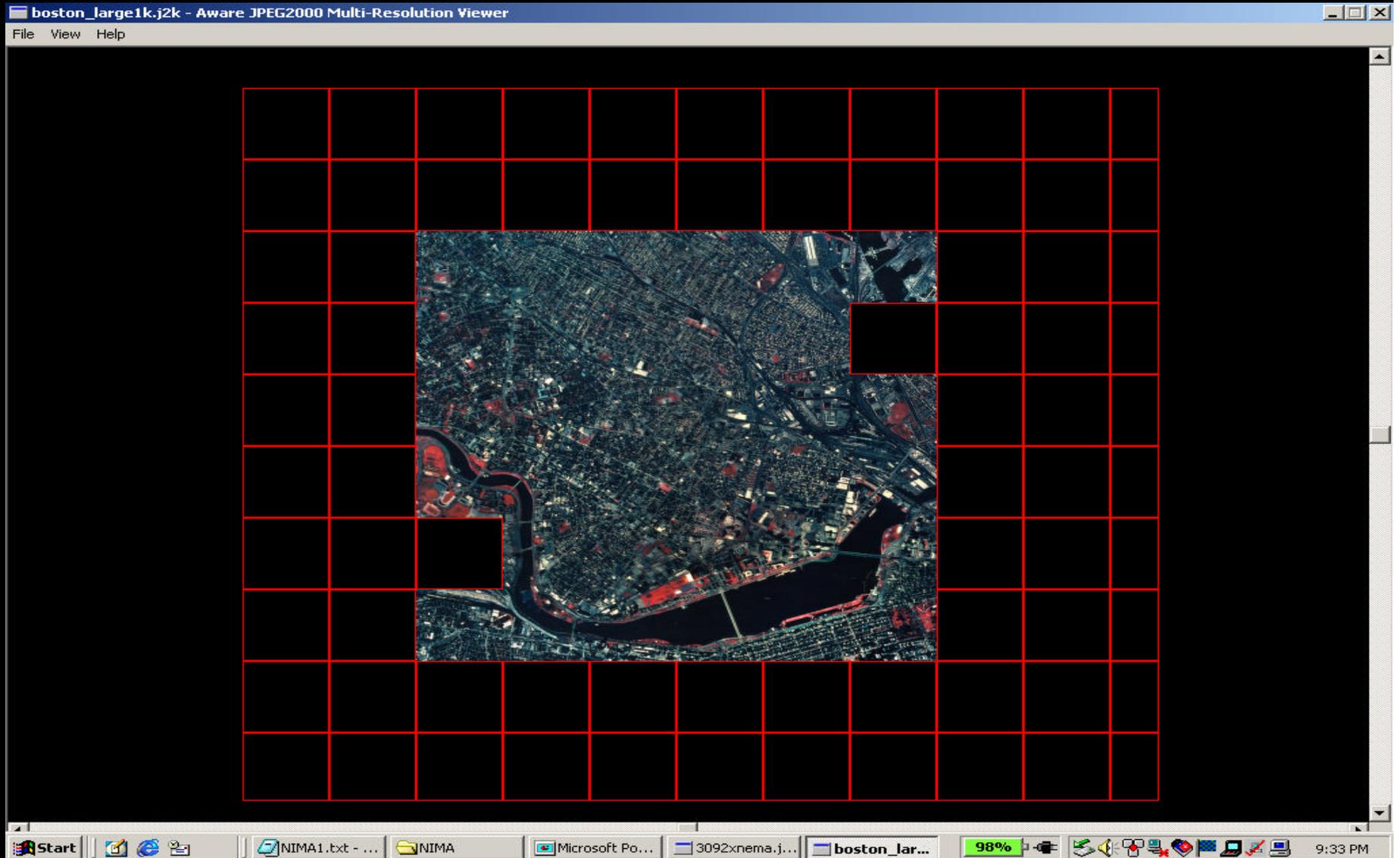
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## ■ Display (cont.)

- ☰ mouse or keyboard control to decode higher resolutions and to decode (view) different quality layers
- ☰ pan/scroll bars to display all parts of the image

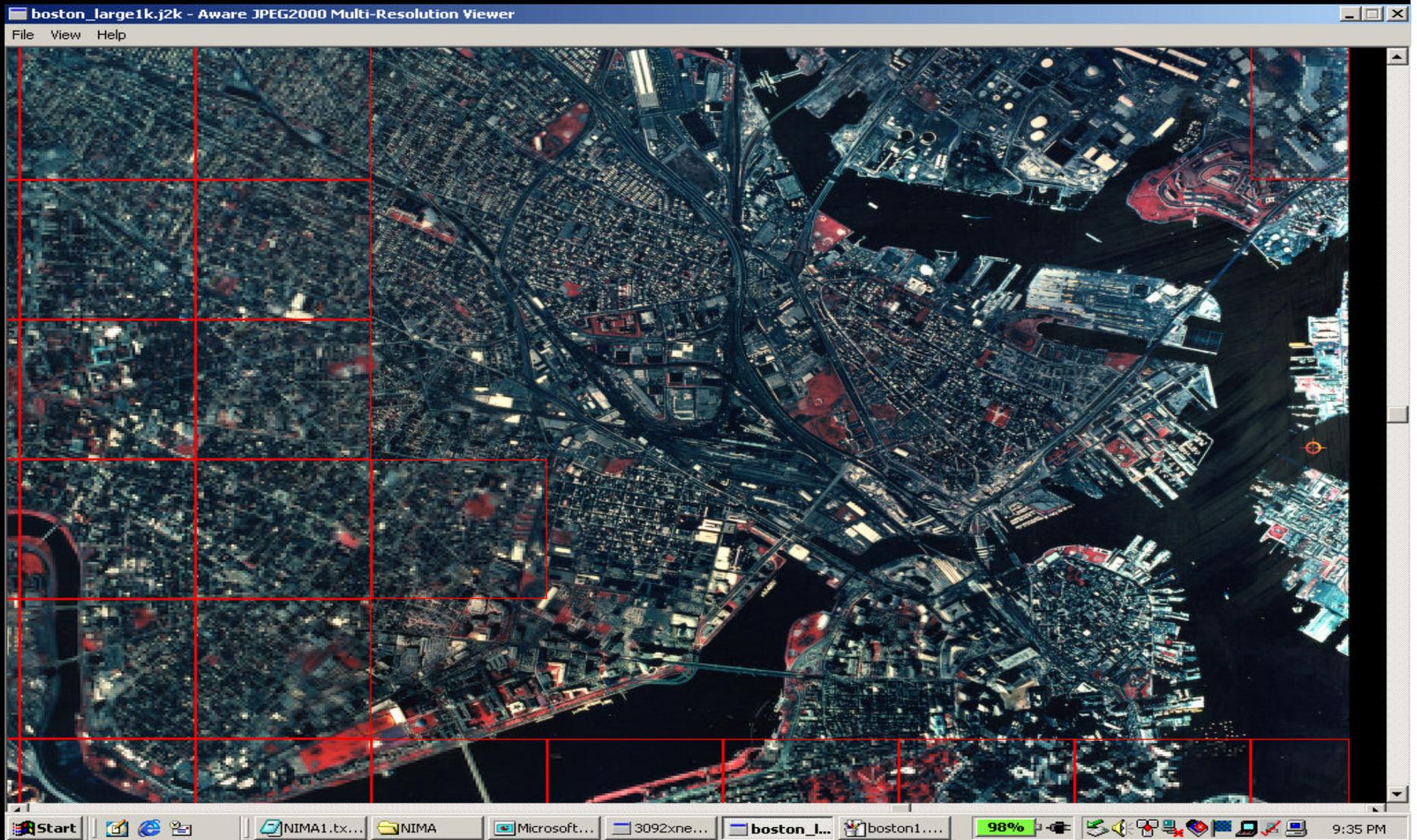


# NIMA Profile Decode - Resolution to fit window

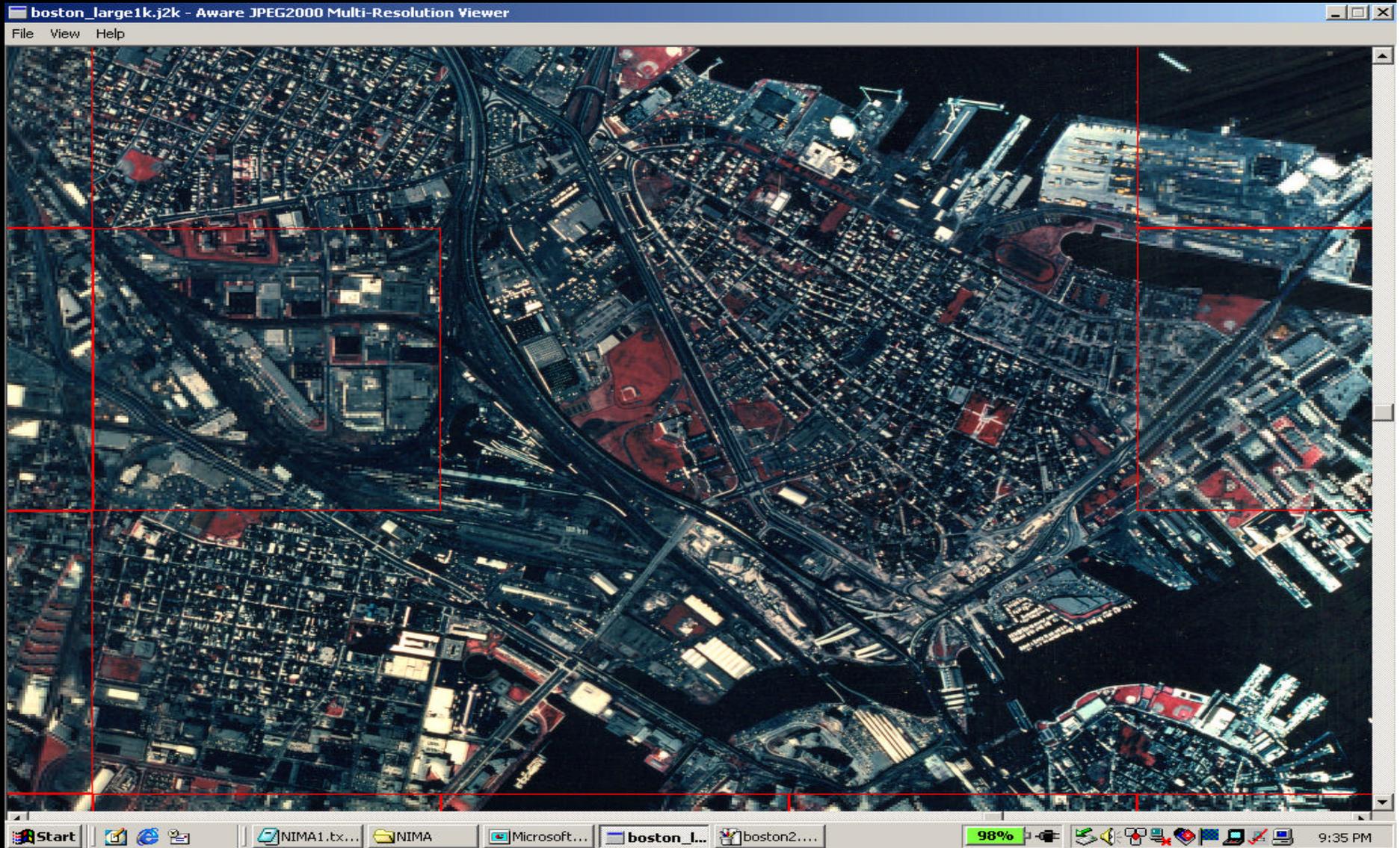


10K x 10K image

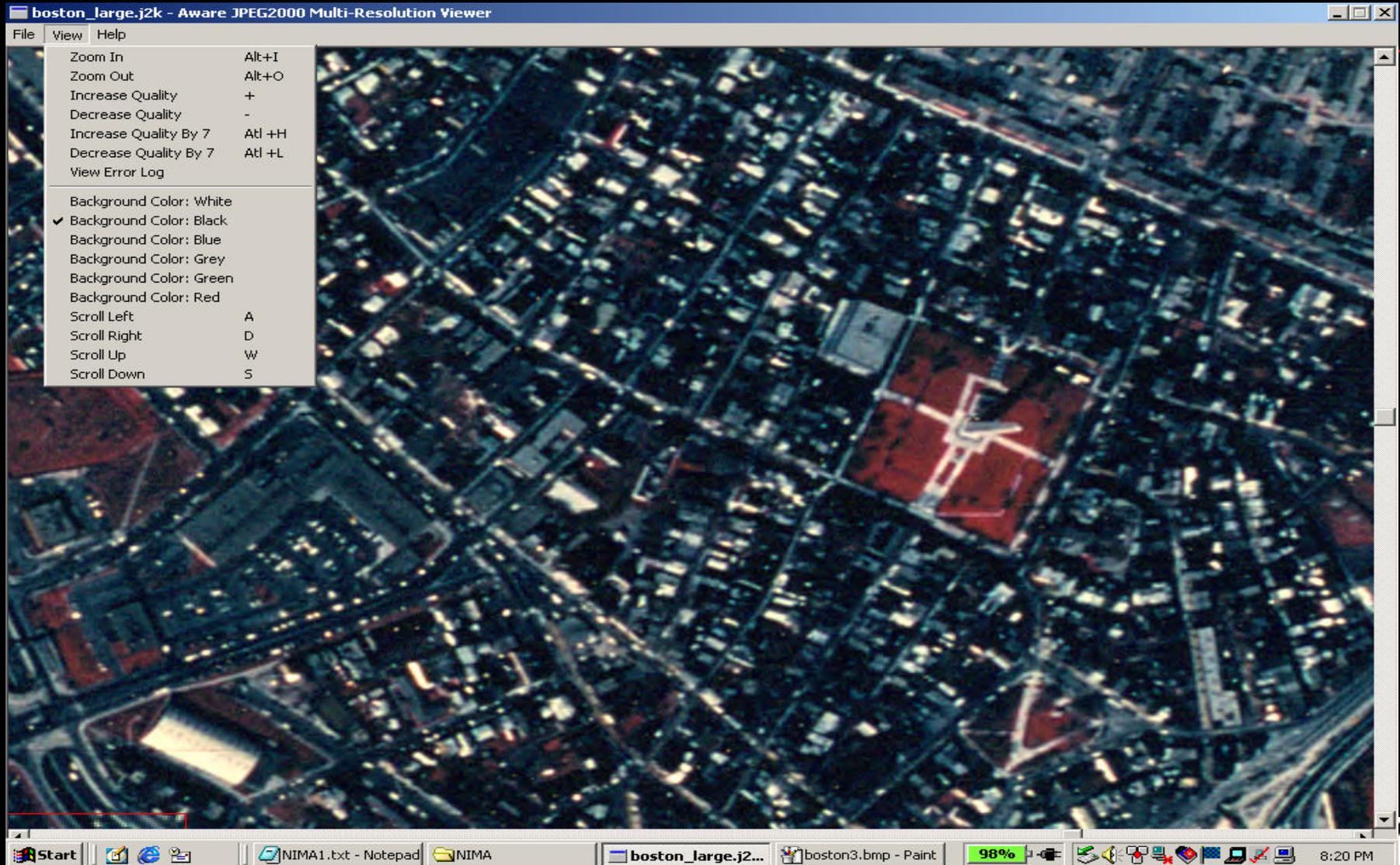
# NIMA Profile Decode- Higher resolution



# NIMA Profile Decode – Higher resolution

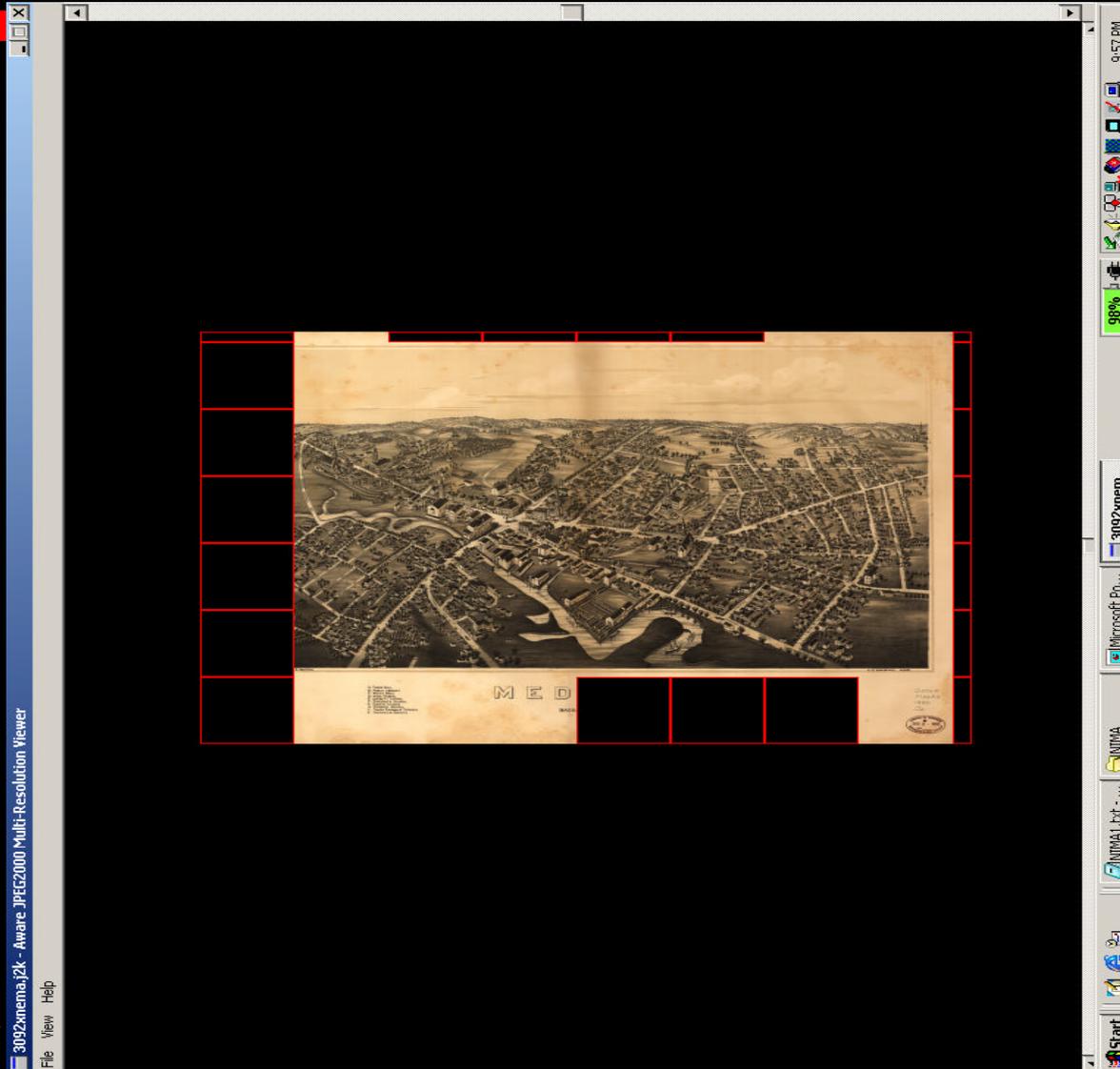


# NIMA Profile Decode- Full Resolution



# NIMA Profile

decode each tile by quality layers



8K x 6K,  
24 bit  
image



# NIMA Profile

Progressive Display, 1K x1K tile, Layer 1 of 19



# NIMA Profile

Progressive Display, 1K x1K tile, all 19 layers



# *NIMA PROFILE*

## How to use the Aware JPEG2000 API (1)

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```
/* initialize the JPEG 2000 image object */
```

```
    retval = aw_j2k_create(&j2k_object);
```

```
/* Read in the input image */
```

```
    input_file_name = "sample_image.bmp";
```

```
    retval = aw_j2k_set_input_image_file(j2k_object,  
    input_file_name);
```

```
/* Request a JPEG 2000 format for the output */
```

```
    retval = aw_j2k_set_output_type(j2k_object,  
    AW_J2K_FORMAT_J2K);
```



# ***NIMA PROFILE***

## **How to use the Aware JPEG2000 API (2)**

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```
/* Set the Compression parameters using the NIMA profile option */
```

```
aw_j2k_set_output_j2k_profile(j2k_object,  
    AW_J2K_PROFILE_NIMA_LOSSLESS);
```

```
/* Request the output image */
```

```
output_file_name = "sample_image.j2k";  
retval = aw_j2k_get_output_image_file(j2k_object,  
    output_file_name);
```



# *NIMA PROFILE*

## How to use the Aware JPEG200 API (3)

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- Optionally.... Each encoding option can be set separately

Examples:

```
/* set number of layers to 19 */
```

```
aw_j2k_set_output_j2k_layers(j2k_object, 19);
```

```
/* set the tile size to 1024 x 1024 */
```

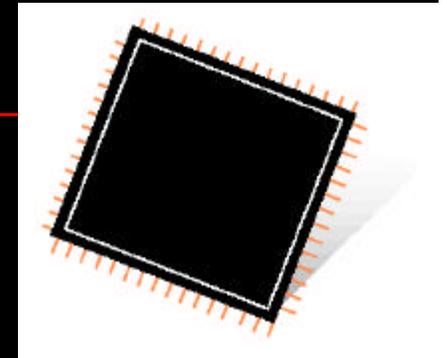
```
aw_j2k_set_output_j2k_tile_size(j2k_object, 1024,  
1024);
```



# Aware & JPEG2000- Embedded

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- Ports to DSP's provided as requested
- Aware C Model is designed to provide platform independent, modularized, commented source code to facilitate ports to DSPs or other embedded devices
- Includes test vectors- Each functional block of the J2K algorithm can be compiled, run, tested



# Aware & JPEG2000- Wireless



# Aware & JPEG2000- Wireless

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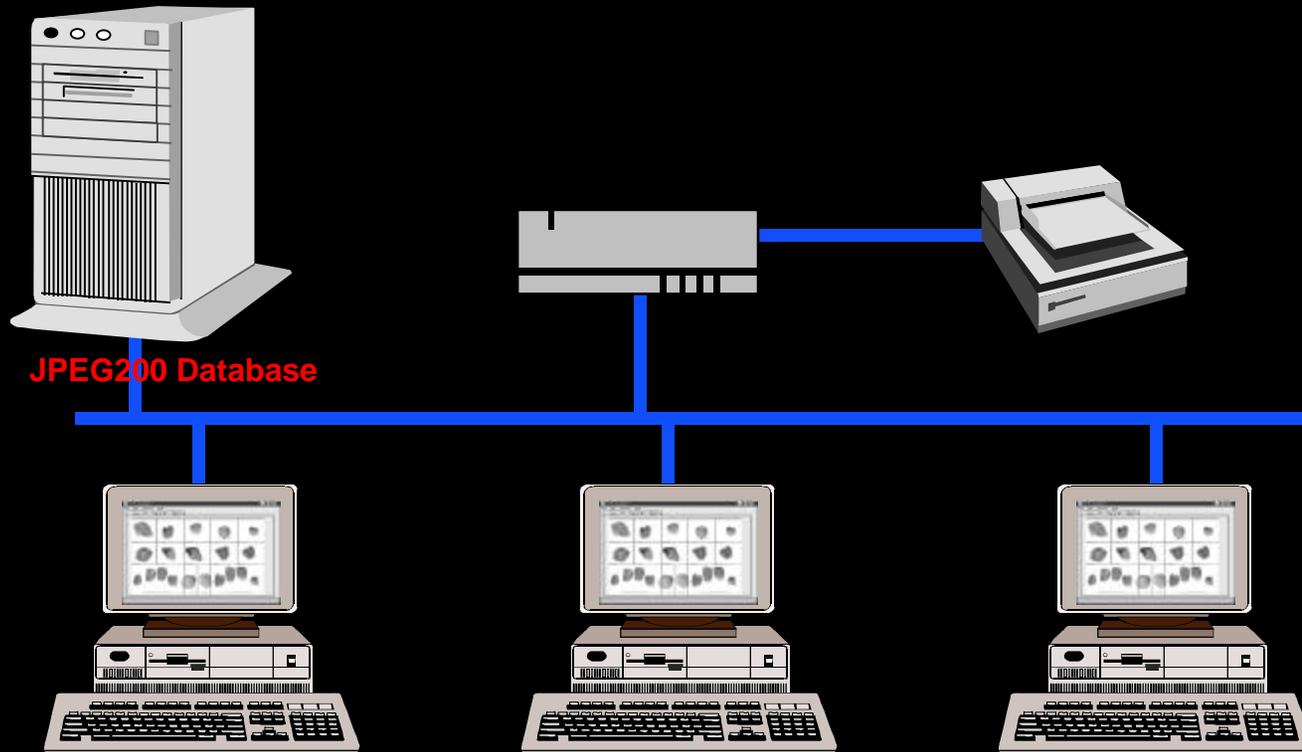
- Pocket PC Plugin and API
- JPEG2000 is ideal
  - ⇒ small file sizes, layered file format, error resilience
  - ⇒ Aware provides a fully functional progressive decoder for the PocketPC devices



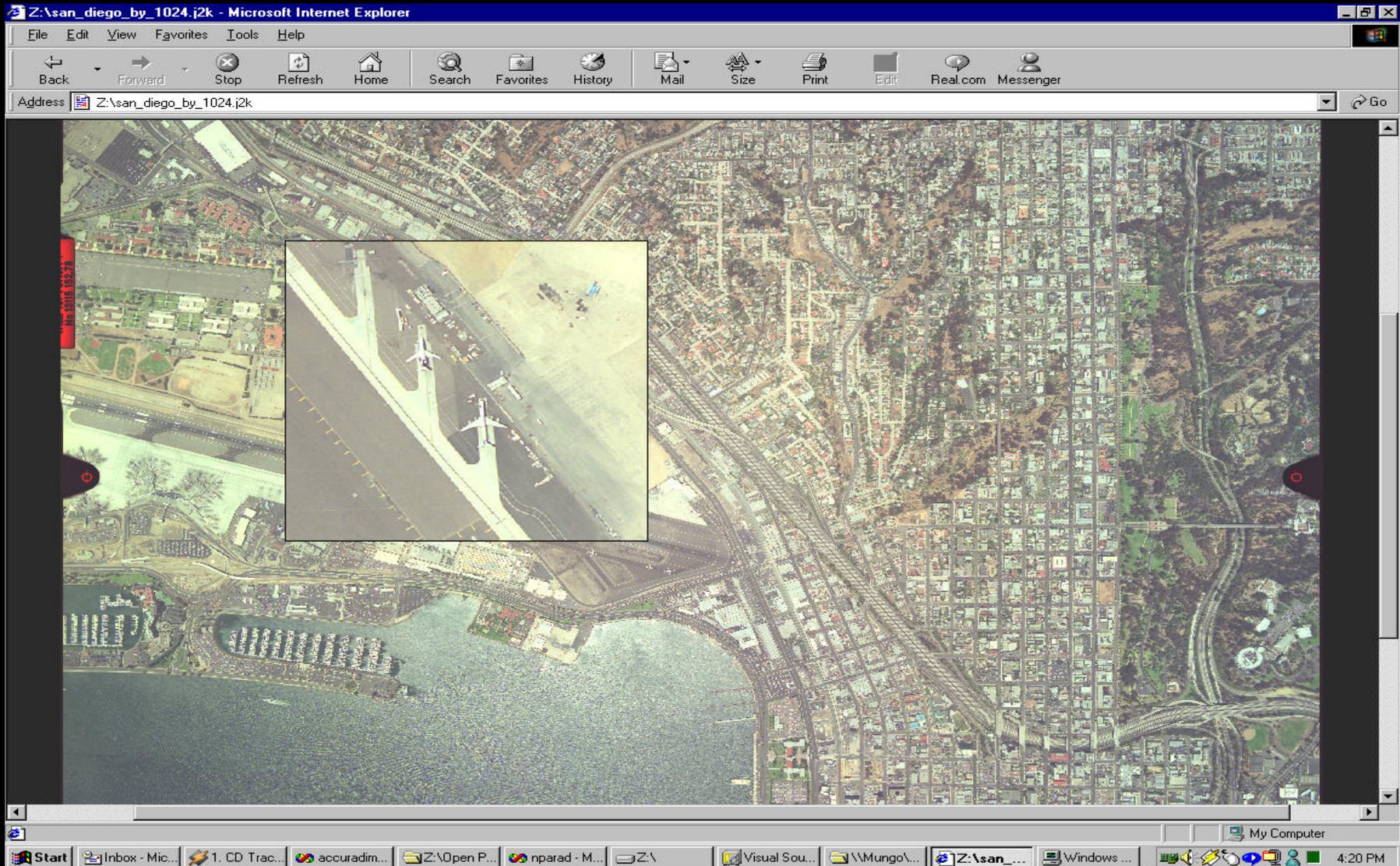
# Aware & Web Based Imaging Solutions-

*CJIS Web* for biometric image database

*FrameWave Web* for medical image database



# JPEG2000 Browser Plugin



Magnify Tool Enabled in Browser



# The Value of Aware to NIMA

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- All J2K software developed and written by Aware engineers and mathematicians
- All US based code development
- No university based development or code ownership (important for support and maintenance)
- No cross-licensing of code from third parties
- All code written in ANSI C - facilitates ease of porting



# Aware's Value to NIMA

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- 16 years of experience in wavelet compression, including ASICs and MMX-optimized software
- Active participation in the standards body
- Aware is profitable, stable, long term supplier
- Reduced risk and faster time-to-market
- Can provide implementations tailored to specific application requirements
- Full maintenance and support by a team of professional engineers

