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TITLE OF THE INVENTION			
OPTIMIZATION T-JUNCTION CRACKING-PROBLEM OF IMAGE PARCELS BEING PACKET STREAMED BY UTILIZING QUADTREE SCHEME			
<input checked="" type="checkbox"/> Direct all correspondence to Customer Number <u>23488</u> .		 23488 PATENT TRADEMARK OFFICE	
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ENCLOSED APPLICATION PARTS (check all that apply)			
<input checked="" type="checkbox"/> Specification	No. of pages: <u>11</u>	<input type="checkbox"/> Small Entity Statement	
<input checked="" type="checkbox"/> Drawings	No. of sheets: <u>5</u>	<input type="checkbox"/> Power of Attorney	
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<input checked="" type="checkbox"/> This invention was <u>not</u> made by or under contract with a US Government agency.			
US Government agency and Contract: _____			
Signature: <u>Gerald B. Rosenberg</u>	Date: <u>December 26, 2000</u>		
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1 EFFICIENT CORRECTION OF T-JUNCTION
2 CRACKING-PROBLEM OF IMAGE PARCELS BEING
3 PACKET STREAMED BY UTILIZING QUADTREE
4 SCHEME
5
6
7

8 Inventors:
9 Isaac Levanon
10 Yoni Lavi
11

12 Background of the Invention
13
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15 The present invention is generally related to the delivery of high-resolution
16 highly featured graphic images over limited and narrowband communications
17 channels.
18

19 Summary of the Invention

20 The objective is to display a two-dimensional pixel map, a 16-Bit RGB color
21 image in the preferred embodiments, of very large dimensions and permitting the
22 viewing of the image from a dynamic three-dimensional viewpoint. Multiple such
23 images are remotely hosted for on-demand selection and transfer to a client
24 system for viewing.

25 Images, as stored by the server, may individually range from gigabytes to
26 multiple terabyte in total size. A correspondingly large server storage and

1 processing system is contemplated. Conversely, client systems are contemplated
2 to be conventional personal computer systems and, in particular, mobile, cellular,
3 embedded, and handheld computer systems, such as personal digital assistants
4 (PDAs) and internet-capable digital phones, with relatively limited to highly
5 constrained network communications capabilities. For most wireless applications,
6 conventional narrowband communications links have a bandwidth of less than
7 approximately three kilobytes of data per second. Consequently, transmittal of
8 entire images to a client system in reasonable time is infeasible as a practical
9 matter.

10
11 Description of the Invention

12 Overview:

13 For purposes of the present invention, each image (Figure 1) is at least
14 logically defined in terms of multiple grids of image parcels with various levels of
15 resolutions (Figure 2) that are created through composition of information from
16 all level of resolutions, and stored by the server to provide an image for transfer
17 to a client system (Figure 3). Composed and separate static and dynamically
18 created layers are transferred to client system in parcels in a program selectable
19 order to optimize for fast quality build-up of the image presented to a user of the
20 client system, particularly when the parcels are streamed over a narrowband
21 communication link.

22 The multiple layers of an image allow the selectivity to incorporate
23 topographical, geographical, orientational, and other terrain and mapping
24 related information into the image delivered. Other layers, such as geographic
25 grids, graphical text overlays, and hyperlink selection areas, separately provided

1 or composed, aid in the useful presentation and navigation of the image as
2 presented by the client system and viewed by the user.

3 Compositing of layers on the server enables the data transfer burden to be
4 reduced, particularly in analysis of the requirements and capabilities of the client
5 system and the connecting communications link. Separate transfer of layers to the
6 client system allows the client system selectivity in managing and presentation of
7 the data to the user.

8 The system and methods of the present invention are designed to, on
9 demand, select, process and immediately transfer data parcels to the client
10 system, which immediately processes and displays a low-detail representation of
11 the image requested by the client system. The system and methods immediately
12 continue to select, process and sequentially transfer data parcels that, in turn, are
13 processed and displayed by the client system to augment the presented image
14 and thereby provide a continuously improving image to the user.

15 Selection of the sequentially transferred data is, in part, dependent on the
16 progressive translation of the three-dimensional viewpoint as dynamically
17 modified on the client system during the transfer process. This achieves the
18 above-stated objective while concurrently achieving a good rendering quality for
19 continuous fly-over of the image as fast as possible, yet continuously building the
20 image quality to the highest resolution of the image as stored by the server.

21 To optimize image quality build-up over limited and narrowband
22 communication links, the target image, as requested by the client system, is
23 represented by multiple grids of 64x64 image pixels (Figure 4) with each grid
24 having some corresponding level of detail. That is, each grid is treated as a
25 sparse data array that can be progressively revised to increase the resolution of

1 the grid and thereby the level of detail presented by the grid. The reason for
2 choosing the 64x64 pixel dimension is that, using current image compression
3 algorithms, a 16-bit 64x64 pixel array image can be presented as a 2KByte data
4 parcel. In turn, this 2KByte parcel is the optimal size, subject to conventional
5 protocol and overhead requirements, to be transmitted through a 3KByte per
6 second narrowband transmission channel. Using a smaller image array, such as
7 32x32, would create a 0.5KByte parcel, hence causing inefficiencies due to packet
8 transmission overhead, given the nature of current wireless communications
9 protocols.

10 Image array dimensions are preferably powers of two so that they can be
11 used in texture mapping efficiently. Each parcel, as received by the client system,
12 is preferably immediately processed and incorporated into the presented image.
13 To do so efficiently, according to the present invention, each data parcel is
14 independently processable by the client system, which is enabled by the selection
15 and server-side processing used to prepare a parcel for transmission. In addition,
16 each data parcel is sized appropriate to fit within the level-1 cache, or equivalent,
17 of the client system processor, thereby enable the data processing intensive
18 operations needed to process the data parcel to be performed without extended
19 memory access delays. In the preferred embodiment of the present invention,
20 data parcels are also processed for texture mapping and other image features,
21 such as topographical detailing.

22 Currently, with regard to conventional client systems, a larger image array,
23 such as 128x128, is too large to be fully placed within the level-1 cache of many
24 of the smaller conventional current processors, such as used by personal digital

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