

METHODS AND APPARATUS FOR FAST CHANNEL SWITCHING BETWEEN REAL TIME CONTENT ON A DEVICE

Claim of Priority under 35 U.S.C. §119

[0001] The present Application for Patent claims priority to Provisional Application No. 60/983,840 entitled "METHODS AND APPARATUS FOR FACILITATING FAST CHANNEL SWITCHING FOR REAL-TIME FLOWS" filed October 30, 2007, and assigned to the assignee hereof and hereby expressly incorporated by reference herein.

BACKGROUND

[0002] Real time multimedia content is typically delivered over a communication network to devices for rendering. For example, the real time content may be organized into content channels that are delivered over the network. Each content channel comprises a "flow" which may include video, audio, closed captioning, overlay information and any other suitable information for rendering on a device. Rendering logic, such as multimedia players and associated hardware and software at the device operate to process the received channels, perform any necessary decoding, descrambling, filtering, transformations, and any other processes necessary to render the content at the device. For example, the rendering logic typically constructs a rendering pathway that comprises all the processing functions necessary to process a received flow to extract and render the content on the device.

[0003] Typically, devices are able to switch between received content channels at the request of the device user. For example, a device user may switch between news and entertainment channels by navigating a programming guide and selecting the desired programming. When channel changes are requested, it is desirable that the change occurs very quickly. Otherwise, the device user may experience a long delay, blank screen, distorted images or other undesirable effects.

[0004] Unfortunately, conventional media players or other rendering logic at the device may "re-initialize" when it is detected that the source of the content has changed. For example, when the user requests a channel change, a media player on the user's device may be re-initialized to render the content on the

new channel. However, re-initialization may take more than a few seconds. For example, a content channel switch may result with the media player tearing down its existing rendering pathway and constructing a new rendering pathway to render the content associated with the new channel. This process may take a few seconds and as a consequence, a device user will experience a delay in viewing the selected channel, which may result in an unsatisfactory user experience.

[0005] Therefore, what is needed is a mechanism for use on a device to provide fast channel switching between available content channels to reduce or eliminate delays and provide an enhanced user experience.

SUMMARY

[0006] A method for channel switching. Receiving a channel selection indicator that identifies a second channel comprising second content to be rendered instead of a first channel having first content currently being rendered via an first rendering pathway. Next a determination is made as to whether the second content can be rendered using the first rendering pathway. If it is determined that the second content can be rendered using the first rendering pathway, inputting the second content into the first rendering pathway.

[0007] An apparatus for channel switching at a device to render real time content. The apparatus includes a user interface configured to receive a channel selection indicator that identifies a channel comprising real time content to be rendered. The apparatus also includes processing logic configured to determine whether the real time content can be rendered using an existing rendering pathway. The apparatus further includes a rendering interface configured to input the real time content into the existing rendering pathway if it is determined that the real time content can be rendered using the existing rendering pathway.

BRIEF DESCRIPTION OF THE DRAWINGS

- [0008] The foregoing aspects described herein will become more readily apparent by reference to the following Description when taken in conjunction with the accompanying drawings wherein:
- [0009] **FIG. 1** shows a network that illustrates aspects of a channel switching system;
- [0010] **FIG. 2** shows a detailed diagram illustrating exemplary aspects of a channel switching system;
- [0011] **FIG. 3** shows exemplary channel switching logic for use in aspects of a channel switching system;
- [0012] **FIG. 4** shows an exemplary method for providing aspects of a channel switching system; and
- [0013] **FIG. 5** shows exemplary channel switch logic for use in aspects of a channel switching system.

DESCRIPTION

- [0014] The following description describes aspects of a channel switching system that operates to provide fast and efficient channel switching at a device. The system is especially well suited for use with devices in wireless networks environments, and may be used by devices in any type of network environment, including but not limited to, communication networks, public networks, such as the Internet, private networks, such as virtual private networks (VPN), local area networks, wide area networks, long haul network, or any other type of data network.
- [0015] In various aspects, the channel switching system operates to avoid the time needed for rendering logic to tear down and construct new rendering pathways by determining whether or not content to be rendered is compatible with a currently existing rendering pathway. If the content is compatible, the system directs the content into the currently existing rendering pathway for rendering at a device. As a result, the time typically spent tearing down an old rendering pathway and constructing a new rendering pathway is saved, which provides a very fast and efficient channel switch thereby enhancing the user's experience.

[0016] **FIG. 1** shows a network **100** that illustrates aspects of a channel switching system. The network **100** comprises a device **102** that is coupled to a data network **104**. The data network **104** may be any type and/or combination of wired and/or wireless networks that allow data to be transmitted between devices in communication with the network **100**. For example, the data network **104** may comprise a mobile broadcasting network such as a MediaFLO network from the assignee of the present application, or a DVB-H network. Two content providers (**106**, **108**) are coupled to the network **100**. The content providers **106** and **108** communicate with the network **104** via any suitable communication channel. For example, the communication channel may be any type of wired or wireless communication channel that allows the content providers **106** and **108** to communicate with the data network **104**. The device **102** communicates with the data network **104** with the via a wireless communication link that allows data to be wirelessly transmitted between the network **104** and the device **102**. In an aspect, the wireless communication links comprise forward communication channels, reverse communication channels, control channels, and/or any other type of communication channel that may be used to communicate information between the network **104** and the device **102**. It is also to be recognized that a variety of intermediary network devices are not illustrated in **FIG. 1** to avoid obfuscating the subject matter of the described aspects.

[0017] A third content provider **110** is in communication with the device **102** without going through the network **104**. For example, the content provider **110** may communicate with the device **102** using any type of communication channel or may be directly coupled to the device **102**. For example, the communication channel may comprise a 3G wireless network. The content providers **106**, **108** and **110** operate to provide content to the device **102**. For example, the content may be provided in a real time transport protocol (RTP) or provided as files in (MP4) format. For example, the content comprises content channels carrying flows that include applications, programs, multimedia content, advertising and/or any other type of content and/or data that may be rendered on the device **102**.

[0018] The device **102** comprises a receiver **124**, channel switch logic **112**, a user interface **114**, protocol stack **122**, and rendering logic **116**. In an aspect, the

channel switch logic **112** operates to receive or have access to the content channels provided by the content providers **106**, **108**, and **110**. For example, the receiver **124** receives content channels and provides real time content to the protocol stack **122**, which in turn passes the content to the channel switch logic **112** based on flow identifiers; one flow per channel and each flow comprising video, audio, captioning, and overlays etc.

[0019] The channel switch logic **112** operates to select a particular content channel and inputs data from this content data to the rendering logic **116**. In an aspect, the user interface **114** operates to receive user input which specifies the particular content channel to be rendered at the device **102**. The user interface **114** signals the channel selection to the channel switch logic **112**. The channel switch logic **112** then operates to control the rendering logic **116** to construct the functional elements **118** needed to decode and render the content. For example, the functional elements comprise content filters, transform filters, decoders, and/or any other type of functional element needed to process the content flow of the selected channel for rendering at the device **102**. In an aspect, the functional elements **118** that are assembled to render the content stream form a rendering pathway, as illustrated at **120** that can be used to render the content of the selected channel.

[0020] During operation, the device user may request a channel change to render content from a different channel. The user interface **114** passes the channel selection request to the channel switch logic **112**. In an aspect, the channel switch logic **112** operates to control the rendering logic **116** to reinitialize itself in response to the channel change request. Thus, the existing rendering pathway is torn down or disassembled. The channel switch logic **112** then controls the rendering logic **116** to construct a new rendering pathway to process and render content from the new channel.

[0021] In another aspect, the channel switch logic **112** receives the channel change request from the user interface **114** and determines the type of content on the new channel to be rendered. The channel switch logic **112** then determines if a current rendering pathway can be used to render the content on the new channel. For example, channel switch logic **112** determines whether or not the functional elements **118** that currently exist on the rendering pathway **120** are able to process and render the content on the new channel.

[0022] If the channel switch logic **112** determines that the current rendering pathway **120** can process and render the content on the new channel, then the channel switch logic **112** does not re-initialize the rendering logic **116** but instead, feeds the content from the new channel into the current rendering pathway. As a result, the content from the new channel is rendered very quickly without the delays necessary to reconstruct a new rendering pathway. Thus, in various aspects, the channel switching system operates to provide for fast channel switching on a device for an enhanced user experience.

[0023] **FIG. 2** shows exemplary aspects of a channel switching system **200** for use at a device. In an aspect, channel switch logic **202** is provided as part of a multimedia manager **204**. In other aspects, the channel switch logic **202** may be a stand-alone module or provided as part of any other module at the device. A protocol stack **206** receives content streams from one or more sources. For example, the protocol stack **206** may receive the content streams from a network and/or from another communication channel. The content streams comprise one or more content channels that can be selected for rendering on a device.

[0024] A user interface **208** operates to receive user input and signals the multimedia manager **204** with channel selection requests from a user. The multimedia manager **204** provides control signals to control logic **212** of rendering logic **210**. The rendering logic **210** comprises decoders and a renderer **218**. The control logic **212** operates to construct a rendering pathway **220** that includes functional elements that operate to process content data associated with a selected content channel. For example, the rendering pathway **220** comprises a source filter **214** and a transform filter **216**. The source filter **214** and the transform filter **216** process content data received from the multimedia manager **204**. For example, the source filter **214** understands the format of the received transport stream and extracts media data for presentation to the transform filter **216**. The transform filter **216** is a pluggable filter, such as an H264 decoder that takes in data from the source filter **214** and decompresses it. The processed data is then input to a renderer **218** that operates to render the content on the device. For example, the renderer **218** operates to render video, audio, and overlays that are included in the content data.

[0025] For the purpose of this description, it will be assumed that a first content channel is being rendered. For example, the protocol stack **206** provides content data of the first channel to the multimedia manager **204**. The multimedia manager **204** communicates with the protocol stack **206** to receive real time content and also functions to multiplex in streams from other transports if needed. The multimedia manager **204** communicates with the control logic **212** to set up a rendering pathway **220** to decode the data for rendering. The renderer **218** operates to render the data on the device. In an aspect, the user provides input to the user interface **208** to indicate a channel switch to a particular content channel. The user interface **208** sends a channel selection indicator to the multimedia manager **204** indicating the new channel selection. The channel switch logic **202** also receives this selection indicator. In various aspects, the channel switch logic **202** operates to perform one or more of the following functions.

1. Determines if the content on the new channel has the same format as the content currently being rendered. For example, there is no guaranteed that the source **214** and transform **216** filters to decode the new channel will be the same as those being used for the current channel.
2. If the content on the new channel is formatted differently from the content currently being rendered, the channel switch logic **202** notifies the control logic **212** to construct a new rendering pathway **220** to decode the content on the new channel.
3. If the content on the new channel is formatted the same as the content currently being rendered, (i.e., same source **214** and transform **216** filters may be used) the channel switch logic **202** operates to input data from the new content channel into the current rendering pathway without re-initializing the rendering logic **210**.

[0026] Therefore, a fast channel switch is achieved because the current rendering pathway is used for the new content thereby avoiding the time necessary to tear down and reconstruct a new rendering pathway.

[0027] **FIG. 3** shows exemplary channel switch logic **300** for use in aspects of a channel switching system. For example, the channel switch logic **300** is suitable for use as the channel switch logic **202** shown in **FIG. 2**. The channel

switch logic **300** comprises processing logic **302**, user interface **304**, rendering logic interface **306**, data output logic **308**, and protocol stack interface **310**, all coupled to a data bus **312**.

[0028] In various aspects, the processing logic **302** comprises at least one of a CPU, processor, gate array, hardware logic, memory elements, virtual machine, and/or hardware executing software. Thus, the processing logic **302** generally comprises logic to execute machine-readable instructions to control one or more functional elements of the channel switch logic **300** via the data bus **312**.

[0029] The user interface **304** comprises hardware and/or hardware executing software that allow the channel switch logic **300** to communicate with a user to receive user input. For example, the user input comprises channel selection requests that request the rendering of content from a selected channel. The user interface **304** passes channel section information to the processing logic **302**.

[0030] The protocol stack interface **310** comprises hardware and/or hardware executing software that operate to allow the channel switch logic **300** to receive content data and/or other information associated with one or more received content channels. For example, in an aspect, a protocol stack associated with a device may receive channel content from a variety of sources and operates to make this channel content available to the protocol stack interface **310**. The protocol stack interface **310** is configured to provide protocol stack control signals to request selected content data from a protocol stack. The protocol stack interface **310** is also configured to receive content data associated with a selected content channel from the protocol stack.

[0031] The rendering logic interface **306** comprises hardware and/or hardware executing software that operate to allow the channel switch logic **300** to pass control information to rendering logic at a device. For example, the control information that is passed operates to control the rendering logic to re-initialize and to construct a rendering pathway to render a selected channel content.

[0032] The data output logic **308** comprises hardware and/or hardware executing software that operate to allow content data from a selected content channel to

be passed to rendering logic to be processed by a rendering pathway so that it can be rendered on the device.

[0033] During operation of the channel switch logic **300**, a user enters channel selections into the user interface **304**, which passes the information to the processing logic **302**. The processing logic **302** determines if a content channel is currently being rendered. If no content channel is being rendered, the processing logic **302** controls the protocol stack interface **310** to obtain the content for the selected channel. The processing logic **302** also controls the rendering logic interface **306** to signal the rendering logic to construct a new rendering pathway to render the selected content channel. The processing logic **302** then controls the data output logic **308** to output the data of the selected content channel to the rendering logic for processing and rendering by the newly constructed rendering path.

[0034] In an aspect, the processing logic **302** operates to determine that the selected content channel can be rendered by an existing rendering pathway. For example, if an existing rendering pathway has been previously constructed to render content, the processing logic **302** determines if that existing pathway can be used to render the selected content. If the existing pathway can be used, the processing logic **302** operates to control the data output logic **308** to output the data of the selected content channel to the rendering logic where it is processed by the existing rendering pathway. Thus, a fast channel switch is achieved, since a new rendering pathway does not need to be constructed to render the content of the selected content channel.

[0035] In various aspects, the channel switching system comprises a computer program product having one or more program instructions (“instructions”) or sets of “codes” stored or embodied on a machine-readable medium. When the codes are executed by at least one processor, for instance, a processor at the processing logic **302**, their execution causes the processor to provide the functions of the channel switching system described herein. For example, the machine-readable medium comprises a floppy disk, CDROM, memory card, FLASH memory device, RAM, ROM, or any other type of memory device or machine-readable medium that interfaces to channel switch logic **300**. In another aspect, the sets of codes may be downloaded into the channel switch logic **300** from an external device or communication network resource. The

sets of codes, when executed, cause the channel switch logic **300** to provide aspects of a channel switching system as described herein.

[0036] **FIG. 4** shows an exemplary method **400** for providing aspects of a channel switching system. For clarity, the method **400** will be described with reference to the channel switch logic **300** shown in **FIG. 3**. In one or more aspects, the processing logic **302** executes program instructions to perform the functions described below.

[0037] At block **402**, rendering logic at a device is controlled to construct a rendering pathway to render selected content. For example, the processing logic **302** controls the rendering logic interface **306** to signal the rendering logic to construct a rendering pathway to render content having a selected format.

[0038] At block **404**, the rendering logic begins rendering the selected content on a device. In an aspect, the processing logic **302** operates to control the protocol stack interface **310** to obtain the selected content data from a protocol stack and pass this content data to the data output logic **308**. The data output logic **308** then passes the content data to rendering logic to be rendered using the current rendering pathway.

[0039] At block **406**, a channel request is received to render content on a different channel. In an aspect, a user inputs a channel request to the user interface **304**. The channel request is passed to the processing logic **302**.

[0040] At block **408**, the content type of the new channel is determined. In an aspect, the processing logic **302** determines the content type of the content on the requested channel.

[0041] At block **410**, a determination is made as to whether the content type of the content on the requested channel is the same as the content type of the content currently being rendered. If the content types are different, the method proceeds to block **416** to tear down the existing rendering pathway. If the content types are the same, the method proceeds to block **412**. In an aspect, the processing logic **302** makes this determination.

[0042] At block **416**, rendering logic at a device is controlled to tear down the existing rendering pathway so that a new rendering pathway can be constructed to render different content. For example, the processing logic **302**

controls the rendering logic interface **306** to signal the rendering logic to tear down the existing rendering pathway.

[0043] At block **412**, the content associated with the new channel selection is obtained from a protocol stack. In an aspect, the processing logic **302** controls the protocol stack interface **310** to obtain the content associated with the new channel selection.

[0044] At block **414**, the content associated with the new channel selection is input into the current rendering pathway. In an aspect, the processing logic **302** operates to control the data output logic **308** to output the content associated with the new content channel to the rendering logic where it is processed by the existing rendering pathway.

[0045] It should be noted that the method **400** illustrates just one aspect and that changes, additions, or rearrangements of the operations described above may be made without deviating from the spirit and scope of the various aspects.

[0046] **FIG. 5** shows an exemplary device **500** for providing aspects of a channel switching system. In an aspect, the device **500** is implemented by at least one processor or integrated circuit comprising one or more modules configured to provide aspects of a channel switch system as described herein. For example, each module comprises hardware and/or hardware executing software.

[0047] The device **500** comprises a first module that comprises means **502** for receiving a channel selection indicator that identifies a channel comprising real time content to be rendered. For example, in an aspect, the means **502** comprises the user interface **304**.

[0048] The device **500** comprises a second module that comprises means **504** for determining whether the real time content can be rendered using an existing rendering pathway. For example, in an aspect, the means **504** comprises the processing logic **302**.

[0049] The device **500** also comprises a third module that comprises means **506** for inputting the real time content into the existing rendering pathway if it is determined that the real time content can be rendered using the existing rendering pathway. For example, in an aspect, the means **506** comprises rendering logic interface **306**.

[0050] The various illustrative logics, logical blocks, modules, and circuits described in connection with the aspects disclosed herein may be implemented

or performed with a general purpose processor, a digital signal processor (DSP), an application specific integrated circuit (ASIC), a field programmable gate array (FPGA) or other programmable logic device, discrete gate or transistor logic, discrete hardware components, or any combination thereof designed to perform the functions described herein. A general-purpose processor may be a microprocessor, but, in the alternative, the processor may be any conventional processor, controller, microcontroller, or state machine. A processor may also be implemented as a combination of computing devices, e.g., a combination of a DSP and a microprocessor, a plurality of microprocessors, one or more microprocessors in conjunction with a DSP core, or any other such configuration.

[0051] The steps of a method or algorithm described in connection with the aspects disclosed herein may be embodied directly in hardware, in a software module executed by a processor, or in a combination of the two. A software module may reside in RAM memory, flash memory, ROM memory, EPROM memory, EEPROM memory, registers, a hard disk, a removable disk, a CD-ROM, or any other form of storage medium known in the art. An exemplary storage medium is coupled to the processor, such that the processor can read information from, and write information to, the storage medium. In the alternative, the storage medium may be integral to the processor. The processor and the storage medium may reside in an ASIC. The ASIC may reside in a user terminal. In the alternative, the processor and the storage medium may reside as discrete components in a user terminal.

[0052] The description of the disclosed aspects is provided to enable any person skilled in the art to make or use the present invention. Various modifications to these aspects may be readily apparent to those skilled in the art, and the generic principles defined herein may be applied to other aspects, e.g., in an instant messaging service or any general wireless data communication applications, without departing from the spirit or scope of the invention. Thus, the present invention is not intended to be limited to the aspects shown herein but is to be accorded the widest scope consistent with the principles and novel features disclosed herein. The word “exemplary” is used exclusively herein to mean “serving as an example, instance, or illustration.” Any aspect described

herein as “exemplary” is not necessarily to be construed as preferred or advantageous over other aspects.

[0053] For example, the apparatus and methods described herein may be implemented in a MediaFLO system. In a Media Flo system, flow content is delivered over UDP/IP across a FDAI interface in a device. Flows can be activated by a service layer or apps opening a UDP socket and joining a multicast IP Address:Port. The multicast IP Address:Port maps to a flow ID per a defined mapping algorithm. Switching to a new flow means leaving multicast for old flow and joining multicast IP address:Port for new flow (i.e. data is now delivered to new IP Address:Port). However, some media players re-initialize when they detect that the source of the content has changed (i.e. data is now coming from a different IP address). Such re-initialization may take more than 2 seconds. Therefore, to facilitate fast channel switching the following is implemented to avoid re-initialization of the media player: flows are activated by clients opening a TCP/IP socket and sending an activation message over the FDAI messages interface; unicast IP Address:Port (End-Point) that the flow contents need to be sent to is supplied in the message; when switching channels, supplied end-point for new target flow can be the same as the end-point for the old de-activated flow. It is to be remembered that the described methods and apparatus are applicable to systems other than a MediaFLO system, this example being provided for illustrative purposes and not to limit the invention thereto.

[0054] Accordingly, while aspects of a channel switching system have been illustrated and described herein, it will be appreciated that various changes can be made to the embodiments without departing from their spirit or essential characteristics. Therefore, the disclosures and descriptions herein are intended to be illustrative, but not limiting, of the scope of the invention, which is set forth in the following claims.

CLAIMS

What is claimed is:

1. A method for channel switching, the method comprising:
receiving a channel selection indicator that identifies a second channel comprising second content to be rendered instead of a first channel having first content currently being rendered via an first rendering pathway;
determining whether the second content can be rendered using the first rendering pathway;
inputting the second content into the first rendering pathway if it is determined that the second content can be rendered using the first rendering pathway.
2. The method of claim 1, wherein said receiving comprises receiving the channel selection indicator from a device user.
3. The method of claim 1, wherein the first rendering pathway comprises at least one of a source filter and a transform filter.
4. The method of claim 3, wherein said determining comprises determining that the second content can be rendered using the first rendering pathway if the second content is of the same format as the first content.
5. The method of claim 1, further comprising obtaining the second content from a protocol stack.
6. The method of claim 1, further comprising:
if it is determined that the second content can not be rendered using the first rendering pathway, then performing the operations of:
tearing down the first rendering pathway; and
constructing a second rendering pathway to render the second content.
7. An apparatus for channel switching at a device to render real time content, the apparatus comprising:
a user interface configured to receive a channel selection indicator that identifies a channel comprising real time content to be rendered;

processing logic configured to determine whether the real time content can be rendered using an existing rendering pathway;

a rendering interface configured to input the real time content into the existing rendering pathway if it is determined that the real time content can be rendered using the existing rendering pathway.

8. The apparatus of claim 7, wherein said user interface is configured to receive the channel selection indicator from a device user.

9. The apparatus of claim 7, wherein the existing rendering pathway comprises at least one of a source filter and a transform filter used to render selected real time content associated with a different channel.

10. The apparatus of claim 9, wherein said processing logic is configured to determine that the real time content can be rendered using the existing rendering pathway if the real time content is of the same format as the selected real time content associated with the different channel.

11. The apparatus of claim 7, further comprising a protocol stack interface configured to obtain the real time content from a protocol stack.

12. The apparatus of claim 7, wherein if it is determined that the real time content can not be rendered using the existing rendering pathway, said processing logic is configured to:

tear down the existing rendering pathway; and

construct a new rendering pathway to render the real time content.

13. An apparatus for channel switching at a device to render real time content, the apparatus comprising:

means for receiving a channel selection indicator that identifies a channel comprising real time content to be rendered;

means for determining whether the real time content can be rendered using an existing rendering pathway;

means for inputting the real time content into the existing rendering pathway if

it is determined that the real time content can be rendered using the existing rendering pathway.

14. The apparatus of claim 13, wherein said means for receiving comprises means for receiving the channel selection indicator from a device user.

15. The apparatus of claim 13, wherein the existing rendering pathway comprises at least one of a source filter and a transform filter used to render selected real time content associated with a different channel.

16. The apparatus of claim 15, wherein said means for determining comprises means for determining that the real time content can be rendered using the existing rendering pathway if the real time content is of the same format as the selected real time content associated with the different channel.

17. The apparatus of claim 13, further comprising means for obtaining the real time content from a protocol stack.

18. The apparatus of claim 13, wherein if it is determined that the real time content can not be rendered using the existing rendering pathway, then said means for determining comprises:

means for tearing down the existing rendering pathway; and

means for constructing a new rendering pathway to render the real time content.

19. A computer program product for channel switching at a device to render real time content, the computer program product comprising:

a machine-readable medium encoded with codes executable to:

receive a channel selection indicator that identifies a channel comprising real time content to be rendered;

determine whether the real time content can be rendered using an existing rendering pathway; and

input the real time content into the existing rendering pathway if it is determined that the real time content can be rendered using the existing rendering pathway.

20. A device operable to channel switch between real time content channels, the device comprising:

a receiver configured to receive content channels;

a user interface configured to receive a channel selection indicator that identifies a channel comprising real time content to be rendered;

processing logic configured to determine whether the real time content can be rendered using an existing rendering pathway;

a rendering interface configured to input the real time content into the existing rendering pathway if it is determined that the real time content can be rendered using the existing rendering pathway.