METHOD AND APPARATUS FOR IMPLEMENTING SOFTWARE UPGRADE IN THE DIGITAL TELEVISION RECEIVING DEVICE

Field of the Invention

[0001] The invention relates to the field of digital television, and particularly, to a method and an apparatus for software upgrade in a digital television receiving device.

Background of the Invention

[0002] In addition to abundant digital television programs, broadcast television operators have to frequently offer personalized, bi-directionally interactive, and development-sustainable digital television data services, in order to attract the subscribers, to boost the growth of the number of digital television subscribers, and to excavate new profit increasing points.

[0003] In the field of digital television, a digital television receiving device provider and a digital television service provider are usually not the same one. However, their software is closely linked with each other on a digital television receiving device, neither is dispensable. The software from the digital television receiving device provider is oriented to providing fundamental and hardware-level software operation platforms, for example, providing a stable operating system platform, resource management, hardware driver, image decoding, and screen displaying. Whereas, the software from the digital television service provider is oriented to a secondary development on the basis of the platforms provided by the digital television receiving device provider, i.e., providing digital television data services, such as Multimedia Messaging Service, Short Message Service, stock information service, and information consultation, according to the requirements of thebroadcast operators. The different orientations bring about different requirements for software upgrade.

[0004] Digital television receiving device software currently available in the market usually includes three parts, such as system terminal software, service software, and interface adaptation software. After being processed by a compiler and a linker, these three parts are stored as a whole in a nonvolatile memory in a digital television receiving device under certain rules. Any partial modification to data in one of the three parts regardless of the other two parts may cause a system collapse during running. Therefore, when any of the three parts

needs upgrade, a Makefile has to be re-created. The three parts have to be upgraded together. Figure 1 shows the principle of a conventional upgrade solution.

[0005] When a service provider requires to upgrade his software, the conventional upgrade solution executes the following steps.

[0006] (A) A compiler coordinated with the CPU of the digital television receiving device is obtained, to make a Makefile, to compile service software, and to create a service software library.

[0007] (B) The digital television receiving device modifies the Makefile, creates a digital television receiving device software library and an interface adaptation module library.

[0008] (C) The digital television receiving device links the service software library, the system terminal software library, and the interface adaptation module library into an object file, and generates an executable file.

[0009] (D) The executable file is multiplexed into a Transport Stream (TS) via an upgrade server according to a predefined protocol.

[0010] (E) An upgrade module of the digital television receiving device software receives and extracts the data, and assembles a new upgrade file;

[0011] (F) The new upgrade file is written into a nonvolatile memory (e.g., a FLASH).

[0012] Apparently, in the conventional technical solution, the digital television receiving device software has to be upgraded together with the service software. However, the digital television service provider has a much higher demand for software upgrade than the digital television receiving device provider. In consideration of the inconvenience of the subscribers resulted from the upgrade process, the digital television receiving device provider is often unwilling to upgrade the software, or is unwilling to provide assistance to the digital television service provider to upgrade the software. Undoubtedly, this may cause unnecessary troubles in the development of digital television services. Due to the fact that the digital television receiving device software has to be upgraded at the same time when the service software is upgraded, the service software provider is restricted by the digital television

receiving device provider sometimes. In addition, in the case of a narrow bandwidth, it will take a long time to upgrade the software, resulting in a poor experience of the subscriber, and the bandwidth of the multiplexer will be wasted.

Summary of the Invention

[0013] In view of the above, the invention provides a method and an apparatus for software upgrade in a digital television receiving device, to solve the problem in the prior art that the terminal software of the digital television receiving device has to be upgraded at the same time when the service software needs upgrading in the digital television receiving device.

[0014] The invention provides a method for software upgrade in a digital television receiving device. The method includes:

A. multiplexing service software into a transport stream according to a predefined protocol;

B. extracting, by the digital television receiving device, data of the service software from the transport stream and storing the data of the service software;

C. restarting the digital television receiving device, so that digital television receiving device software obtains addresses of interface functions of the service software, and the service software obtains addresses of interface functions of the digital television receiving device software;

D. updating, by the digital television receiving device software, default addresses of the interface functions of the service software according to the addresses obtained by the digital television receiving device software, and updating, by the service software, default addresses of the interface functions of the digital television receiving device software according to the addresses obtained by the service software.

[0015] In step B, before storing the data of the service software, the method may further include: checking integrity and/or validity of the data of the service software.

[0016] The data of the service software may be stored in a nonvolatile memory after the checking is passed.

[0017] In step C, the method may further include: invoking, by the digital television receiving

device software, an initialization interface of the service software, and sending the addresses of the interface functions of the digital television receiving device software required by the service software to the service software, and sending, by the service software, the addresses of the interface functions of the service software required by the digital television receiving device software to the digital television receiving device software.

[0018] The method may further include: invoking, by the digital television receiving device software, a relocation function provided in an operating system to relocate the service software, and returning, by the relocation function, relocated addresses of the interface functions of the service software.

[0019] The invention also provides a software loading apparatus for software installation and upgrade, which includes: an initialization interface module, a new version service software processing module, a service software interface extraction module, and a service software interface update module;

the new version service software processing module is adapted for detecting and storing service software of a new version, and returning storage location of the service software to the initialization interface module;

the initialization interface module is adapted for interacting with digital television receiving device software, receiving an invocation instruction, and invoking the service software interface extraction module to extract interface information of service software under the invocation instruction;

the service software interface module is adapted for interacting with the service software, and extracting the interface information of the service software, and sending the interface information of the service software to the service software interface update module;

the service software interface update module is adapted for updating default addresses of interface functions of the service software required by the digital television receiving device software in accordance with function addresses provided by the service software interface extraction module.

[0020] The software loading apparatus may further include a checking module, adapted for receiving an instruction from the new version service software processing module, checking

validity and/or integrity of the service software, and returning a result of the checking to the new version service software processing module.

[0021] The service software interface extraction module may be further adapted for extracting an initialization interface of the service software, sending addresses of interface functions of the digital television receiving device software required by the service software to the service software, receiving addresses of interface functions of the service software, required by the digital television receiving device software, from the service software, and returning the addresses of the interface functions of the service software to the service software interface update module.

[0022] The service software interface extraction module may be further adapted for invoking a relocation function module provided in an operating system of a digital television receiving device, relocating the service software, and returning relocated address of the interface functions of service software to the service software interface update module.

[0023] The software loading apparatus may be integrated in a digital television receiving device, a service software server, or any other separate devices.

[0024] With the technical solutions according to the invention, the service software and the digital television receiving device terminal software may be upgraded separately since there is no direct function interface between the service software and the terminal software, in other words, the service software and the terminal software are independent from each other.

[0025] With the method according to the invention, the operators need not to build their own upgrade servers repeatedly, so that the networking cost may be saved.

[0026] Since the service software is independent from the digital television receiving device terminal software, in the case of the originally allocated bandwidth of the upgrade server, the service software may be upgraded quickly, and the waiting time of the users may be reduced.

[0027] Since the service software is independent from the digital television receiving device terminal software, the service software may be stored in a nonvolatile memory independent of the digital television receiving device terminal software. In this way, the service software may

be encrypted and compressed, so as to protect the service software from being disassembled. Thus the software security may be enhanced significantly.

Brief Description of the Drawings

[0028] Figure 1 shows a technical solution for upgrading digital television receiving device software and service software in the prior art;

[0029] Figure 2 shows a technical solution for upgrading digital television receiving device software and service software according to an embodiment of the invention;

[0030] Figure 3 is a flow diagram showing a method for software upgrade according to the invention;

[0031] Figure 4 is a structural diagram showing a downloading module according to the invention.

Detailed Description of the Embodiments

[0032] Hereinafter the principle of the invention will be described with a set-top box (STB), which is a digital television receiving device, as an example. Figure 2 shows a technical solution for upgrading according to the invention. As shown in Figure 2, an upgraded service file is sent to a service upgrade server separately. A compiler coordinated with the CPU of the set-top box is obtained, to create a Makefile, compile the service software and build a service software library. Figure 3 shows an upgrade process according to the invention as follows.

[0033] A. A service software is multiplexed into a specified transport stream (TS) by a service software upgrade server according to a predefined protocol.

[0034] B. A set-top box terminal software detects the service software of a new version, extracts data, and stores the data in a nonvolatile memory.

[0035] C. After the set-top box terminal software is restarted, the set-top box terminal software obtains addresses of interface functions of the service software, and the service software obtains addresses of interface functions of the set-top box terminal software.

[0036] D. The set-top box terminal software updates required default addresses of the

interface functions of the service software by using the addresses obtained by the set-top box terminal software, and the service software updates required default addresses of the interface functions of the set-top box terminal software by using the addresses obtained by the service software.

[0037] After storing the service software of the new version, the set-top box terminal writes a specified identification into a specified storage unit. When starting next time, the set-top box terminal software reads the specified identification, e.g., "DSMCCUPGRADE", from the storage unit. If the set-top box terminal finds that the identification read from the specified storage unit is the specified identification, the set-top box terminal proceeds to the upgrade process, i.e., the process for upgrading service software. Otherwise, the set-top box terminal proceeds into a normal service process.

[0038] In step B, after detecting the service software of the new version and extracting the data, the set-top box terminal software may check the integrity, the validity, and the verification version of the service software, and check the validity of the upgrade information. After the check is passed, the set-top box terminal software stores the data in the nonvolatile memory.

[0039] The service software may be a re-locatable object file or an absolute location object file.

[0040] In a first embodiment of the invention, after the creation of the service software library, the service software library may be absolutely located to a negotiated memory position by using a specialized location tool. In this case, an upgrade method according to the invention is as follows.

[0041] (A1) An absolute location service software is multiplexed into a specified transport stream (TS) by a service software upgrade server according to a specified protocol (e.g., Digital Storage Media - Command & Control (DSMCC) protocol).

[0042] (B1) The set-top box terminal software detects the service software of a new version, extracts data, and checks the validity and integrity of the service software, then stores the service software after the check is passed.

[0043] (C1) When restarting, the set-top box terminal software invokes an initialization interface of the service software, and sends required addresses of interface functions of the set-top box terminal software to the service software. In response, the initialization interface of the service software returns addresses of interface functions of the service software required by the set-top box terminal software to the set-top box terminal software.

[0044] (D1) When starting regularly, the service software updates internally defined default addresses of the set-top box terminal software according to the addresses of the interface functions of the set-top box terminal software provided by the set-top box terminal software.

[0045] (E1) The set-top box terminal software updates default addresses of the interface functions of the service software required by the set-top box terminal software according to the addresses of the interface function of the service software provided by the service software.

[0046] (F1) The set-top box terminal software and the service software both use the updated addresses.

[0047] In a second embodiment of the invention, for a set-top box terminal that partially supports software relocation, the service software may be built into a re-locatable object file by using the library functions provided in the operating system of the set-top box terminal. In this case, an upgrade method according to the invention is as follows.

[0048] (A2) A service software is multiplexed into a specified transport stream (TS) by a service software upgrade server according to a specified protocol.

[0049] (B2) The set-top box terminal software detects the service software of a new version, extracts data, and checks the validity and integrity of the service software, then stores the service software after the check is passed.

[0050] (C2) When restarting, the set-top box terminal software invokes a relocation function provided in the operating system to relocate the service software, and returns relocated addresses of the interface functions of the service software.

[0051] (D2) After starting regularly, the service software updates internally defined default

addresses of the set-top box terminal software according to the addresses of the interface functions of the service software provided by the set-top box terminal software.

[0052] (E2) The set-top box terminal software updates default addresses of the interface functions of the service software required by the set-top box terminal software according to the addresses of functions provided by the service software.

[0053] (F2) The set-top box terminal software and the service software both use the updated interface addresses.

[0054] The invention also provides a loading apparatus. The apparatus is designed to extract the upgrade file data of a service software from a transport stream (TS) according to a specified protocol, e.g., DSMCC protocol, and to write the data into a nonvolatile memory e.g., FLASH. In addition, when the service software starts, the apparatus may check the version, the validity, and the integrity of the service software, and check the validity of upgrade information, and the like.

[0055] As shown in Figure 4, the loading apparatus includes an initialization interface module, a new version service software processing module, a service software interface extraction module, and a service software interface update module. When a service software is multiplexed into a specified transport stream (TS) by a service software upgrade server according to a specified protocol, the new version service software processing module detects the service software of a new version, extracts data, and stores the service software, and returns the storage location of the service software to the initialization interface module.

[0056] When the set-top box terminal software starts next time, the set-top box terminal software invokes the initialization interface module. The initialization interface module invokes the service software interface extraction module requesting to extract interface information of the service software. The service software interface extraction module interacts with the modules of the service software to extract the interface information of the service software, and sends the interface information of service software to the service software interface update module. The service software interface update module updates default addresses of the interface functions of the service software required by the set-top box

terminal software according to addresses of functions provided by the service software.

[0057] In a first implementation of the loading apparatus according to the invention, after a service software is multiplexed into a specified transport stream (TS) by a service software upgrade server according to a specified protocol, the new version service software processing module detects the service software of a new version, extracts data, and sends a checking instruction to a checking module. The checking module receives the instruction and checks the validity and integrity of the service software, and then returns the result to the new version service software processing module after the checking is passed. The new version service software processing module stores the service software, and returns the storage location of the service software to the initialization interface module.

[0058] When the set-top box terminal software starts next time, the set-top box terminal software invokes the initialization interface module. The initialization interface module invokes the service software interface extraction module requesting to extract interface information of the service software. The service software interface extraction module extracts the initialization interface of service software, sends interface addresses of the set-top box terminal software to the service software, and receives addresses of interface functions of the service software, required by the set-top box terminal software, from the service software, and sends the addresses of the interface functions of the service software to the service software interface update module. The service software interface update module updates default addresses of the interface functions of the service software according to the addresses of the interface functions provided by the service software, as required by the set-top box terminal software.

[0059] In a second implementation of the loading apparatus according to the invention, after a service software in the form of a re-locatable object file is multiplexed to a specified transport stream (TS) by s service software update server according to a specified protocol, the new version service software processing module detects the service software of a new version and extracts data, and sends a checking instruction to a checking module. The checking module receives the instruction, checks the validity and integrity of the service software, and then returns the result to the new version service software processing module when the checking is

passed. The new version service software processing module stores the service software, and returns the storage location of the service software to the initialization interface module.

[0060] When the set-top box terminal software starts next time, the set-top box terminal software invokes the initialization interface module. The initialization interface module invokes the service software interface extraction module requesting to extract interface information of the service software. The service software interface module invokes a relocation function module provided in the operating system of the set-top box to relocate the service software, and sends the relocated addresses of the interface functions of the service software to the service software interface update module. The service software interface update module updates default addresses of the interface functions of the service software interface functions according to the addresses of the interface functions provided by the service software, as required by the set-top box terminal software.

[0061] With the method and apparatus for software upgrade according to the invention, the service software and the digital television receiving device software may be upgraded separately since there is no direct function interface between the service software and the digital television receiving device software, that is, the service software and the digital television receiving device software are independent from each other. The operators need not to build their own upgrade servers repeatedly, so that the networking cost may be saved. In addition, with the method and apparatus of the invention, quick upgrade of the service software may be achieved, such that the waiting time may be reduced for users. Further, the security of the intellectual properties of the service providers may be enhanced greatly.

CLAIMS

What is claimed is:

1. A method for software upgrade in a digital television receiving device, characterized by comprising the following steps:

A. multiplexing service software into a transport stream according to a predefined protocol;

B. extracting, by the digital television receiving device, data of the service software from the transport stream and storing the data of the service software;

C. restarting the digital television receiving device, so that digital television receiving device software obtains addresses of interface functions of the service software, and the service software obtains addresses of interface functions of the digital television receiving device software;

D. updating, by the digital television receiving device software, default addresses of the interface functions of the service software according to the addresses obtained by the digital television receiving device software, and updating, by the service software, default addresses of the interface functions of the digital television receiving device software according to the addresses obtained by the service software.

2. The method according to claim 1, characterized in that, in step B, before storing the data of the service software, the method further comprises: checking integrity and/or validity of the data of the service software.

3.The method according to claim 2, characterized in that, the data of the service software is stored in a nonvolatile memory after the checking is passed.

4. The method according to claim 1, characterized in that, in step C, the method further comprises: invoking, by the digital television receiving device software, an initialization interface of the service software, and sending the addresses of the interface functions of the digital television receiving device software required by the service software to the service software, and sending, by the service software, the addresses of the interface functions of

the service software required by the digital television receiving device software to the digital television receiving device software.

5. The method according to claim 1, characterized by further comprising: invoking, by the digital television receiving device software, a relocation function provided in an operating system to relocate the service software, and returning, by the relocation function, relocated addresses of the interface functions of the service software.

6. A software loading apparatus for software installation and upgrade, characterized by comprising: an initialization interface module, a new version service software processing module, a service software interface extraction module, and a service software interface update module; wherein:

the new version service software processing module is adapted for detecting and storing service software of a new version, and returning storage location of the service software to the initialization interface module;

the initialization interface module is adapted for interacting with digital television receiving device software, receiving an invocation instruction, and invoking the service software interface extraction module to extract interface information of service software under the invocation instruction;

the service software interface module is adapted for interacting with the service software, and extracting the interface information of the service software, and sending the interface information of the service software to the service software interface update module;

the service software interface update module is adapted for updating default addresses of interface functions of the service software required by the digital television receiving device software in accordance with function addresses provided by the service software interface extraction module.

7. The software loading apparatus according to claim 6, characterized by further comprising a checking module, adapted for receiving an instruction from the new version service software processing module, checking validity and/or integrity of the service software,

and returning a result of the checking to the new version service software processing module.

8. The software loading apparatus according to claim 6 or 7, characterized in that, the service software interface extraction module is further adapted for extracting an initialization interface of the service software, sending addresses of interface functions of the digital television receiving device software required by the service software to the service software, receiving addresses of interface functions of the service software, required by the digital television receiving device software, from the service software, and returning the addresses of the interface functions of the service software to the service software interface update module.

9. The software loading apparatus according to claim 6 or 7, characterized in that, the service software interface extraction module is further adapted for invoking a relocation function module provided in an operating system of a digital television receiving device, relocating the service software, and returning relocated address of the interface functions of service software to the service software interface update module.

10. The software loading apparatus according to claim 6, characterized in that, the software loading apparatus is integrated in a digital television receiving device, a service software server, or any other separate devices.