Software-Defined Data Formats in Telecommunication Systems

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Abstract. The paper considers an approach to solving the problem of formats succession and agreement in software reconfigurable telecommunication systems. This problem is relevant for many modern telecommunication systems characterized by intensive growth. Several approaches are proposed: format metadescriptions, hierarchical format analysis, active data concept.

Keywords: Telecommunication systems · Software-defined systems · Active data · Softwarization

1 Introduction

Expansion of new information technologies in society causes the need for their inclusion in the research paradigm of almost all branches of science especially in telecommunication systems.

An important trend in the telecommunication systems market – is improving access to interactive communications by expansion of relatively inexpensive software services that comes in several directions. One of them – is distribution of a variety of video conferencing software clients to smartphones and tablets. Another trend is the «softwarization» which means the conversion to software form of all that may be devoid of its physical embodiment [1–4].

In the telecommunications sector softwarization can be achieved by virtualization of the content delivery channels. Virtualization – is the way to organize a set of physical resources or their logical configuration which gives any advent ages over the original configuration.

The traditional communication channels are targeted to a specific type of content which demands a specialized terminal communication equipment (telephone for voice, telegraph to send text messages, etc.).

Using softwarization principle in content delivery allows to convert the transmitted data into a universal form that can be transmitted through the universal infocommunication environment (Fig. 1). A combination of converters between content-oriented form (images, sound) and transport-oriented (universal) form and the physical components of the communication environment can be considered as a universal virtual channel [5]. The functions of terminal units (content visualization) in this case are

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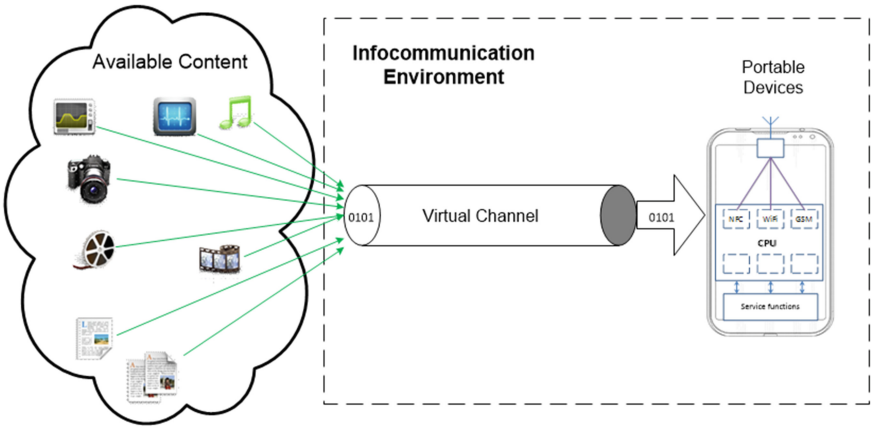

Fig. 1. Universal infocommunication environment

carried out by universal mobile devices (computers, smartphones) by implemented software.

Currently there are a set of software-defined technologies: Software-Defined Network (SDN), Software-Defined Data Center (Software-Defined Data Center - SDDC), Software-Defined Storage (SDS), Software-defined radio (SDR). It makes sense to consider all of these technologies as a single development direction of the software-reconfigurable environments.

2 The Proposed Approach

In some cases it is needed to provide access to telecommunications services in those geographic locations without public wireless network access and where the use of special radio or satellite systems is not possible. Often such access is required only for a limited amount of time without deployment of network base stations (e.g., for rescue operations).

This dynamic deployment of specialized data networks is possible by temporary reconfiguration of standard telecommunications devices (especially mobile) (Fig. 2).

The next approaches to implement dynamic temporary deployment are offered:

1. Using a regular data relay mode between mobile devices without reconfiguring.
2. The reconfiguration by switching the data relaying mode of consumer devices supporting such functionality by design.
3. Software reconfiguration of consumer units using the approach of active data for relaying data in the network of mobile devices. It has the most flexible options for configuring devices.

Approach 1 is only possible in networks built on the mesh-network technology which allows third-party traffic through the device network.

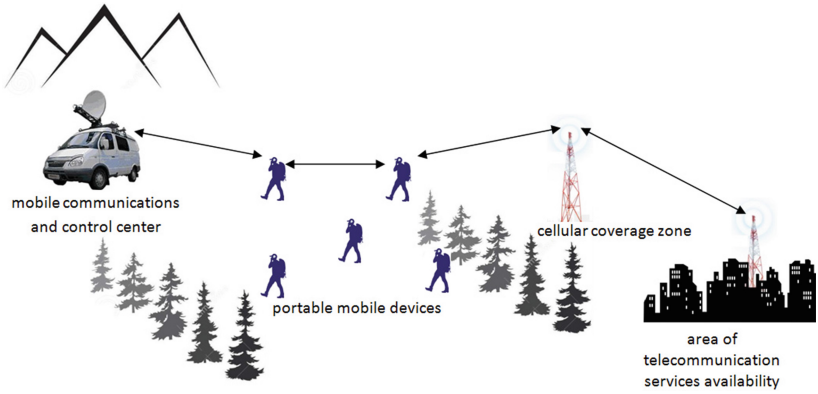

Fig. 2. The principle of virtual data channels deployment by reconfiguring of available consumer mobile devices

The main problem of approaches 2 and 3 is the need for hardware support of such reconfiguration (special relay mode or support for active data) by communication equipment manufacturers.

Another problem in the implementation of this approach is that the existing system of commercial cellular communication when working over long distances are focused on terminal↔base station interaction model, and the terminal↔terminal interaction is allowed only within the framework of nano- and pico-cells [6].

Software-defined system can remove these restrictions overriding terminal communication protocol and adjusting the characteristics of the equipment (given the availability of broadband receiver), which will take an "uplink" mobile channel and process it by receivers of the consumer devices.

3 Reconfiguration of Formats and Protocols

Reconfiguration of formats and protocols, on the one hand, is determined by the software parser functions which easily can be replaced. On the other hand, if the format is based on a data structure with a variable set of fields that are not fixed in size then the partial format correction in design-time operation is difficult, and in the run-time operation is often not possible.

Interpretation of the data streams can be carried out by the following software functions:

- Built on the basis of a formal description of a grammar or a finite state machine;
- Without the use of a formal stream description by direct reading and interpretation of individual values (the most common option).

To simplify the solution to the problem of format reconfiguration the following approaches based on software-defined systems are proposed:

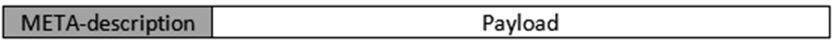

Fig. 3. Method of the meta-description injection

1. Introduction of a meta-description format placed in the format itself (Fig. 3). The main drawback - the increase in the volume of the data stream. Thus the meta-description format in such an approach requires a specification and so on ad infinitum. This solution will allow producing software reconfiguration of the formats both in design-time and run-time.
2. For design-time software reconfiguration we can use the principle of hierarchical containers i.e. the construction of the hierarchy format syntax elements in case of failure of the linear format wherever it is possible (Fig. 4). In this case the parser function is required to maintain the call hierarchy within the hierarchical structure analysis.

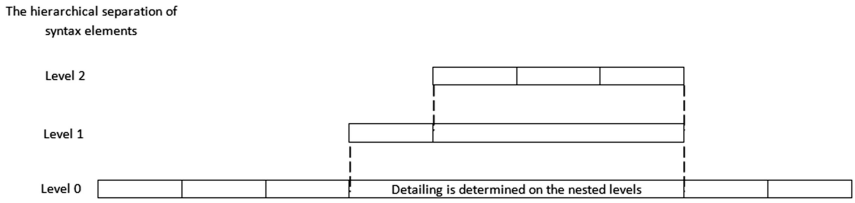

Fig. 4. Hierarchical separation of syntax elements

3. For run-time software reconfiguration the approach of active data (AD) can be used provided the principle of hierarchical containers in a configurable format is satisfied [7]. In this case executable AD blocks may be implemented as sub-functions each of which is responsible for parsing its syntactic level of format and can be replaced independently by software reconfiguration procedure (Fig. 5).

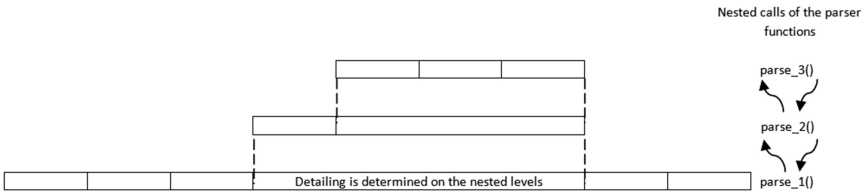

Fig. 5. Application of active data concept to format reconfiguration

4 Conclusion

The paper describes approaches to development of software-defined communication systems including active data concept. It is shown that the application of the concept of active data while respecting the principle of hierarchical containers in a configurable format makes possible complete run-time reconfiguration. These approaches are of particular importance in addressing format inheritance problems in the areas of modern telecommunications systems which are characterized by the most intensive development and rapid obsolescence of communications equipment.

The proposed approach allows providing access to telecommunication services in geographic locations without public wireless network access and where the use of special radio or satellite systems is not possible. Often such access is required only for a limited amount of time without deployment of network base stations (e.g., for rescue operations).

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