

ESTIMATION OF CONNECTION SETUP TIME FOR IPTV SERVICES USING THE
IMS PLATFORM

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Abstract. *The article presents the results of estimating the connection establishment time when providing IPTV services using the IMS platform. To estimate the connection establishment time, mathematical models have been developed for calculating basic delays in various sections of the network, taking into account the lengths of signaling messages. The results of estimating the connection establishment time and comparing the obtained results with the recommendations of the DSL forum (Digital Subscriber Line) and ITU-T are presented.*

Keywords: *IMS platform, IPTV services, estimation of connection, connection establishment time, video connection.*

In the second stage of implementation of the NGN concept, the problems of convergence of fixed networks and cellular communication (mobile) networks were solved. IP Multimedia Subsystem (IMS) based on the IP protocol was recommended by the 3GPP (3rd Generation Partnership Project) and TISPAN (Telecommunications and Internet converged Services and Protocols for Advanced Networking) working groups as the main architecture for the convergence of these networks.

IPTV (Internet Protocol Television) service is one of the services provided in real-time in broadband multiservice communication networks based on the IMS (IP Multimedia Subsystem) multimedia platform. The IMS platform is designed to manage sessions during the provision of any multimedia services to users of fixed and mobile communication networks using IP/MPLS technologies. Estimation of the establishment time of VoIP voice connections using the IMS platform was performed in [1]. The procedure for establishing an IPTV (Internet Protocol Television) video connection using the IMS platform is reviewed in detail and the duration of the connection establishment is estimated.

There is a network architecture for providing IPTV services using the IMS platform. The IPTV network consists of the following main elements [2-4]: a home network containing a terminal device (TV receiver or computer), STB set-top box, and modem; a subscriber access network including access channel and digital subscriber line access multiplexer DSLAM (Digital Subscriber Line Access Multiplexer); traffic aggregation network consisting of switches; IP/MPLS transport network; Application servers and media servers.

Only a functional architecture is defined for the IMS subsystem, and the physical implementation of these functions is at the discretion of the particular manufacturer. The interfaces of the IMS platform are listed in Table 1, which shows the type of interface, the nodes of the distributed IMS system to which this interface is connected, its functions, and the signaling protocol used in the interface.

Table 1

Interfaces of the IMS platform

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| Interface | Node | The task | Protocol |
|-----------|------------------------|---|----------|
| Gm | STB, P-CSCF | The interface between STB and CSCF | SIP |
| Mw | P-CSCF, I-CSCF, S-CSCF | The interface between different CSCF blocks | SIP |
| ISc | S-CSCF, I-CSCF, AS | Exchange interface between CSCF and AS | SIP |
| Cx | I-CSCF, S-CSCF, HSS | Exchange interface between I-CSCF, S-CSCF and HSS | Diameter |
| Sh | IPTV AS, HSS | Exchange interface between IPTV AS and HSS | Diameter |
| Ut | STB, IPTV AS | User management interface (customization of management) | HTTP |

Connection setup process. The average duration of signal message processing in the server or IMS functional block is assumed to be constant and equal to 20 ms. In the IP/MPLS network, signaling is determined by the formula based on the duration of the message transmission:

$$\Delta IP_i = \frac{S_i}{v_{IP}} \quad (1)$$

where S_i - is the length of the i -signal message in bits; v_{IP} - network transmission speed is taken as 4 Mbit/sec.

Information about the length of alarm messages is presented in Table 2.

Table 2

The length of signal messages

| SIP message | Length (bytes) | SIP message | Length (bytes) | Diameter message | Length (bytes) |
|----------------------|----------------|------------------|----------------|------------------|----------------|
| INVITE | 976 | ACK | 676 | UAR | 618 |
| 100 Trying | 496 | BYE | 556 | SAR | 728 |
| 183 Session Progress | 956 | REGISTER | 856 | SAA | 798 |
| PRACK | 496 | 401 Unauthorized | 726 | LIR | 458 |
| 200 OK | 1036 | SUBSCRIBE | 946 | LIA | 728 |
| UPDATE | 496 | NOTIFY | 596 | MAA | 798 |
| 180 Ringing | 496 | 486 Busy | 496 | MAR | 728 |

The connection establishment time using the IMS framework can be calculated using the following formula:

$$\Delta IMS = \Delta IMS_{pr.} + \Delta IMS_{ob.} + \Delta_{us}, \quad (2)$$

$\Delta IMS_{pr.}$, $\Delta IMS_{ob.}$ - respectively, the duration of transmission of signal messages in the right direction (from STB) and in the opposite direction in the IP/MPLS network; Δ_{us} is the duration of signal message processing in IMS servers and functional blocks, including the duration of signal transmission between blocks.

$$\Delta IMS_{pr.} = 5\Delta IP_{INVITE} + 4\Delta IP_{PRACK} + 4\Delta IP_{UPDATE} + \Delta IP_{UR} = 0,018 \text{ s.}$$

$$\Delta IMS_{ob.} = 5\Delta IP_{100Trying} + 5\Delta IP_{183SessionProgress} + 8\Delta IP_{200OK} + 4\Delta IP_{100Ringing} + \Delta IP_{UA} = 0,036 \text{ s.}$$

$$\Delta_{us} = 5\Delta_{STB} + 8\Delta_{P-CSCF} + 8\Delta_{S-CSCF} + 4\Delta_{I-CSCF} + \Delta_{HSS} + 8\Delta_{IPTVAS} + 5\Delta_{MCF} = 0,780 \text{ s.}$$

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The connection establishment time using the IMS framework was equal to $\Delta_{IMS} = 0.834$ seconds. Quality of signal reception according to QoE (Quality of Experience) [5] and the DSL Forum [6], according to the recommendations of ITU-T, the allowed time to change channels in the MPEG 2 standard should not exceed 1 second. Calculations show that when the connection is established through the IMS platform, the connection time does not exceed one second.

Estimated connection establishment time for IPTV services using the IMS platform. The signal procedure for establishing a connection from an IPTV subscriber to a server and an assessment of the connection establishment time for IPTV services using the IMS platform were made. The procedure for establishing an IPTV (Internet Protocol Television) video connection using the IMS platform was examined in detail and the duration of the connection establishment was evaluated. The average duration of signal message processing in the server or IMS functional block is assumed to be constant and equal to 20 ms. The transmission duration of signal messages in the IP/MPLS network was determined by the formula.

Conclusions

Calculated the connection establishment time using the IMS framework. As a result, the connection establishment time using the IMS infrastructure was equal to $\Delta_{IMS} = 0.834$ seconds. QoE (Quality of Experience) and signal reception quality according to the DSL forum, according to the recommendations of the ITU-T, the allowed time to change channels in the MPEG 2 standard should not exceed 1 second. Calculations show that when the connection is established through the IMS platform, the connection time does not exceed one second.

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