



IMS-Enabled Access Networks

Enabling network-independent access to personalized services

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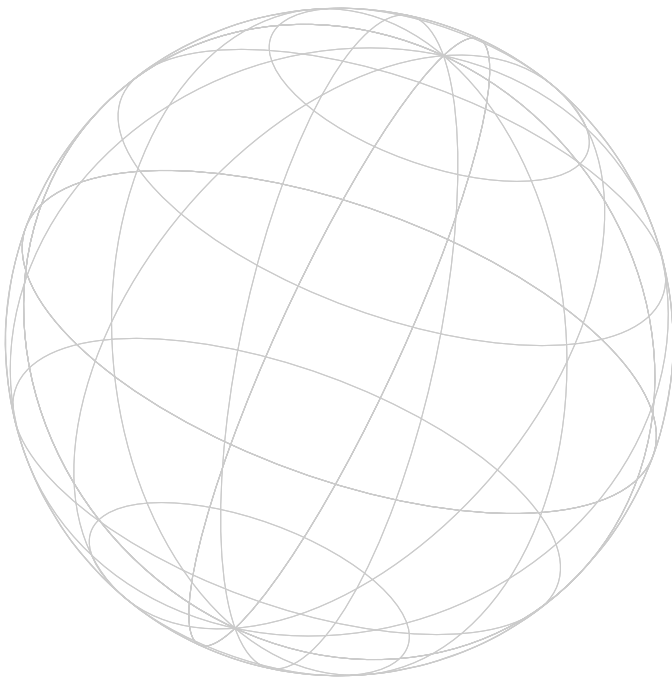
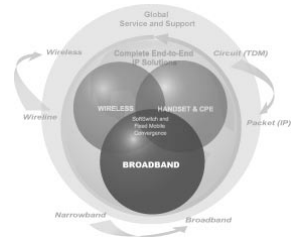


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Introduction

The IP Multimedia Subsystem or IMS appears to be the silver bullet that will eventually unshackle the world of telecommunications from the traditional classifications of wireline and wireless communications. In the past year, the IMS architecture has been the key driver behind the frenzied pace of development in the realm of fixed-mobile convergence.

So what is IMS? Stated simply, an IMS-based architecture is one in which all services offered to a particular customer can access the same subscriber database. This enables a service provider to offer its customers a consistent set of personalized services, independent of the access media they use.

The foundation of IMS is a two-layer architecture that relies on a Service Layer and a Transport Layer. This generally simple concept enables an amazing array of possibilities. As an example, the underlying subscriber database can be a learning entity: as more and more of a customer's personal choices accumulate in the database, the service provider has a growing opportunity to offer highly personalized services to the customer. If more than one network domain or service provider can access this database, it becomes possible for the customer to get the same level of personalized service virtually anywhere in the world, irrespective of which physical network they are using. This is just one example of what is possible with IMS.

Although the IMS architecture was first specified by the Third Generation Partnership Project (3GPP/3GPP2), it is now being embraced by other standards bodies such as ETSI/TISPAN. IMS-based architectures and services can be used across multiple access types, including GSM, WCDMA, CDMA2000, xDSL, Ethernet and Wireless LAN. For most operators, the value proposition for an IMS-based architecture lies in the ability to reuse common functions across multiple applications. The layered IMS architecture allows service providers to roll out new applications and services faster by reusing well-structured and well-defined common functions such as service provisioning, billing, group management, presence, and so on.

To illustrate the power of IMS, this paper focuses on the TISPAN subsystems that interwork—or need to be implemented in a wireline access node—to enable migration to an IMS-enabled network architecture.

TISPAN Network Architecture

In its simplest form, the TISPAN architecture can be visualized as two main layers: the Transport Layer and the Service Layer (Figure 1). Through a collection of gateway functions, these two layers can easily interact with outside-world components such as the PSTN network, an ISDN network, or other IP networks. A closer examination of the functions and capabilities embedded in these two layers will help outline the ability of IMS to deliver personalized services through any access media.

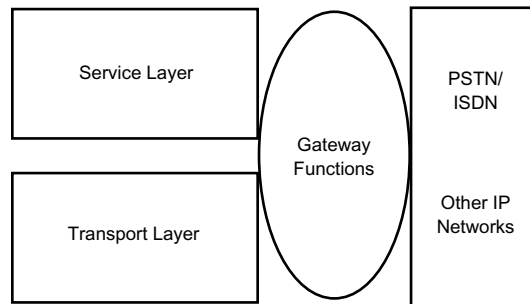


Figure 1: The TISPAN¹ network architecture for IMS-based next-generation networks.

The Transport Layer

The transport layer shown in Figure 1 can be further divided into two sub-layers: transport control and transfer functions (Figure 2).

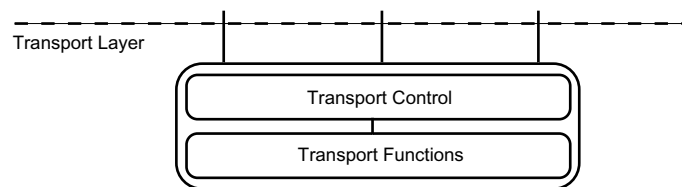


Figure 2: The two sub-layers of the Transport Layer²

Transport Control

The Transport Control sub-layer includes two subsystems: the Network Attachment Subsystem (NASS) and the Resource and Admission Control Subsystem (RACS)

NASS: This module provides registration and (potentially) initialization of user equipment so that the subscriber can access the services provided in the Service Layer. From a network perspective, NASS provides network-level identification and authentication. This module is also responsible for managing the IP address space within the Access Network and providing authentication to service sessions. Network attachment is provided based on either implicit or explicit user identification credentials stored in its database (respectively, physical or logical Layer 2 addresses, or user name and password). This subsystem provides five essential functions³ :

- Dynamic provisioning of IP addresses and other terminal-configuration parameters
- Authentication at the IP layer prior to or during the address-allocation procedure
- Authorization of network access based on user profiles
- Access network configuration based on user profiles
- Location management at the IP layer

RACS⁴: This subsystem provides admission control and directs network traffic. Before admitting traffic to or from an individual user, the RACS module checks three things: the user profile stored in the NASS, any operator-specific policies, and resource availability (e.g., subscribed or available bandwidth). RACS essentially provides policy-based transport control

¹ TISPAN: Telecoms and Internet converged Services and Protocols for Advanced Networks

³ Final Draft ETSI ES 282 001 V1.1.1(2005-06)

² Picture Source: ETSI ES 282 001 v1.1.1: TISPAN NGN Functional Architecture Release 1

⁴ Final Draft ETSI ES 282 003 V1.1.1(2005-06)

services to the higher-level applications that enable them to request and, in many cases, reserve transport resources from the transport network. This function is key: consistent with the central notion of IMS, this level of mediation between the applications and the underlying transport networks themselves means applications need not be aware of the transport networks. Finally, RACS also provides access to services provided by Border Gateway Functions such as NAT and hosted NAT traversal.

The architecture of the RACS model (Figure 3) supports both guaranteed and relative QoS mechanisms. Guaranteed QoS mechanisms are achieved by performing admission control and enforcement of admission control decisions in the access network via throughput control and traffic policing. For relative QoS mechanisms, traffic class differentiation is achieved by applying appropriate QoS profiles that are dynamically updated in the IP Edge.

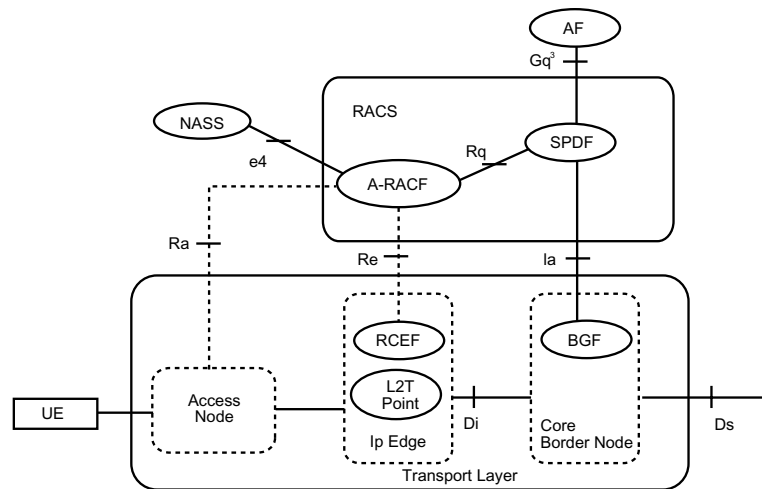


Figure 3: Internal architecture of the RACS model⁵

The Access-Resource and Admission and Control Function (A-RACF) manages access resource reservations; it receives requests from the Service-based Policy Decision Function (SPDF) and, based on available resources in its control, processes or rejects those requests. The SPDF provides higher-level applications with a single point of contact. The Resource Control Enforcement Functions (RCEF) enforce policy control based on subscriber profiles.

Transfer Functions

This sub-layer includes a collection of functions that provide a varied range of capabilities (Figure 4). Six of these functions are worth a closer look: Border Gateway Function (BGF); Layer 2 Termination Function (L2TF); Access Relay Functions (ARF); Media Gateway Functions (MGF); Media Resource Function Processor (MRFP); and Signaling Gateway Functions (SGF).

⁵ Picture Source: ETSI ES 282 003 v1.1.1: TISPAN RACS Functional Architecture

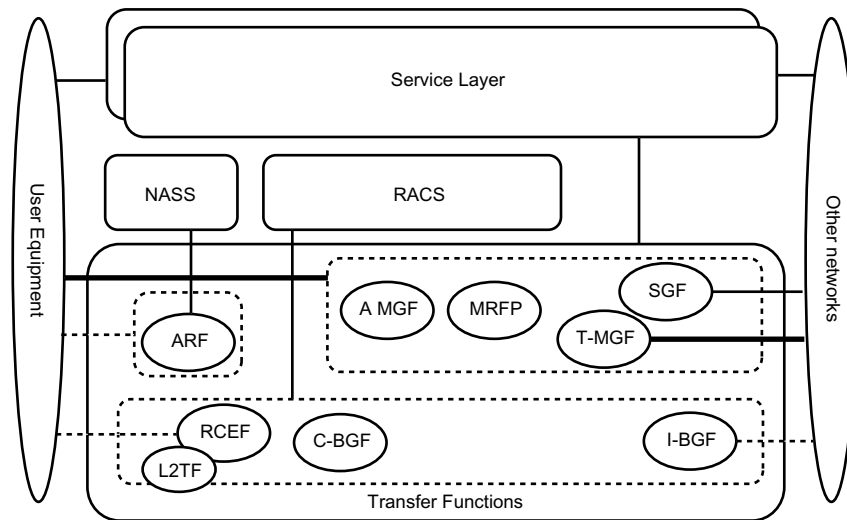


Figure 4: A detailed view of the Transfer Functions sub-layer⁶

BGF: As the name suggests, the BGF acts a gateway between two IP transport domains. Gateway functions are realized in one of three ways: between the CPE and the access node; between the access node and the core network; or between two core networks. The BGF can provide many capabilities⁷ :

- Packet filtering based on IP address or port (gate control function)
- Marking of outgoing packets and policing of incoming traffic
- Resource allocation
- IP address and port number allocation (NAPT)
- Hosted NAT traversal
- Usage metering
- Topology hiding
- Interconnection between IPv4 and IPv6 networks

L2TF: This function provides termination of Layer 2 procedures of the Access Networks.

ARF: This serves as a relay between the user equipment and the NASS. The ARF also can insert relevant local configuration information before forwarding a request to the NASS. Prime examples of this are insertion of subscriber line identification into a PPPoE session (PPPoE Intermediate Relay Function) or a DHCP session (DHCP Option 82). ARF also provides protocol conversions such as PPPoA to PPPoE.

MGF: This module provides media transcoding or mapping functions between an IP network and legacy switched-circuit networks. MGF can be further classified into R-MGF (Residential MGF) that is located on customer premises (usually in a DSL CPE); A-MGF (Access MGF), which is a part of the Access Network; and T-MGF (Trunk MGF), which sits on the boundary between an IP network and the PSTN network. A-MGR and R-MGF are required to access services provided by the PSTN Emulation System.

⁶ Picture Source: ETSI ES 282 001 v1.1.1: TISPAN NGN Functional Architecture Release 1

⁷ Final Draft ETSI ES 282 001 V1.1.1(2005-06)

MRFP: The MRFP provides specialized resources such as multimedia announcements, multimedia conferencing, and IVR functionalities.

SGF: The function of the SGF is to provide conversion between SS7 signaling used in the PSTN network and IP signaling used in the NGN.

The Service Layer

The Service Layer consists of several key subsystems (Figure 5). Four of these are especially important: Core IMS; PSTN/ISDN Emulation; Streaming; and Content Broadcasting.

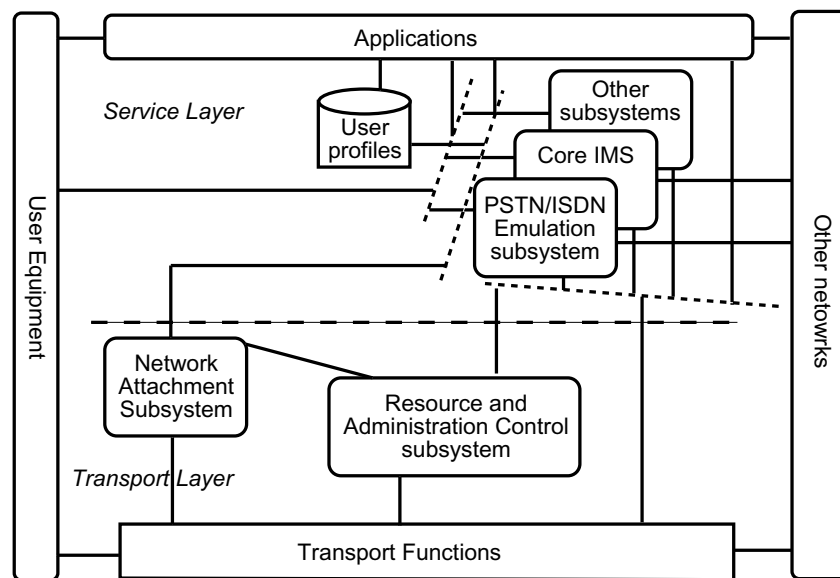


Figure 5: A detailed view of the Service Layer⁸

Core IMS Subsystem: For subscribers of next-generation networks, this core component of the NGN architecture is the subsystem that provides access to SIP-based multimedia services. It is the wireline equivalent—and a subset—of the 3GPP IMS. While much of the 3GPP IMS architecture is reused in this subsystem, it is essential to note that there are important differences between Core IMS and 3GPP IMS. Most of these arise from the fact that Access Networks employing xDSL or WLAN are fundamentally different from UMTS. In contrast, NGN terminals are usually more feature rich, with IPv4 still used predominantly in NGNs. Also, the mechanisms for resource reservations and location information are quite different in NGN networks.

PSTN/ISDN Emulation Subsystem: This subsystem supports emulation of PSTN/ISDN services, enabling legacy PSTN terminals to access the NGN through Residential, Access and Trunking Gateways.

Streaming Subsystem⁹: This subsystem provides support for RTSP-based streaming services to NGN terminals.

⁸ Picture Source: ETSI ES 282 001 v1.1.1: TISPAN NGN Functional Architecture Release 1

⁹ Final Draft ETSI ES 282 001 V1.1.1(2005-06)

Content Broadcasting Subsystem: This subsystem enables broadcasting of multimedia content to NGN subscribers.

In addition to the subsystems described above, there are a number of common components that are accessed by more than one subsystem. Three of these are especially noteworthy:

- **User Profile Server Function (UPSF):** This stores all relevant information regarding the user, including identification, addressing, numbering, access controls and location information.
- **Application Server Functions (ASF):** These provide value-added services.
- **Charging and Data Collection Functions:** As the names suggest, these provide data collection and billing mediation for online and offline charging.

Pulling together all of the concepts described above—within the Transport Layer and the Service Layer—provides a more detailed illustration of the TISPAN NGN architecture (Figure 6).

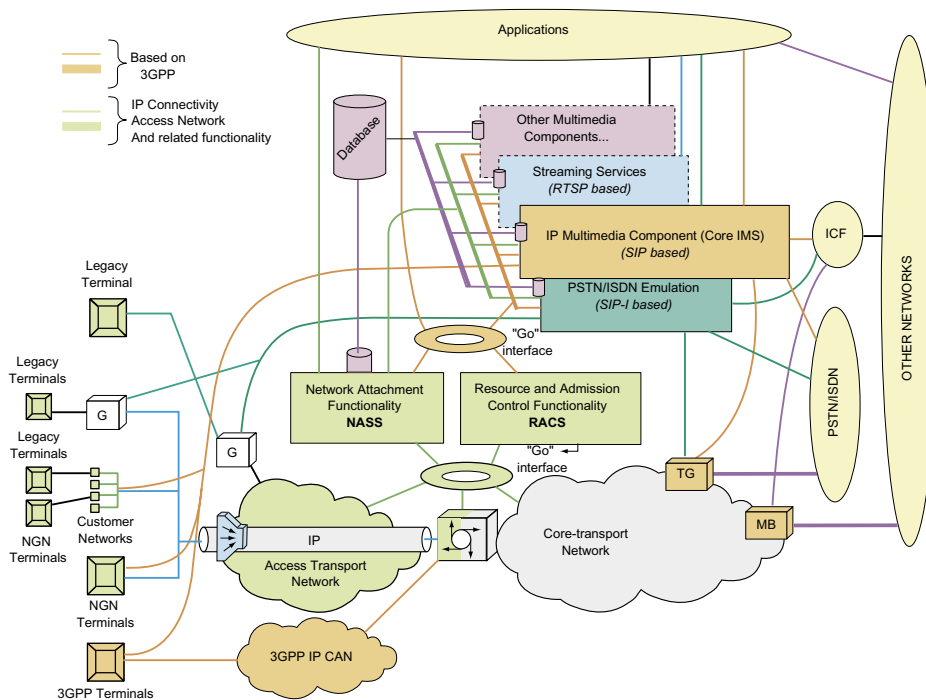


Figure 6: A detailed view of the TISPAN NGN architecture¹⁰

The UTStarcom Solution

UTStarcom is a leader in offering all-IP network solutions to carriers. The UTStarcom product portfolio includes a series of open platforms that can enable carriers to seamlessly migrate from a legacy TDM voice and ATM DSL network to a next-generation IP-access infrastructure. The UTStarcom offering includes four key elements:

- **RollingStream™:** This distributed IPTV streaming, storage and management platform

¹⁰ Picture Source: ETSI ES 282 001 v1.1.1: TISPAN NGN Functional Architecture Release 1

provides a way to offer truly differentiated on-demand TV services

- **mSwitch®**: A high capacity C4/C5 softswitch
- **Netring®**: A metro core multi-service provisioning platform
- **iAN8K B1000**: An integrated access platform that provides legacy TDM as well as next-generation DSL and PON services. These are terminated and delivered to subscribers through an extensive suite of network end points (e.g., STBs, CPEs and handsets)

The iAN8K B1000 is UTStarcom's third-generation access platform. It combines the functionalities of a DSLAM, a DLC and an Access Media Gateway to form a Multimedia Network Edge (MNE).

Utilizing the iAN8K

Various functionalities of an IMS-compliant TISPAN NGN architecture are already in place in the iAN8K MNE. For example, UTStarcom's range of DSL Residential Gateways enables both legacy PSTN calls and derived PSTN Calls. For legacy PSTN terminals, the iAN8K subscriber modules provide A-MGF functionality by converting these interfaces into either H.248 or SIP protocols for transport via the IP network. Additional capability exists in the iAN8K for providing V5UA and ISDN UA functions.

Internally, the iAN8K B1000 consists of subscriber-facing DSL and legacy interface modules as well as powerful IP Edge functionality that is realized using the Controller module. The IP Edge encompasses a majority of the functional subsystems in the Transfer Function sub-layer of the TISPAN architecture. For example, the iAN8K IP Edge provides L2 termination for traffic originating from CPE. It also can provide ARF capabilities such as PPPoE Intermediate Relay and DHCP Option 82 as well as protocol conversions such as PPPoA to PPPoE.

The iAN8K Controller module also provides the interface to the NASS in the Transport Control sub-layer. The Controller and the IP Edge in the iAN8K B1000 employ strict policy-enforcement modules based on multiple queues, scheduling algorithms and programmable access-control lists. This forms the basis of the RCEF and A-RACF functional subsystems of the RACS in the Transport Control sub-layer of the TISPAN architecture.

UTStarcom's Rolling Stream IPTV solution provides the missing piece in this puzzle, plugging into the Content Broadcasting and RTSP-based streaming services module in the Service Layer.

Figure 7 maps the functionality of the iAN8K B1000 onto the TISPAN NGN architecture shown previously in Figure 6.

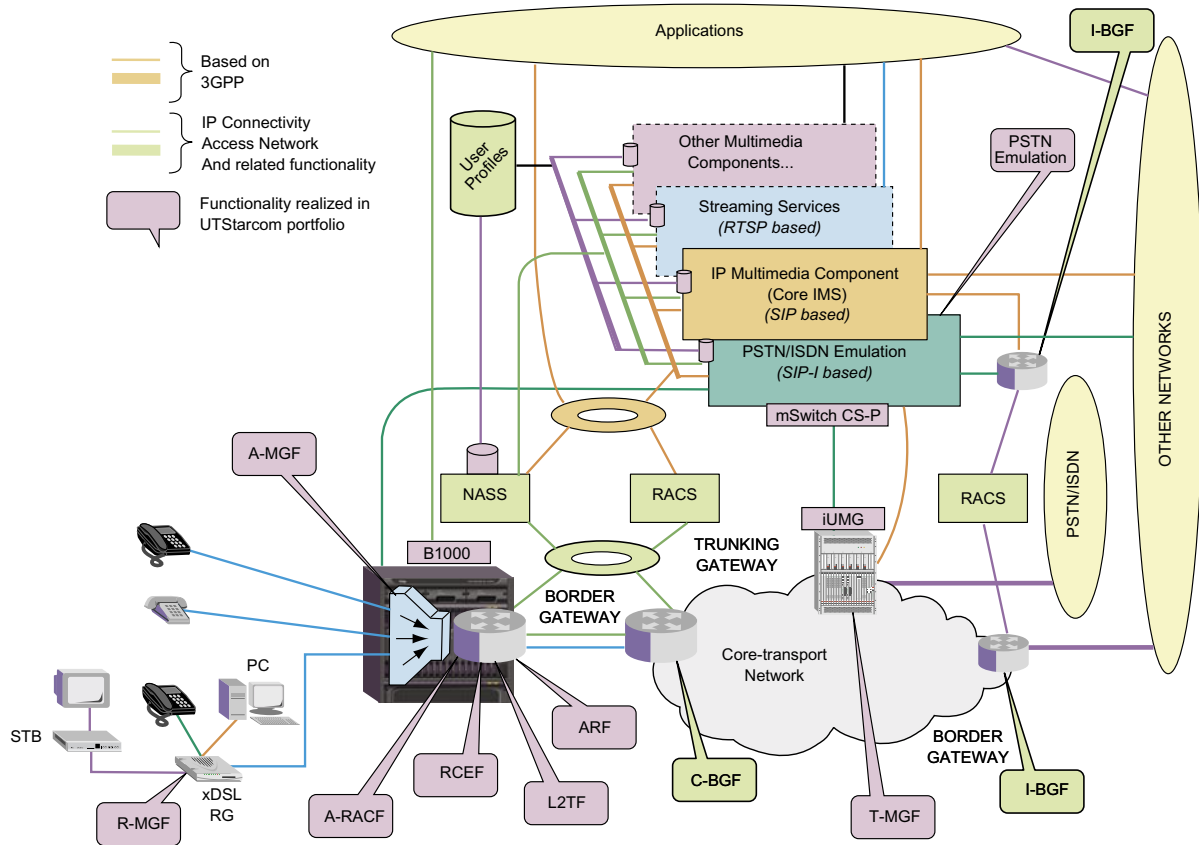


Figure 7: Implementing a TISPAN NGN architecture with the UTStarcom iAN8K B1000

Conclusion

With IMS, mobile or nomadic customers can still have access to a wealth of personalized services— independent of their mode of access. The increased popularity of this concept has brought about the need for a wireline access network architecture that can take advantage of core IMS concepts. The foundation for this architecture is based on a simple two-layer approach, which utilizes a Service Layer and a Transport Layer. The UTStarcom Broadband portfolio offers an open platform that can be evolved into an IMS-compliant NGN access architecture that reaches all the way from the residential gateways to a comprehensive, carrier-based IPTV system.

References

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