Modern Broadband Network Architecture by Iskratel

ISA

Intelligent Service Access

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Content

1 Summary

The intelligence of the current broadband-access infrastructure (authentication, authorization and accounting) lies in the BRAS/BNG routing devices. The proposed new architectural approach, named Intelligent Service Access (ISA), moves the intelligence to the access node and takes advantage of a pure IP architecture. This architecture enables network and service providers to manage and monitor the services per flow and to deliver additional, high-value-added services to customers.

The purpose of this paper is to present a network architecture that enables FTTH/FTTx network access and service providers to efficiently align with the ever-changing requirements for broadband-services offers and access-networking business models.

By adding more intelligence and higher flexibility to the access network, the operators reduce the total costs of ownership (TCO) for FTTH/FTTx networks, enhance the network security, the quality-of-service policy and ease the customer self-provisioning. The ISA architecture adds the ability to support wholesale and open-access environments. It thus answers specific operator demands in multiservice environments.

The goal of the ISA architecture presented here is to offer a free choice of services and a free selection of service providers with a guaranteed highest level of end-user experience. In addition, it enables the operator to simplify the existing operational and user-support complexity and to harmonize the access-network elements' functionalities over Ethernet-based protocols, regardless of the access technology used.

2 Business and Technology Trends

Current business trends in next-generation access (FTTx) networks are promoting the open use of infrastructure. The access-network developments have already started to include support for wholesale and open access. The ability to offer services in a flexible way makes modern access networks directly adaptable to the subscribers' needs.

There are three basic requirements for a dynamic and adaptable service offer:

- A well-defined and dynamic user profile that allows the instant activation or deactivation of services. The operator's goal is to offer the widest possible range of services in the most economical way.
- A high ARPU. The operator achieves this by offering more segmented services to the target group of users in a flexible way by using a centralized user database, a dynamic bandwidth and a QoS policy management.
- A pay-as-you-grow investment principle that eliminates the need for large start-up investments.

The higher transmission capabilities achieved with FTTx/FTTH technologies are not sufficient to ensure long-term revenue streams in the field of highly capable broadband connectivity. When offering new services, the operators face the challenges of the technical and cost-related issues associated with building an on-demand service-enabled network.

Such a network must allow a per-user bandwidth management and ensure the simple creation and provisioning of services that are subsequently available according to service-level agreements. A higher ARPU must be achieved with a broader service offer and new market entries.

Business facts
Broadband access is becoming widely requested by governments.
Infrastructure investments are gaining new government-supported momentum.
Local-loop unbundling is an all-European process that results in incumbent operators' smaller-scale investments.
Incumbent operators strive for a shorter ROI period.
New business models are emerging. New private investors are gaining importance.

The ISA architecture answers the needs for an access-networking model, aligned with the presented business facts.

The previously described business trends strongly affect the technological development sphere. The challenges that arise from the current access-networking situation are as follows:

- service creation and provisioning dilemmas,
- attracting new users,
- reducing churn,
- ease of subscription and optimized subscriber management,
- on-demand service provisioning,
- maintaining and enforcing service-level agreements (SLAs),
- accounting, billing and BSS

3 Challenging familiar concepts

3.1 The role of BRAS

Today's broadband networks are highly heterogeneous. Operators are facing the issues of multi-edge solutions that typically provide a critical range of scalability, whereas the control and service functionalities remain duplicated for each segment. This results in the operation of multiple policy and service-enforcement points, each requiring independent and fully functional control and management.

This often near-chaotic situation is especially evident in the case of hybrid networks that provide triple-play services. Hybrid networks' data-service control and policy enforcement are centrally implemented in the BRAS, while IPTV and other multicast services require a distributed control among the BNG/BRAS and the access node.

When discussing the distribution of network intelligence and service-flow awareness, there are a significant number of legacy conceptual approaches in the BRAS-based triple-play network architectures. The BRAS model supports the PPPoE service concept for data services and DHCP service concepts for IPTV and VoIP services. It promotes centralized end-user provisioning.

Moreover, the PPP concept promotes weak modularity due to integrated data and control-plane functionalities and is therefore not optimal from the scalability viewpoint and OPEX reduction. Due to multiple traffic-entry points the network planning and traffic control are complex, which, in this case, has to be resolved on the BRAS for data services and on the BNG for IPTV and VoIP services simultaneously.

3.2 The BRAS service-provisioning dilemma

The issue of promoting centralized intelligence in the BRAS is specifically challenging with regard to the quality of the service provisioning. In its essence, BRAS represents a central QoS enforcement point. It typically supports hierarchical queuing and other advanced QoS features.

The dilemma lies in the fact that the BRAS concept does not include last-mile line-status awareness. To ensure a proper access quality control, the operator needs to ensure line-status awareness within the access nodes.

Due to the demanding services and complex network architecture, service and QoS provisioning becomes a demanding challenge that needs to be faced. Being required on the BRAS and the access equipment simultaneously, this even increases the complexity of dynamic on-demand bandwidth management and results in increased OPEX.

An additional drawback to the BRAS-based service-provisioning solutions is the fact that the latter require a substantial initial CAPEX investment. Heavy investments are often not an option for green-field service providers that are implementing a broadband infrastructure from scratch.

The future of the service-provisioning infrastructure lies in pure IP-based concepts and technologies that prioritize the DHCP service model and optimize CAPEX and OPEX. The functional consolidation combined with centralized services' control and policy intelligence on access nodes is becoming a necessity.

4 ISA – An Architecture for a Truly Intelligent Service Access

4.1 Why choose ISA?

The pure IP-based network concept provides decoupled control-plane and data-flow provisioning. Network intelligent functions are moving closer to the end users. The subscriber control in this case is based on DHCP and Radius technologies.

The ISA architecture incorporates centralized AAA provisioning and thus promotes a high scalability with a decentralized service and quality assurance. The core network complexity is reduced to account for the increased access-network intelligence.

The ISA architecture introduces an enhanced role for the access nodes in the network and resolves the issue of increased complexity of control and provisioning with BRAS-based aggregation.

Every access node in the ISA architecture is service-flow aware, and therefore represents the next-generation access-intelligence concentrator. Every access node performs two roles. It acts as a single service-provisioning/policy-enforcement point and as an end-user traffic aggregator, both at the same time.

The proposed ISA architecture approach moves the intelligence to access nodes and reduces the complexity of the L3 edge. Because of service-flow awareness, the last-mile line status can be handled accordingly.

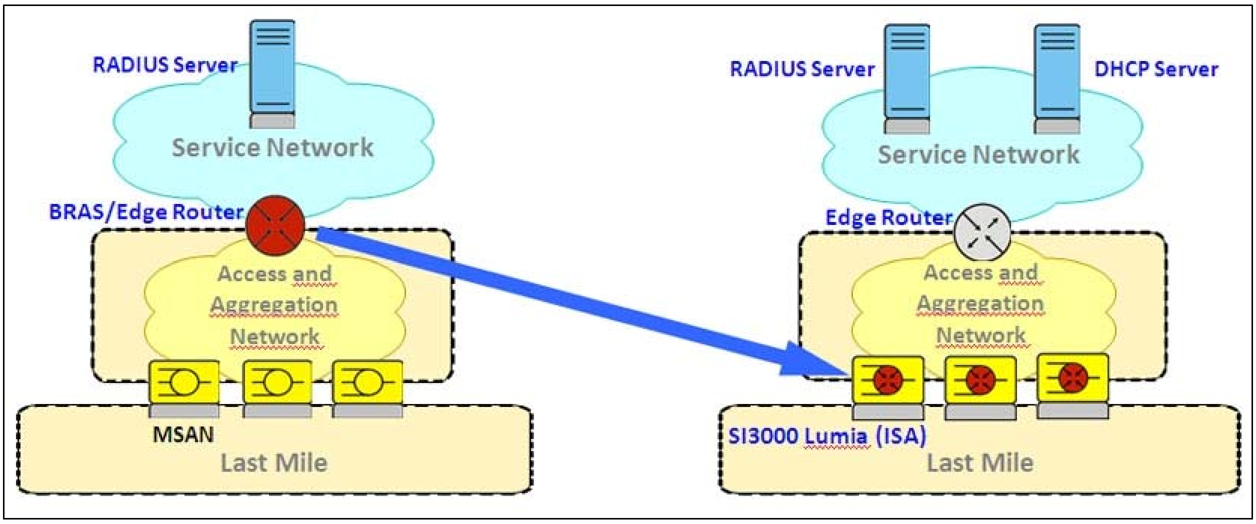

Figure 1 Classical BRAS concept vs. ISA architecture

The ISA architecture results in simplified traffic management and network planning. Based on the Radius and DHCP service model, the AAA functionalities are centralized and therefore enable dynamic service/user policy enforcement and self-provisioning using service-selection portal selection.

The ISA architecture significantly reduces the amount of required access-infrastructure investments. Placing intelligence inside the access nodes requires less advanced equipment (e.g., dummy routers) and results in obsolescent, expensive BRAS equipment.

The decision for a pure IP-based architecture and technologies enables vendor-agnostic implementations of the Ethernet aggregation and IP core networks. The architecture enables a free choice of competitive vendor solutions and enables multi-vendor support for advanced service functions (L2/L3 VPN, firewalling, IPS, virus/spam filtering). The latter additionally promotes the true pay-per-grow concept, which enables the operators and service providers to plan their investments according to their current capabilities and needs.

4.2 The benefits of ISA

As suggested in the previous section, the ISA architecture has many benefits. The below listed benefits are directly connected to the reduction of the operator's CAPEX and OPEX:

- **The "Pay-as–you-grow" concept** enables operators and service providers to invest according to their size and needs. The ISA architecture eliminates the need for large-scale investments in an expensive aggregation and core infrastructure.
- **Very fast deployment.** The ISA architecture allows the deployment of an access network in a very rapid and flexible way. ISA therefore reduces the OPEX and allows for a more rapid ROI.
- **BRAS-less network –** The ISA architecture, deployed on the operator's access nodes, already incorporates part of the BRAS function (without L3 routing).
- **Simplified aggregation L2 and core L3 network –** ISA reduces the need for sophisticated aggregation switches and edge-routing devices.
- **Single edge –** The ISA architecture joins the formerly separated data and video BNG devices in a single network element.
- **Establishing value-added services in an efficient and economical way –** The ISA architecture enables the efficient implementation of value-added services such as bandwidth on demand, QoS on demand, prepaid and quota-limited services.

The key technical motivators for choosing the ISA concept are as follows:

- An **entirely centralized** intelligent-access network model ensures a single subscriber-management point.
- **A dynamic user and service policy is enforced**
- **Flow awareness** ensures service-provisioning control and access QoS.
- **ISA is pure IP-based network architecture** and serves as a single fundament with no additional layers, multi-edge approaches and PPP sessions. The ISA architecture means IP network sessions only!

- **Last-mile awareness**. Every access node is enabled to respond to the current traffic flow and event-pattern characteristics.
- **Enhanced network security –** security mechanisms in the ISA architecture are applied on the subscriber port. This is the point where network security becomes truly effective.
- **Centralized AAA on the RADIUS server**. Authentication is based on DHCP Options Fields and the Radius protocol

5 Final Thoughts

Current broadband-networking trends show that access equipment no longer represents just a “dumb pipe”. The equipment must support the entire end-to-end architecture that ensures high bandwidth, service management, dynamic policy-driven resource control, the assurance of QoS and consequently QoE. The flexible access equipment makes a modern network architecture possible. It supports future network upgrades and future network-access-provider growth.

A brief comparison between the classical, widely adopted BRAS-based access-networking architecture and the proposed Iskratel ISA architecture shows that there are many feature-development options still open. The ISA architecture is becoming a strong alternative, which is especially suitable for alternative operators’ infrastructure and price-optimized green-field deployments.

Iskratel strongly believes that the new-generation access-networking portfolio represents a fresh approach to the area of subscriber-centered access networking. The ISA architecture and the new generation of Iskratel’s broadband-access product portfolio is the right decision in the age of economic uncertainty.

6 Abbreviations

BNG	Broadband Network Gateway
ISA	Intelligent Service Access
AAA	Authentication Authorization Accounting
OPEX	Operational Expenditure
CAPEX	Capital Expenditure
ARPU	Average Revenue Per User
QoS	Quality of Service
FTTH	Fiber to the Home
FTTx	Fiber to the x
PPP/PPPoE	Point-to-Point Protocol/Point to Point Protocol over Ethernet
DHCP	Dynamic Host Configuration Protocol
SLA	Service Level Agreement

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