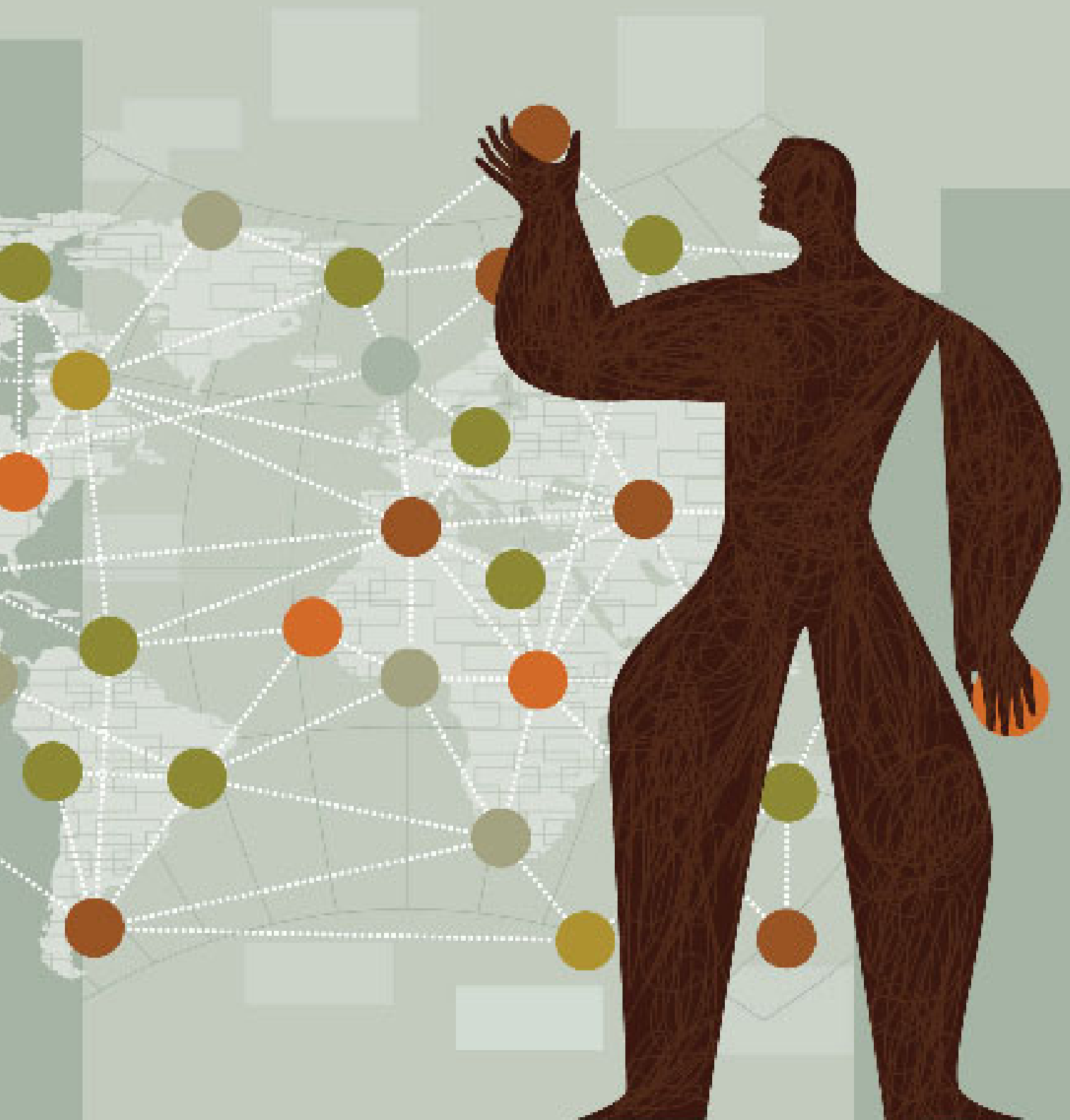


STOKE

SSX-3000 PACKET DATA GATEWAY

WIRELESS LAN INTERWORKING FOR GSM/UMTS NETWORKS



INTRODUCTION

Widespread demand by wireless data consumers for audio, video, high resolution images, and other bandwidth intensive content is creating a significant bottleneck in the mobile operator's Radio Access Network (RAN). In response to this, operators are tapping into the ubiquity and open nature of Wi-Fi access networks, and the growing set of Wi-Fi capable mobile devices. By taking this step, operators are able to support rising traffic demands at very low cost, extend the life of their RAN investments, and deliver the rich broadband experience customers are expecting.

Recognizing the advantages of Wireless LAN interworking services, mobile operator and equipment supplier members of the GSM/GPRS standards setting body, 3rd Generation Partnership Project (3GPP), developed technical specifications for deploying Wireless LAN Interworking solutions. However, with standards in place and trial deployments undertaken, service rollouts are stalled due to a dearth of operator confidence in current generation edge routers, session border controllers, and Gateway GPRS Serving Nodes (GGSN) in the role of Packet Data Gateway and tackling the rigors of broadband mobile services. They are finding that a re-tooling of the network edge is needed to deliver the performance, scalability, security, control, and economies required for full deployment. Stoke delivers new machinery to meet these demands.

3GPP WIRELESS LAN INTERWORKING: OVERVIEW

The GSM standards group, 3GPP, has developed a standard, TS 23.234 "3GPP system to Wireless Local Area Network (WLAN) interworking," that extends cellular system specifications to include WLANs. This specification defines how subscribers access a WLAN and other attached IP networks (such as an operator's network, the Internet, or a private intranet) using procedures and facilities that are compatible with a 3GPP infrastructure.

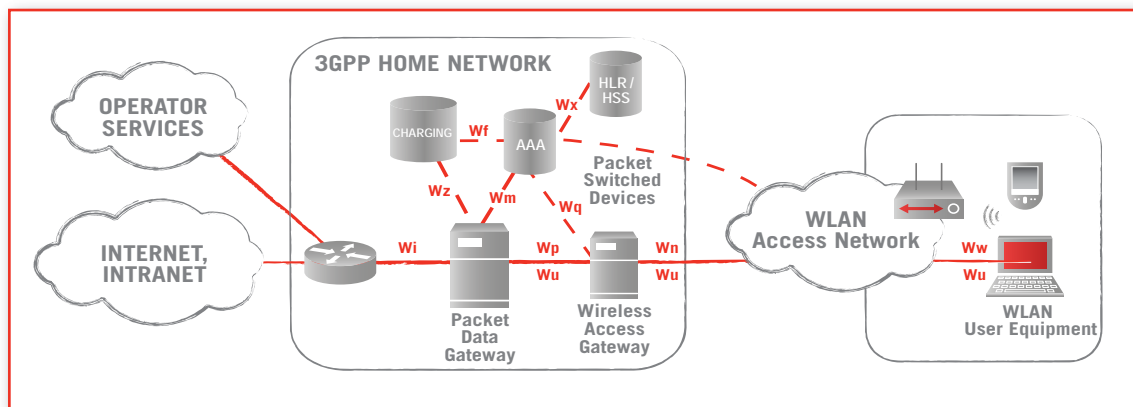


Figure 1: 3GPP WLAN Interworking Reference Diagram

The standard defines the network elements, their capabilities, and the communications interfaces required to safely deploy services to subscribers connected over WLANs. A 3GPP WLAN Interworking reference diagram is depicted in Figure 1. The diagram illustrates the functions and interfaces defined in the standard for providing User Equipment (UE) access to an operator's data services and other networks via a WLAN. A new component identified in the standard, that this paper will discuss, is the Packet Data Gateway (PDG). The PDG is the gateway between the WLAN and operator packet switched services. It is also tasked with policy enforcement for managing traffic, as well as keeping track of and reporting subscriber and flow level charging details. A partial list of capabilities required of the PDG includes routing traffic between UE and the operators packet data network;

session and application flow QoS and policy enforcement; session and context caching, distribution, & management; AAA and location proxy relay agent; secure admission control, firewall and distributed denial of service (DDoS) protection; and UE-to-PDG and PDG-to-Wireless Access Gateway tunneling.

TODAY'S MOBILE BROADBAND DEMANDS NEW MACHINERY

Mobile data users are insatiable in their demands for bandwidth and rich media applications, and increasingly capable handheld devices, like the iPhone, are being introduced that only increase their appetite. Implications of these demands include active data communications duration increases, taxing packet gateway capacity; average packet sizes shrink and packets-per-second rates go up, which amplifies latency; and popular Internet services are becoming a mix of web and media traffic, which challenges accounting and policy enforcement capabilities. Today's operators must ensure that network element selection accounts for these new realities.

Legacy equipment, whose design focus did not consider these new requirements are poorly architected for mobile broadband, and building out WLAN Interworking services with them can be disastrous to the subscriber experience, service adoption, and ultimately the operator's brand. New machinery is required to service a mobile broadband world. In particular, operators should focus their evaluations in the following areas:

- System performance, scalability, and security
- Highly flexible service profiling and charging models
- Capital and operating efficiencies

PERFORMANCE, SCALABILITY, AND SECURITY FOR 3GPP WLAN INTERWORKING

The SSX-3000 is the only product available today engineered specifically for the delivery and control of high volume walled garden and Internet-based services on broadband mobile networks. Not a refit of technology designed for yesterday's services and yesterday's challenges, but a purpose-built system that delivers the functionality, system performance and scalability, and security required for the services and challenges of today and tomorrow.

SCALABILITY AND PERFORMANCE

The compact 5RU SSX-3000 economically supports deployments ranging from less than ten thousand and up to 96,000 subscribers. Its unique single hop architecture adds packet processing, security, and forwarding capacity as subscriber support demands increase. Figure 2 illustrates throughput capacity for the SSX-3000 at across its subscriber configuration range, and indicates the cost per subscriber for a kilobit of throughput. For wireless broadband, it is no longer enough to simply consider subscriber count or cost per subscriber; network planners must include raw throughput capacity and throughput scaling in their evaluations. This ensures operators can invest in deployment models for servicing a small number of subscribers, and can count on scalability and consistent revenue margins as service adoption grows.

PDG EVALUATION CHECKLIST

- ✓ Adequate, sustained subscriber throughput
- ✓ Encrypted sessions for every subscriber
- ✓ Best-in-class system latency and jitter
- ✓ Operator-defined, service traffic profiles and classification
- ✓ Flow, session, and aggregate-level QoS policy enforcement
- ✓ Efficient support of low-density distributed and high-density centralized deployments
- ✓ Hardware-based DoS and DDoS protection

The explosion of video services and video traffic is the most disruptive component of mobile broadband. The demands it places on the operator network in terms of traffic volumes and delivery sensitivity are huge. The SSX-3000 was designed with these demands in full view, distributing adequate traffic switching capacity to deliver streaming video in high volume. The number of concurrent multimedia sessions supported is a key metric of system performance, combining both session scale and throughput. Using encrypted 300kbps sessions as a reasonable definition, the SSX-3000 supports over 300,000 concurrent, unique streaming videos per 7' rack.

Low system latency is another critical performance requirement for delivering multimedia applications, and packet processing steps should not be sacrificed to achieve it. By distributing packet processing resources to the line cards, the SSX-3000 design eliminates excessive packet data movement and practically eliminates latency. System latency is measured at less than 50 microseconds while performing all packet treatments including encryption/decryption, traffic classification, Quality of Service (QoS), and policy enforcement.

SECURE SERVICE DELIVERY; SECURE OPERATOR INFRASTRUCTURE

As a gateway function, the PDG has critical security responsibilities. They must protect the operator network from malicious traffic and unauthorized service access, and they must protect the subscriber from the same. The SSX-3000 supports authentication and authorization techniques specified in 3GPP standard to prevent fraudulent use, and it can offer military grade session encryption and decryption for every session on the system up to 96,000.

Additional security features in the SSX-3000 include hardware-based DoS and DDoS protection, dynamic firewalls, and session admission control to protect resources in the core network. Access Control Lists (ACLs) and rate limiting features also protect user equipment from potentially damaging downstream traffic.

FLEXIBLE SERVICE PROFILING AND CHARGING

Policy-based identification, prioritization, admission control, and accounting of home grown and third party applications and services are critical to a network operator's business model. Stoke is the first multi-access gateway to introduce these functions in a completely integrated fashion. With the SSX-3000, operators gain full control of the traffic flows important to their business and their subscribers, and are afforded the capacity and architecture needed to ensure quality service delivery.

FINE GRAINED TRAFFIC CLASSIFICATION

The SSX-3000's distributed architecture delivers flow-based, application aware traffic classification using hardware assisted L2/3/4 (header) and L7 (payload) packet inspection resources. With these capabilities the SSX-3000 can deconstruct subscriber sessions to identify individual flows within applications and apply corresponding QoS (policing, queuing, scheduling, congestion management) and accounting policies. Moreover, QoS functions can be applied at the flow, session, and aggregate traffic levels.

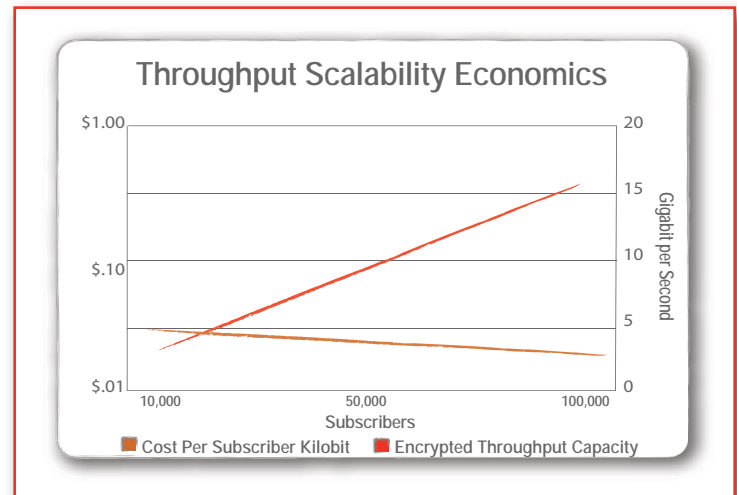


Figure 2. New scalability economics: affordable full featured, high throughput for all subscriber configurations

FLEXIBLE SERVICE DEFINITIONS

Operators are also provided a flexible means for defining services or 'traffic of interest' within subscriber sessions. In the SSX-3000, a service class is defined as a set of applications and/or traffic flows to be managed as part of a broader subscriber service plan. Service class definitions also include which traffic control policies are to be applied (e.g. give traffic priority value 3, rewrite type of service (ToS) bit to 4, and rate limit the service to no more than 100kbps). Service classes can define the associations among otherwise disparate flows (so composite applications perform properly), and tracks associations between flows, sessions, tunnels, and subscribers to ensure fairness among subscribers and adherence to terms of service.

ENHANCED CHARGING MODELS

Telecom services have traditionally used coarse metrics such as bulk usage statistics (minutes, megabytes) or a monthly contracted rate as the basis for billing. Through features like flow level application awareness, sophisticated bandwidth management, and bearer and signaling integration, the SSX-3000 dramatically increases billing possibilities. For example, accounting can be triggered when a session is activated, or as application flows are detected through traffic classification (based on time, content, events, service level, etc.), or through awareness of application signaling. Other enhancements increase the depth and breadth of information that can be gathered, aggregated, and forwarded to external systems, allowing tiered and differentiated billing models to meet wholesale and retail customer requirements.

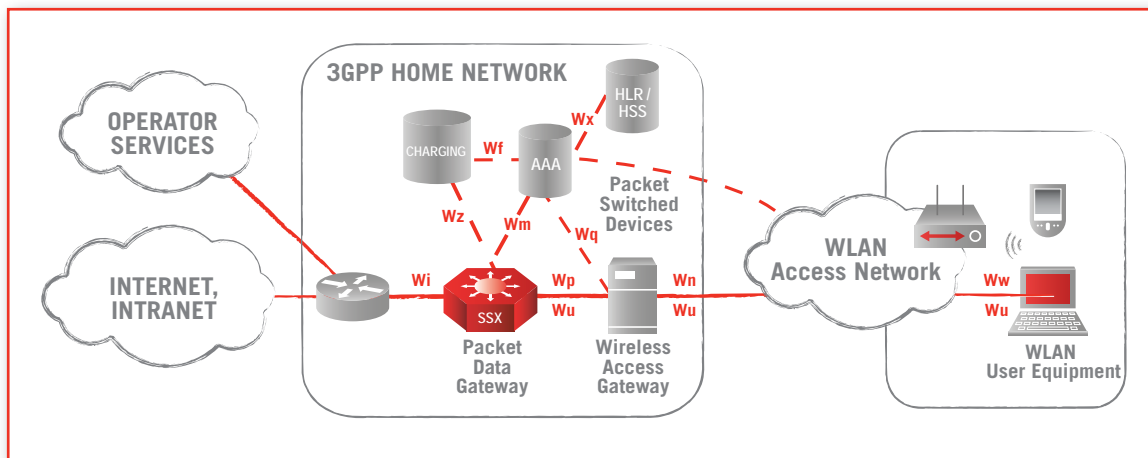


Figure 3: The purpose-built SSX-3000 delivers the throughput, scalability, and security to keep pace with traffic controls and demands for true mobile broadband Internet service delivery.

OPERATIONAL EFFICIENCY FOR MAXIMUM INVESTMENT RETURN

In today's competitive environments operational efficiency is a strategic imperative for network operators. A first order objective for operators must be to drive cost out of their networks and operations, and ensure that every capex dollar spent serves this objective. The SSX-3000 is compact, modular, and multi-function; all key factors in enabling operators to build for today's operational efficiency requirements.

COMPACT FORM FACTOR WITH SCALABILITY MINIMIZES COST

The cost and burden of additional network equipment to roll out new services cannot sink the business case for the service altogether. In the case of delivering data services over Wi-Fi, the SSX-3000 minimizes PDG capex with low subscriber count configurations, its form factor minimizes rack space and power requirements, and the system scales subscriber and traffic processing resources linearly spreading the cost of growth in a similar fashion.

MULTIPLE APPLICATION SUPPORT INCREASES INVESTMENT UTILITY

The SSX-3000 can fulfill several roles at the mobile carrier edge including this PDG application, UMA and Femtocell security gateways, and a host of other adjunct functionality to address a variety of session management needs with a single network element. Moreover, it can perform these duties simultaneously. These characteristics ensure the SSX-3000 remains relevant regardless of access network strategies and technology developments, and that the operator investment is protected.

RELIABILITY TO MAXIMIZE SERVICE UPTIME

The SSX-3000 hardware employs a carrier-class design with no single point of failure, and system availability has been independently confirmed to be > 99.999%. Control cards can be implemented with 1:1 redundancy and line cards with 1:N. Power supplies and fan modules are hot swappable and redundant and system software employs the latest high availability design principles.

SUMMARY

The availability of compelling multimedia content demanding higher bandwidth is outpacing the capabilities of most mobile data infrastructures. Network operators, and the standards bodies that support them, are finding the availability and acceptance of Wi-Fi networks and mobile devices as a low cost access technology they can leverage to satisfy their customers' demands. While they might possess the basic features, current generation packet data gateway devices do not have the traffic carrying capacity for the role of Packet Data Gateway between the high speed Wi-Fi networks and the operator data services core.

Stoke has a history of delivering products and features that enable network operators to use less capital to deploy the next generation of high performance multimedia services, while managing and controlling them more efficiently. With the SSX, Wi-Fi based services can be readily integrated into existing infrastructure today and deployed with confidence. The underlying strength of the platform delivers long term value with support for successive generations of convergence applications. A single system gives operators the processing power and capacity to offer converged services now, and system programmability assures that they can scale and diversify their portfolios to support new access technologies and standards in the future.

ABOUT STOKE

Stoke develops carrier-class solutions specifically designed to help operators realize the economic benefits and competitive advantages of network convergence.

The Stoke Session Exchange (SSX) is a multi-access intelligent session management system, allowing network operators to unify their networks and obtain substantial capital and operational savings. The SSX is the result of careful analysis of market requirements and a fresh perspective on design. It features a contemporary system architecture that is highly optimized for service delivery at carrier scale. Enhanced service creation and billing allows operators to unlock all of the value in their networks.

The SSX is highly versatile, supporting a broad range of operator initiatives, and provides the foundation to realize the full advantages of network convergence over time in a cost-effective, non-disruptive fashion. For more information please visit www.stoke.com.

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