Nomadix Service Engine
Integration into Public Access Devices

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Introduction

The Nomadix Service Engine (NSE) allows manufactures of edge networking devices such as Access Points and wireless switches to deliver feature-enhanced platforms specifically targeted at the public access market. In order to quickly reach the public access market, many device manufactures are looking to leverage Nomadix' development efforts and bring products to market that are NSE-enabled.

The NSE offers the most comprehensive set of features and functionality, and is available as a licensable software package. Depending upon the target platform, the NSE can scale to support any type of HotSpot – from a large, multi-cell location like an airport to a small, single cell coffee shop.

Nomadix also offers a series of NSE Modules and Bundles that can be added to the NSE Core to support vertical billing and other applications or add enhanced functionality:

1. HOSPITALITY - AG 3xxx/5xxx
This module provides the most extensive range of **CERTIFIED Property Management System** (PMS) interfaces to enable in-room guest billing for High-Speed Internet Access (HSIA).

This module also includes one-way and two-way PMS interfaces for in-room billing in a WI-FI network.

Bill mirroring of records to multiple destinations is also provided within this module. In addition, a driverless printing option ("Click to Print") provides the capability for a subscriber to send print jobs to a designated server and have the charge billed to the room.

2. HIGH-AVAILABILITY - AG 2xxx/3xxx/5xxx
Fail-Over functionality provides expanded network uptime and service availability by utilizing a second Nomadix Gateway that is regularly updated by the primary gateway to take over if the primary device should fail.

3. ROUTED SUBSCRIBER Module - AG 5600
Provides additional flexibility in architecting your network by configuring an NSE enabled Access Gateway to support Layer 3, WLAN, MESH and other routed networks on the subscriber or network side of the Nomadix device.

This module is useful where, for example, different departments each require a separate logical network (with typical routed connections between them), but it is desired that users on each

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network are still able make use of the Nomadix subscriber features with respect to the public internet.

METRO BUNDLE – AG 5600
This item is a special factory part number which configures the AG 5600 and packages the Routed Subscriber, High Availability modules with user count upgrades to create an AG5600 Metro Gateway that supports up to 4000 users.

NSE Overview

The NSE is a suite of patented and patent-pending embedded software available for license into networking devices such as wireless Access Points, routers, switches and residential gateways.

The NSE Core and Optional Modules that make up the Nomadix Service Engine are developed to run in a **VxWorks**® environment, using the Tornado® II integrated development tools platform, both of which are provided by Wind River Systems, Inc. VxWorks is the run-time component of the Tornado II embedded development platform and is the most widely adopted real-time operating system (RTOS) in the embedded industry. VxWorks is flexible, scalable, reliable, and compatible with numerous industry standards.

The NSE principally operates at Layer 2 of the OSI Model. This means that the NSE is platform-independent and transport agnostic, making it capable of being integrated into any edge aggregation device, whether the device supports wired or wireless networking interfaces.

The NSE provides functionality in the following key areas:

- ❑ Customer Acquisition
- ❑ Service Provisioning
- ❑ Access Control and Authentication
- ❑ Billing Enablement
- ❑ Advanced Security
- ❑ Policy-based Traffic Shaping

The following set of features make up the NSE Core:

Zero Configuration	Page Redirection
Dynamic Address Translation (DAT™)	Portal Page Redirect
Dynamic Transparent Proxy	Home Page Redirect
iNAT	Post-authentication URL
AAA	Destination HTTP Redirect
RADIUS Client (PAP, CHAP, MS CHAPv1 &2)	HTTPS Redirect
RADIUS Proxy	External Web Server Mode

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Radius Termination Action

Smart Client Support

Tri-Mode Authentication
(UAM/802.1x/Smart Clients)

Remember Me and RADIUS Re-
Authentication

Integrated VPN Client for Management

IP Upsell

Static Port Mapping

Port Mapping

Security

Secure Socket Layer (SSL)

Session Rate Limiting (SRL)

Secure XML API

Lawful intercept

Internal Web Server

Session Termination Redirect

Information and Control Console

Log-out Pop-Up Window/ Good-bye Page

International Language Support

Management

Web Management Interface

Command Line Interface

Bridge Mode

Multi-level Admin Support

Access Control List

MAC Filtering

SNMPv2c Nomadix MIB

NTP Support

Bandwidth Management/ Group Bandwidth
Limit Policy (Radius)

Walled Garden

URL Filtering

RADIUS-driven Configuration

End User Licensee Count

DNSSEC

The following sections detail certain features of the NSE Core in greater detail.

Customer Acquisition

Dynamic Address Translation

Nomadix' patented Dynamic Address Translation™ (DAT™) technology offers a true "plug-and-play" solution that provides transparent broadband network connectivity covering a variety of PC configurations (static IP, DHCP, DNS, and proxies), ensuring that everyone gets access to the public access network.

Nomadix developed DAT™ to actively monitor every packet transmitted from each device to ensure all packets are correctly configured for the network that computer is expecting. If necessary, DAT™ will perform standard Network and Port Address Translation and supports Application Level Gateways (ALGs) for protocols such as FTP, H.323, PPTP, IPSec etc.

DAT™ also ensures that a DNS server is always available to a user through the DNS redirection function. This function redirects a user's DNS requests to a local DNS server closer to the

customer's location—improving the response time and enabling true plug-and-play access when the subscriber's configured DNS server is behind a firewall or located on a private Intranet.
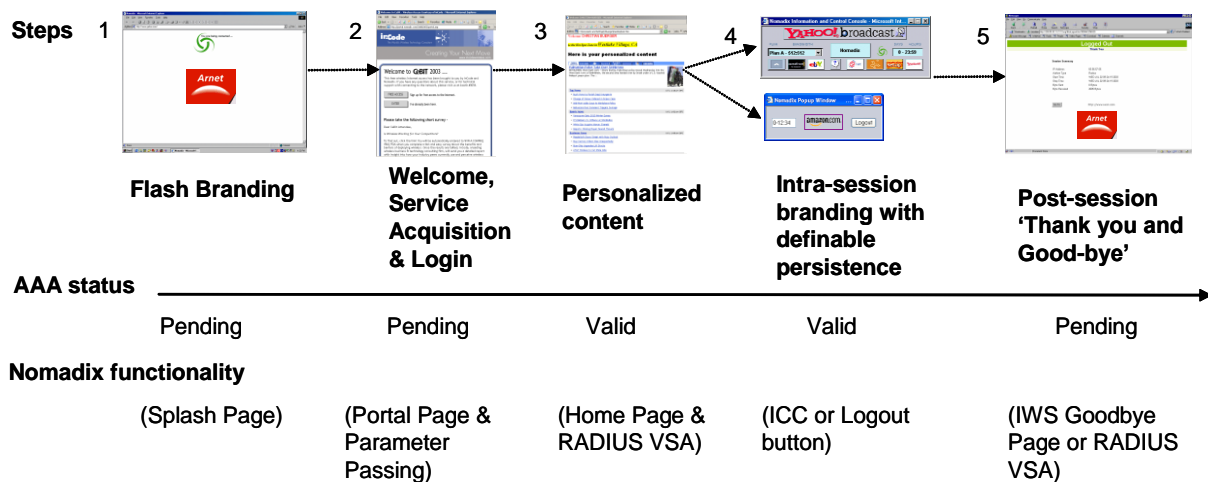
Home Page Redirection

The Home Page Redirect (HPR) feature of the NSE Core enables the device to intercept the browser's home page setting and redirect it to a new portal page determined by the Public Access Service Operator (PASO) or HotSpot owner. When redirecting the customer to a new home page, **the original home page (Origin Server)** is passed as a parameter to the new home page so the customer can still access their default home page after the local or personalized page has been presented.

HPR also allows unique redirects on a per subscriber basis per a RADIUS attribute stored in that customer's account. The NSE Core can deliver limited Web pages through its Internal Web Server.

Service Branding

The NSE offers the unique ability to provide a 5-step service branding experience for the provider and HotSpot owner.

Steps	1	2	3	4	5
	Flash Branding	Welcome, Service Acquisition & Login	Personalized content	Intra-session branding with definable persistence	Post-session 'Thank you and Good-bye'
AAA status	Pending	Pending	Valid	Valid	Pending
Nomadix functionality	(Splash Page)	(Portal Page & Parameter Passing)	(Home Page & RADIUS VSA)	(ICC or Logout button)	(IWS Goodbye Page or RADIUS VSA)

Nomadix offers redirection opportunities pre and post authentication as well as at service disconnect for maximum service branding capability for both the service provider and the venue owner.

Location-based Identification

Depending on the network architecture and vendor, the NSE can determine the physical location of the user to personalize the service presentation and perform security or billing functions. This is achieved by using aggregation equipment that supports port based IEEE 802.1q VLANs or using the integrated SNMP Manager to query the Bridge MIB (RFC 1493 or certain proprietary MIBs) to determine the physical port associated with the user's MAC address and each packet it came through.

Service Awareness

The NSE can drive a HTML/Javascript window down to each customer's Internet browser providing them with the ability to self-select services and upgrade their bandwidth and billing options in real-time.

Nomadix' patented Information and Control Console (ICC) also allows the premise owner or service operator to send custom messages and advertising directly to the screen of the customer. For credit card usage, the ICC displays a dynamic "time" field to inform customers of the time remaining or expired on their account.

Access Control and Authentication

The NSE Core offers a Walled Garden feature allowing pre-authenticated users access to only certain sites on the Internet. Depending upon the device, the NSE provides up to 300 IP pass-through addresses that allows the administrator to enforce security based on whether or not the customer has been authenticated. The "walled garden" can be used to push local content and services' providing a custom experience dependent upon the public HotSpot owner.

By allowing selective access control to the network before the customer authenticates themselves, service selection and Web based self-provisioning can be provided in a standard, efficient, low

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cost and convenient way. The NSE provides an additional layer of security for the public access Wi-Fi network by blocking access to the Internet until the user has been authenticated.

Multi-mode Authentication Methods

In addition to supporting the secure Browser-based Universal Access Method via SSL, the NSE enables the simultaneous support for Port-based Authentication using IEEE 802.1x and authentication mechanisms used by Smart Clients by companies such as Boingo Wireless and iPass. Nomadix is the only company capable of delivering this type of advanced authentication functionality.

Billing Enablement

A NSE-enabled device can automatically authenticate, authorize, track, and bill users for access. Users can be identified and billed according to their Media Access Control (MAC) address, username/password, and/or port identification number.

The NSE supports a wide variety of billing models enabling the deployment of profitable public access network. Our technology allows equipment makers to sell solutions that enable billing plans using credit cards, scratch cards or enable monthly subscriptions—then bill by a host of different parameters including IP address type (Private/ Public), time, volume, or bandwidth.

RADIUS

Nomadix offers an integrated RADIUS client with the NSE Core allowing the service provider to track or bill based upon the number of connections, location of the connection, bytes sent and received, connect time, etc. The customer database can exist in a central RADIUS Server, along with associated attributes for each user. When a customer connects into the network, the RADIUS client authenticates the customer with the RADIUS Server, applies associated attributes stored in that customer's profile, and logs their activity (including bytes transferred, connect time, etc.). Our RADIUS implementation also handles vendor specific attributes (VSAs), required by WISPs—that want to enable more advanced services and billing schemes such as a per device/per month connectivity fee.

XML Interface

Nomadix provides a secure XML Application Programmer's Interface (API) with the NSE Core allowing the device to accept and process XML commands from an external source for integration with OSS, provisioning, and other network management elements for subscriber management and location/port management. XML commands are sent over the network via an SSL tunnel in the form of an encoded query string. The XML interface enables solution providers

and integrators to customize and enhance the installations with value added capabilities and services.

Advanced Security

The NSE enhances today's standards, enabling the secure deployment of large-scale public access networks, regardless of the standards supported at the client, enabling a solution that covers the wide variety of clients that will roam into the location.

VPN tunneling (PPTP, IPSec) remains the recommended method for transmitting data across a wireless network for mobile workers wishing to connect back to their corporate resources. Nomadix' products feature its patented iNAT functionality that creates an intelligent mapping of IP Addresses and their associated VPN tunnels allowing multiple tunnels to be established to the same VPN server creating a seamless connection for all the users at the public access location.

Denial of Service Management

The NSE Core also provides Session Rate Limiting (SLR) and MAC filtering capabilities to significantly reduce the risks of Denial of Service (DoS) attacks helping ensure network uptime and reliability. Administrators can also block all ICMP packets of non-authenticated users to further protect the network against common DoS attacks.

Policy-based Traffic Shaping

The Bandwidth Management feature is part of the NSE Core functionality and enables a service provider to limit bandwidth usage on a per device (MAC Address/User) basis. This ensures every user has a quality experience by placing a bandwidth ceiling on each device accessing the network so every user gets a fair share of the available bandwidth.

The bandwidth for each device can be defined asymmetrically for both upstream and downstream data transmissions. The service provider can also allow the individual user to increase or decrease their bandwidth by the minute—or on an hourly, daily, weekly, or monthly basis—without having to disconnect or re-establish a new session.

The NSE can also manage the WAN Link traffic providing complete bandwidth management through the public access location. Bandwidth Management shapes traffic going over the WAN Link to prevent its over-utilization. The NSE queues traffic from overly busy instances in time and sends the packets over the WAN Link when a lull in traffic occurs.

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Management Features

The NSE Core running on a third party platform can be managed remotely via the built-in Web Management Interface where various level of administration can be set. The NSE Core also contains a CLI (Telnet and serial) and extensive SNMP support.

The NSE Core provides a unique RADIUS-driven Auto-Configuration functionality that utilizes the existing infrastructure of a provider to deliver an effortless and rapid methodology to configure devices for fast network rollout. Once configured, this methodology can also be effectively used to centrally manage configuration profiles for all NSE devices in the public access network.

Summary

Integration of the NSE into an edge device such as an Access Point or wireless gateway allows the equipment maker to provide a full-featured device designed specifically for the public access market.

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