High-Performance Packet Processing Solutions for Intel Architecture Platforms

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Topics

- 6WIND Company Introduction
- Key Performance Challenges for Mobile and Cloud Infrastructure
- 6WINDGate Software Overview
- 6WIND Solutions for Crystal Forest
- 6WIND Support for Intel® DPDK
- Summary
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Company Overview

- Networking and telecom software company

- **Focused on solving the critical performance challenges** for Software Defined Networks
  - Mobile Infrastructure (LTE networks)
  - Cloud Infrastructure (data center networks)

- **Headquartered in Paris, France**
  - Offices in China, Japan, South Korea and US

- **In business since 2000**
  - 6WINDGate™ software deployed in two-thirds of LTE networks worldwide
  - 40% growth and profitable in 2011
Our clients develop leading-edge equipment for software-defined networks.

Some of Our Clients

- Ericsson
- Nokia Siemens Networks
- Alcatel-Lucent
- HP
- LG-Ericsson
- Hitachi
- Allot Communications
- Genband
- NEC
Strong Partnership with Lanner

- Pre-integrated solution for Lanner network appliances
- Provides best-in-class packet processing performance
- Deployed by major OEMs

“The combination of 6WIND’s packet processing software and Lanner’s high-performance network appliances enabled us to quickly bring to market a best-in-class network security solution,” said Dr. Hyochang Nam, Product Development Team Leader at SECUI.
Intelligent Systems Alliance member

Delivering high-performance packet processing solutions for Intel® Architecture platforms for many years
  - Nehalem, Westmere, Sandy Bridge etc.

Intel DPDK experts
  - Providing DPDK to customers both stand-alone and integrated within 6WINDGate

Many joint OEM customers using 6WINDGate on IA platforms
  - Maximum networking performance
  - Accelerated time-to-market
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Problems We Address in Mobile Infrastructure

- **Network Performance**
  - Maximize bandwidth for mobile video and for cloud-based services
  - Minimize latency for mobile gaming
  - High scalability in anticipation of the next "killer app"

- **Network Monetization**
  - Shift from unlimited mobile data plans to tiered pricing
  - Customer-centric service offers
  - Policy-driven content distribution

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![Traffic: 100% CAGR, 500x in 10 years](source)

Source: StarHub

![SERVICE-BASED BROADBAND](service-based-broadband)

Source: Ericsson
#1 supplier of networking software for LTE infrastructure

Used throughout Evolved Packet Core (EPC) and access network equipment

Adopted by multiple tier-1 Telecom Equipment Manufacturers (TEMs)

Deployed in commercial LTE networks worldwide
Problems We Address in Cloud Infrastructure

1. Low-cost, high-performance network appliances

2. Massive growth in number of VMs per application server blade drives need for networking functions
6WIND in Cloud Infrastructure

**CORE**

**AGGREGATION LAYER**
- Physical Appliances using Proprietary Hardware
- Physical Appliances using General-Purpose Processors
- Virtual Appliances using Server Hardware

**ACCESS LAYER**

**APPLICATION SERVER BLADES**
- Application Processing only
- Application Processing and Networking
- Virtual switch for application server blades

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6WINDGate Software Overview

5. Virtualization-ready.
6. Full set of networking protocols with management support.

1. Optimized architecture based on control plane - data plane separation.
4. Compatible with standard Linux distributions and application APIs.
5. Full scalability across processors, blades and racks.
6. Carrier Grade reliability.

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In typical networked applications, 90+% of the workload is sophisticated data plane processing.

Operating system overhead limits the performance of standard networking stacks for these functions.

6WINDGate addresses this issue via:

- Unique, dedicated “fast path” within 6WINDGate Data Plane
- Performing packet inspection, processing and forwarding
- Transparent to Control Plane applications
- Optimized for maximum Intel® Architecture processors
6WINDGate is fully compatible with Linux distributions from:
- Commercial Linux suppliers, both embedded and enterprise
- kernel.org
- Other open-source distributions

Legacy application software runs unchanged
- Full support for standard Linux compilers and debug tools
- Fully compatible with standard Linux APIs
- Fast path is non-intrusive (transparently synchronized with Linux)
6WINDGate maximizes system-level performance of virtualized environments

Hypervisor performance improvements from 6WIND-enhanced version of Intel® DPDK library
- I/O Virtualization (IOV) bypasses hypervisor virtual switch, removing vSwitch performance constraints
- Virtual VIC (vNIC) driver accelerates VM-to-VM communication via virtual switch
- Direct VM-to-VM communication via VM2VM driver for ultimate performance

6WINDGate runs within Virtual Appliances that require high-performance networking
- Fully-compatible with standard hypervisors
- Citrix XEN, Red Hat KVM, VMware ESX etc.
# Comprehensive Protocol Set

## Control Plane Modules

<table>
<thead>
<tr>
<th>Category</th>
<th>Components</th>
</tr>
</thead>
<tbody>
<tr>
<td>Routing Protocols</td>
<td>Static RIP (IPv4, IPv6), RIPng, OSPFv2, OSPFv3, BGP-4, BGP-4+, ECMP (IPv4, IPv6), VRRP, PIMv4-SM, PIMv6-SM, IGMP/MLD snooping &amp; proxy, static route monitoring &amp; BFD</td>
</tr>
<tr>
<td>Security</td>
<td>IKE, IKEv2, EAP, VPN monitoring</td>
</tr>
<tr>
<td>Connectivity</td>
<td>PPP, Multi-link PPP, PPPoE, CHDLC, VXLAN, (NV)GRE, 6in6, 4in4, L2TP, DHCPv4/6, DNS proxy, RADIUS client</td>
</tr>
<tr>
<td>Switching</td>
<td>LACP</td>
</tr>
<tr>
<td>Mobility</td>
<td>Home agent, FMIP, corresponding node, mobile node, IPsec integration, NEMO, proxy MIP</td>
</tr>
<tr>
<td>Virtual Routing (VRF)</td>
<td>Routing protocols, IKE</td>
</tr>
<tr>
<td>High availability</td>
<td>Monitoring system, synchronization daemons for ARP-NDP, routing and IPsec</td>
</tr>
</tbody>
</table>

## Fast Path Modules (IPv6-ready)

<table>
<thead>
<tr>
<th>Fast Path Modules</th>
<th>Functions</th>
</tr>
</thead>
<tbody>
<tr>
<td>IP forwarding</td>
<td>NAT</td>
</tr>
<tr>
<td>IPsec, IPsec SVTI</td>
<td>ROHC</td>
</tr>
<tr>
<td>V(X)LAN, (NV)GRE</td>
<td>Flow inspection</td>
</tr>
<tr>
<td>QoS</td>
<td>Multicast</td>
</tr>
<tr>
<td>IP reassembly</td>
<td>GTP encapsulation</td>
</tr>
<tr>
<td>SSL termination</td>
<td>TCP termination</td>
</tr>
<tr>
<td>IP filtering</td>
<td>MPLS encapsulation</td>
</tr>
<tr>
<td>IPv6 tunneling and transition</td>
<td>DPI engine interface</td>
</tr>
</tbody>
</table>

## Networking Stack

- Optimized multicore Linux networking stack, including:
  - All Linux networking features
  - Large-Scale NAT, SVTI
  - Integrated hardware and software crypto acceleration for IPsec and SSL
  - Full scalability: Netfilter, IPsec, VRF.
  - Graceful Restart extensions for High Availability.
  - IP forwarding
  - NAT
  - IPsec, IPsec SVTI
  - ROHC
  - V(X)LAN, (NV)GRE, link aggregation
  - Flow inspection
  - QoS
  - Multicast
  - IP reassembly
  - GTP encapsulation
  - SSL termination
  - TCP termination
  - IP filtering
  - MPLS encapsulation
  - IPv6 tunneling and transition
  - DPI engine interface
Scalable across Processors and Blades

Hardware Platform
- Fast path maximizes performance by processing packets outside the OS
- Supports dynamic configuration of cores to run Linux or fast path
- Performance scales linearly with number of cores running fast path

Data Plane Performance

<table>
<thead>
<tr>
<th>Number of fast path cores</th>
<th>Data Plane Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
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<tr>
<td>3</td>
<td></td>
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<tr>
<td>4</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>
6WIND's Software Partner Ecosystem

Embedded Software Suppliers

RTOS and Linux Suppliers

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Example: LTE Security Gateway

- Complete integration of routing, security and mobility features
  - Full support for processor crypto engines for maximum IPsec performance
  - High capacity IKE solution maximizes number of access points supported

- Fully-scalable control plane and data plane

- High Availability support for zero downtime or five-nines reliability
Example: Firewall / IPS

Best-in-class cost-performance for physical and virtual appliances
- 15Mpps per core IP Forwarding
- 6Gbps per core IPsec, 100Gbps IPsec overall platform performance
- 1420B packets on dual Intel Xeon E5-2600 Series platform (2.7GHz)

Physical Appliance

Virtual Appliance

- Unlimited scalability across processors and blades
- Full support for industry-standard hypervisors and orchestrators
- Comprehensive set of optimized networking protocols

Virtual Machine

Networking Data Plane
- Firewall / QoS
- VLAN
- Virtual Routing
- IPv4 / IPv6 / IPsec
- TCP / SSL

Networking Control Plane
- High Availability
- Crypto Acceleration

Intel Multicore Processor Platform

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Run-Time Software Model

- One core (or more) runs Linux, with (optionally) 6WINDGate control plane
- Remaining cores run 6WINDGate fast path on Intel® DPDK for maximum performance
- Performance scales linearly with number of cores configured to run fast path.

![Diagram showing the run-time software model with Linux, control plane, fast path, and Intel® DPDK for performance scaling.](image-url)
Sandy Bridge IP Forwarding Performance

- IP forwarding performance per core
  - 15 Mpps (with flow cache)
  - 11 Mpps (without flow cache)

- Performance scales linearly with the number of cores configured to run the fast path

- Other cores can be used
  - For more complex fast path processing or
  - For Linux (networking stack, control plane, applications)

Complete performance information available on request
Sandy Bridge IPsec Performance

- IPsec performance per core
  - 64B packets: 1.8 Gbps
  - 1420B packets: 6.3 Gbps

- Performance scales linearly with the number of cores configured to run the fast path

- Other cores can be used
  - For more complex fast path processing or
  - For Linux (networking stack, control plane, applications).

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Two options for customers to obtain Intel® DPDK from 6WIND

Option 1: Stand-alone library
- Including value-added enhancements and add-ons
- Full technical support

Option 2: Integrated with 6WINDGate
- Complete packet processing solution
- Full technical support

Full technical details in joint white paper

http://www.6wind.com/document-library
Option 1: Intel® DPDK Library from 6WIND

- Optional add-ons available for increased system functionality and performance
  - Enables use of Intel® DPDK in Virtual Appliances and Software-Defined Networks
  - Improves system-level cost/performance in network security applications

- Includes value-added enhancements
  - Crypto support via AES-NI
  - Device monitoring and statistics
  - Additional device support (e.g. NICs)
  - Bug fixes

- Maintained by 6WIND as private branch
  - Synchronized with Intel's on-going releases of baseline library
Option 2: Intel® DPDK Integrated with 6WINDGate

- **6WINDGate provides complete packet processing solution for DPDK platforms**
  - Comprehensive set of optimized networking protocols
  - Full compatibility with application APIs
  - Carrier Grade reliability

- **6WINDGate fully leverages Intel® DPDK library**
  - Exploits Intel® DPDK data plane libraries for best possible utilization of processor resources
  - Optimized NIC drivers for maximum networking performance

- **Delivered as integrated solution to accelerate clients' time-to-market**
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6WIND: Your Partner From Concept to Deployment

System Design
- Requirements analysis
- 6WINDGate evaluation
  - Performance measurements
- 6WIND expertise
  - Migrating applications to multicore
  - Architecture optimizations
  - Protocols

System Development and Integration
- 6WINDGate integration
  - Source code license
- Development support
  - Technical training
  - Customization
  - Software integration

System Deployment
- 6WINDGate product support
  - Technical training
  - Maintenance
  - Updates
  - Roadmap alignment
Networking OEMs face major challenges in:
- Performance
- Cost
- Scalability
- Time-to-market

6WIND provides a proven solution to these problems
- Adopted by tier-1 OEMs worldwide
- Deployed in mobile, cloud and enterprise networks
- Optimized for Intel® Architecture platforms