Best Practices for ISP Core Network

Doing Better & Smarter

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A technical approach to core network design and operation

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Introducing: M. Paesani

- Network consultant for European telecoms, government, aerospace, and financial organizations.
- Early adopter and promoter of IPv6.
- Expert in advanced routing protocols and BGP/MPLS/SRv6 security.
- Recognized worldwide as a skilled and passionate network engineer.
- Member of Open-IX marketing team and active member of the Italy IPv6 Council.

Introducing: A. Giordano

- Master’s degree in Engineering from Turin Polytechnic.
- 20+ years in telecoms management, networking, and ISP development.
- CEO of Warian (Italian ISP) since 2011, active in regulated and custom markets.
- Extensive consultancy in Europe on network training and high-availability design.
- Previous technical roles in the USA and the Caribbean.

Introducing: Warian

- Founded in 2011, WARIAN is an Italian Managed Infrastructure Provider, committed to building smart, green, and high-performance networks.
- We support companies and operators in their digital transformation journey.
- Our portfolio spans from fiber access (AnyNET), dedicated internet (AnyBIZ), optical transport (AnyWAVE), colocation & hybrid cloud (AnyCLOUD) to professional voice services (AnyVOIP).
- We own a proprietary IP infrastructure, interconnected with major European NAPs, ensuring reliability and top-tier performance.
- Every service is tailor-made, driven by customer needs, with direct technical support—no call centers, just real experts.
- Our vision: to drive digital innovation with infrastructures that are intelligent, sustainable, and empowering—because technology should unlock human potential..

Presentation Agenda

This presentation was created for humans, by a human

Tiering

- Local
  - Operates in a city, province, or limited area.
  - Focused on last-mile connectivity for households and SMEs.
  - Relies on upstream provider for national and global access
- Regional
  - Covers nationwide or multi-regional areas.
  - Owns backbone infrastructure and connects at local IXP.
  - Provides aggregation for multiple local ISPs.
- Global
  - Operates worldwide or continent-wide with large backbone networks.
  - Mix of Tier-1 and Tier-2 providers.
  - Peering and transit agreements ensure full Internet reachability.
  - Supply connectivity to regional and local ISPs, enabling global access.

Network Architecture

- ## Redundancy and Resilience 

  Build multiple paths between critical nodes to eliminate single points of failure. Use diverse routing protocols (BGP, OSPF, OSPFv3, IS-IS, MPLS, SR, SRv6, BFD) and maintain backup connections to upstream providers and peering partners. Always deploy IPv6 and IPv4 across your global infrastructure.

- ## Scalable Infrastructure 

  Design networks with growth in mind using modular equipment that can be upgraded incrementally. Implement proper capacity planning with regular traffic analysis and forecasting.

- ## Geographic Distribution 

  Distribute network equipment across multiple locations to reduce latency and improve fault tolerance. Place Points of Presence (PoPs) strategically to minimize customer distances to core infrastructure (EDGE strategy).

Security Framework

- Multi-layered Defense

  Deploy DDoS protection, intrusion detection systems, and traffic filtering (ACL, RPKI and MANRS) at network edges. Implement proper access controls and network segmentation to isolate critical systems (DNS, OOB, PS and radius for AAA)

- Regular Security Audits

  Conduct penetration testing and vulnerability assessments. Keep all network equipment firmware and software updated with security patches.

- Complete and updated technical documentation

  It must contain the operation of the core network as well as: typical configurations, specific details, how to make updates, photographs of all the devices and the related PoPs.

Traffic Management

- Quality of Service (QoS) 
  Prioritize traffic based on service level agreements and application requirements. Implement traffic shaping to manage bandwidth allocation effectively.

- Quality of Experience (QoE) 
  Improve perceive and rate the service experience, incorporating human factors and subjective satisfaction. More bandwidth and low latency, jitter, and packet loss.

- Load Balancing 
  Distribute traffic across multiple paths and servers to optimize performance and prevent congestion. Use both local and global load balancing strategies.

Monitoring and Maintenance

- Comprehensive Monitoring
  Deploy network monitoring tools that track performance metrics, capacity utilization, and fault conditions in real-time. Set up automated alerting for critical issues.

- Proactive Maintenance
  Schedule regular maintenance windows for equipment updates and testing. Maintain detailed network documentation and change management procedures.

- Traffic Quality Monitoring
  Check it out the traffic quality, about AS path and IPv4/IPv6 traffic, in input and output from your backbone.

Peering and Transit

- Strategic Peering Diverse
  Establish peering relationships with Content Delivery Networks (CDN) and other ISPs to reduce transit costs (??) and improve performance (??). Participate in internet exchange points where economically viable and nearby.

- Transit Providers
  Maintain relationships with multiple upstream providers (two is enough ??) to ensure connectivity redundancy and negotiate better performance over price through competition.

- Private Network Interconnect (PNI)
  Consider using PNI on Over The Top (OTT) or large networks when available to enhance multimedia content.

Customer Experience

- Service Level Agreements (SLA)
  Define clear performance metrics and uptime guarantees. Implement customer portal systems for service monitoring and support ticket management.

- Rapid Issue Resolution
  Establish 24/7 network operations center capabilities with trained staff and escalation procedures for quick problem resolution.

- Evaluating Customer Satisfaction
  Using surveys, social media monitoring, direct interaction and analysis of key metrics such as customer churn and retention.

Impact on Network Costs 1/2

Typical CAPEX (CAPital EXpenditure)

- Equipment Lifecycle Management
  Network equipment typically requires replacement every 3-5 years due to technology advancement, maintenance cost increases, and end-of-support issues from vendors.

- Capacity Expansion
  Regular CAPEX investments to increase network capacity ahead of customer demand growth. This includes both equipment upgrades and additional circuit installations.

- Technology Migration
  Major investments in new technologies like IPv6 implementation or 5G infrastructure that require substantial equipment and system changes.

Tax Considerations

Accelerated depreciation schedules, investment tax credits, and deductions can significantly impact the effective cost of CAPEX investments.

Impact on Network Costs 2/2

Typical OPEX (OPerational EXpenditure)

- Personnel (40-50%)
- Bandwidth/Transit (20-30%)
- Facilities (10-15%)
- Equipment Support (8-12%)
- Software/Services (5-10%)

Outsourcing Opportunities

Consider managed services for non-core functions like NOC operations, customer support, or specialized technical services to optimize costs and focus on core competencies.

warapn
innovation enabler

SLA

99,999%

These practices help ensure reliable, secure, and cost-effective network operations while supporting business growth and customer satisfaction.

You can do more and better: work on this goal every day

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