下一世代資訊通訊網路尖端技術與應用(二)

子計畫二

光纖網路及服務品質保證技術

Optical Networking and QoS Technologies

進度會議

子計畫主持人

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January 08, 2007

Outline

- **Technologies and Significant Contributions**
  - **Part I: Optical Networking Technologies**
  - **Part II: Broadband QoS Technologies**
- 計畫整體性成果

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- **Technologies and Significant Contributions**
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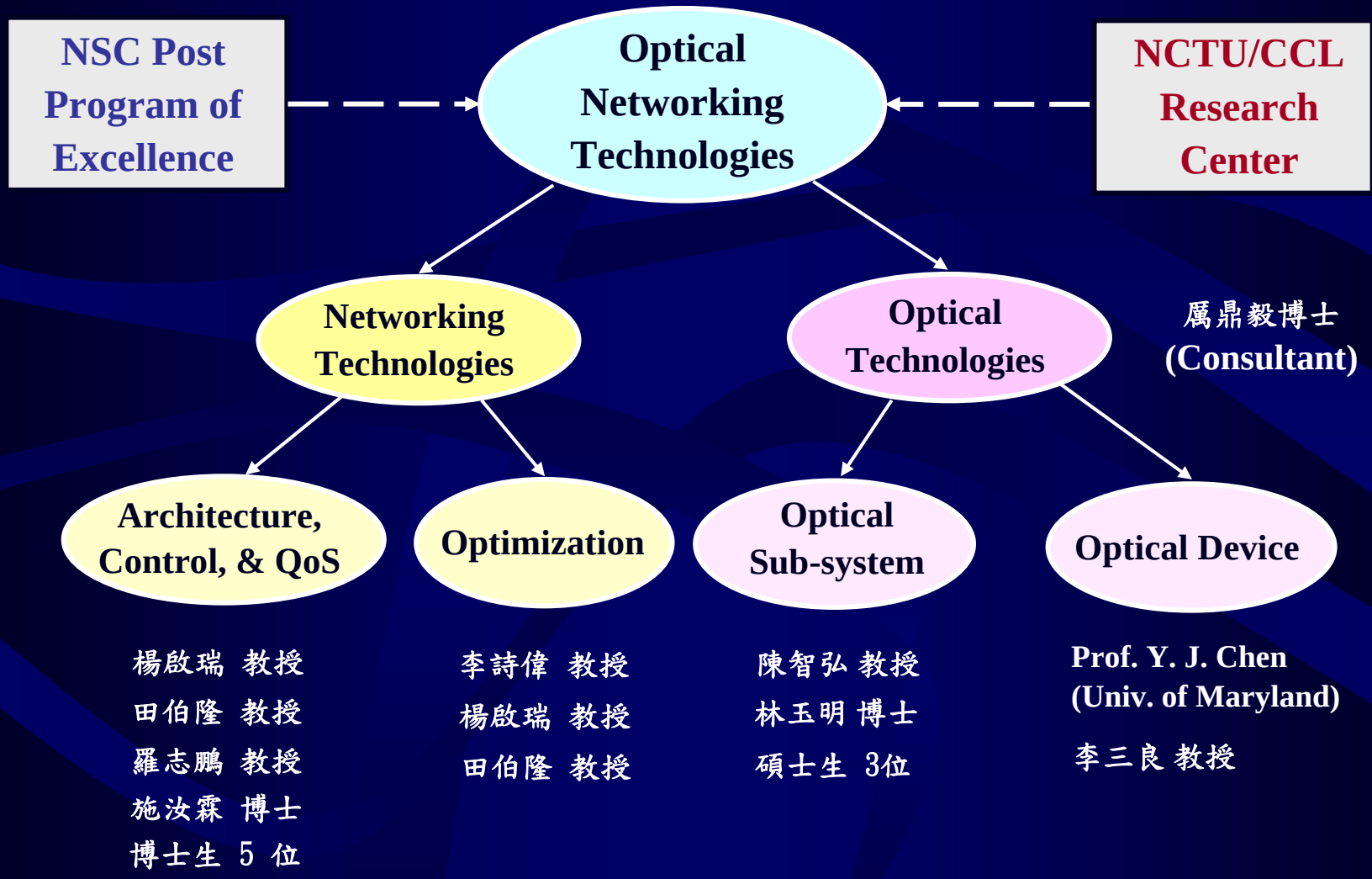
Part I:

Optical Networking Technologies

Project at a Glance



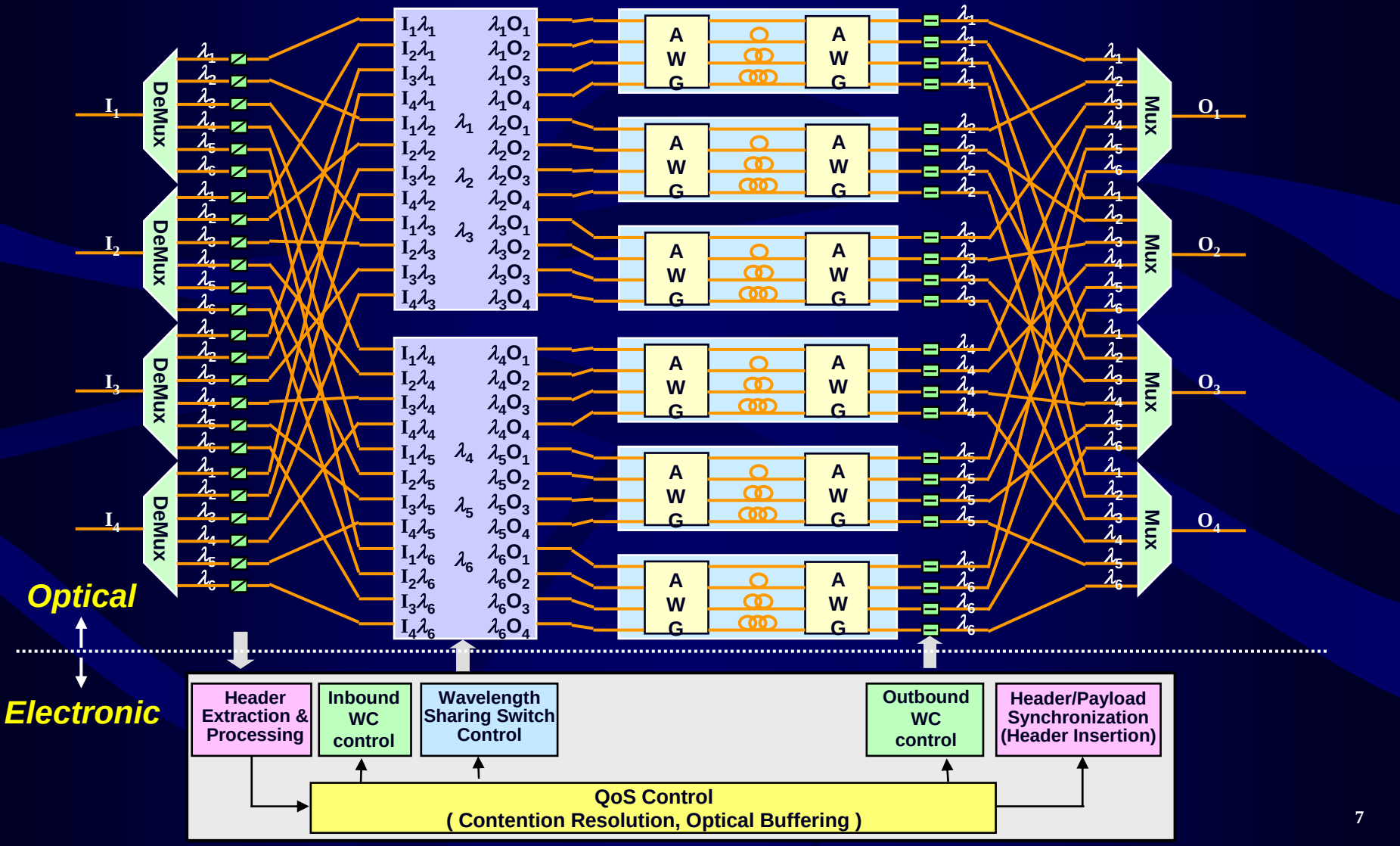
Road Map and Breakthrough

	2000~2004	*2005~2006*	*2007~2008*
Optical Network Testbed	Optical Packet Switched IP-over-WDM Network (OPSINET, OPSINET-II/10G)	High-Performance Optical Packet Switched Metro Area Network (HOPSMAN)	Distributed-control Hybrid Passive Optical Network (DHPON)
Techno-logy	OCPS, QOPS	HOPSMAN MAC and Optical System	DHPON MAC and Optical System

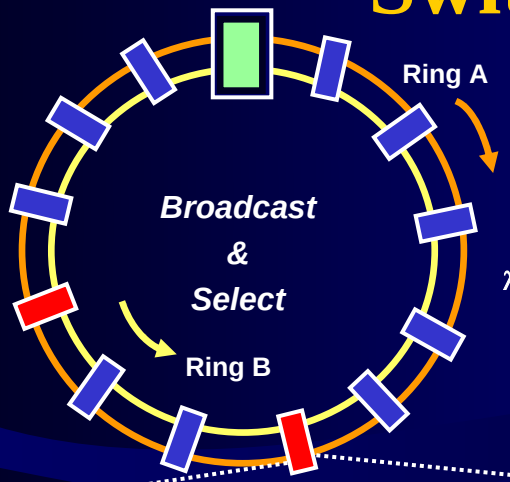
Technology	*State-of-the-art*	*Breakthroughs*
All optical packet-switched metro network	DAVID MAN, European IST	• Achieve all optical slot eraser- directly deleting packets in the optical domain within **5** *n*s • Complete four-wave-mixing based filter- converting wavelength within **40** *n*s tuning delay • Analyze and achieve the design of High performance MAC with Triple-play support • Finish the design of **10** Gbps high speed CDR circuit

All Optical WDM Packet Switching System

- 研究並實現高效能光纖交換器及控制系統 (10 Gbps)

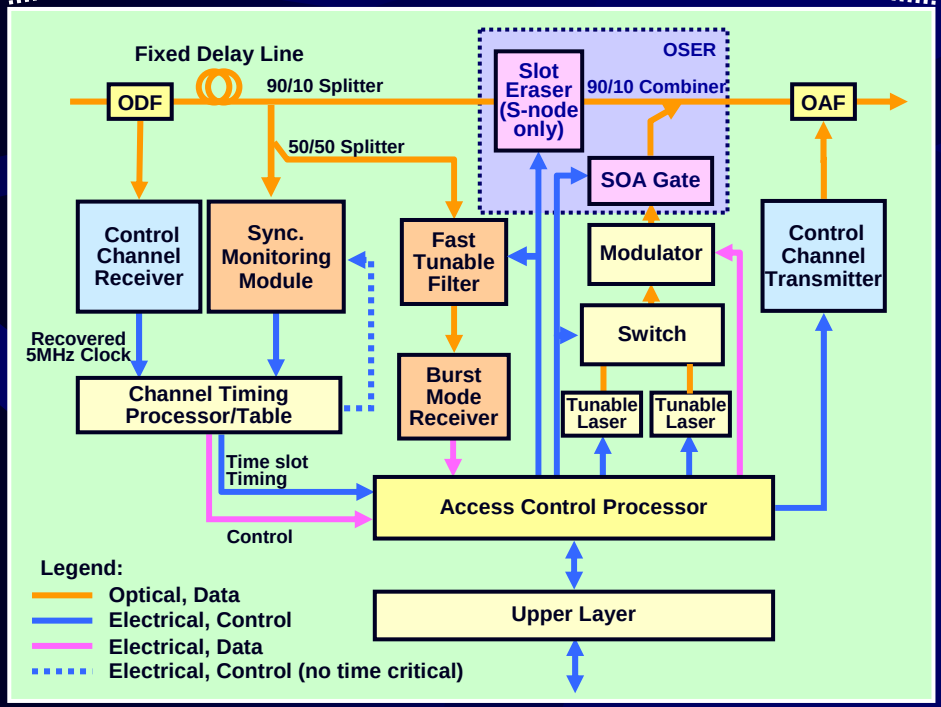


HOPSMAN: High-Performance Optical Packet Switched Metro Network



λ_0: control channel

λ_1~ λ_n : data channel



【高速全光光分封交換】

利用光交換原理，直接於光層進行封包擷取，不需高速電子交換

【完成高效率MAC研發】

保證各節點所需之頻寬，並可保障節點間的公平性

【創新硬體設計】

- 完成全光 slot eraser，可在 5 ns 內將不需要之光封包直接於光層移除，大幅提高頻寬再利用率
- 完成四波混合式高速全光濾波器，可於 40 ns 內調整濾波通道

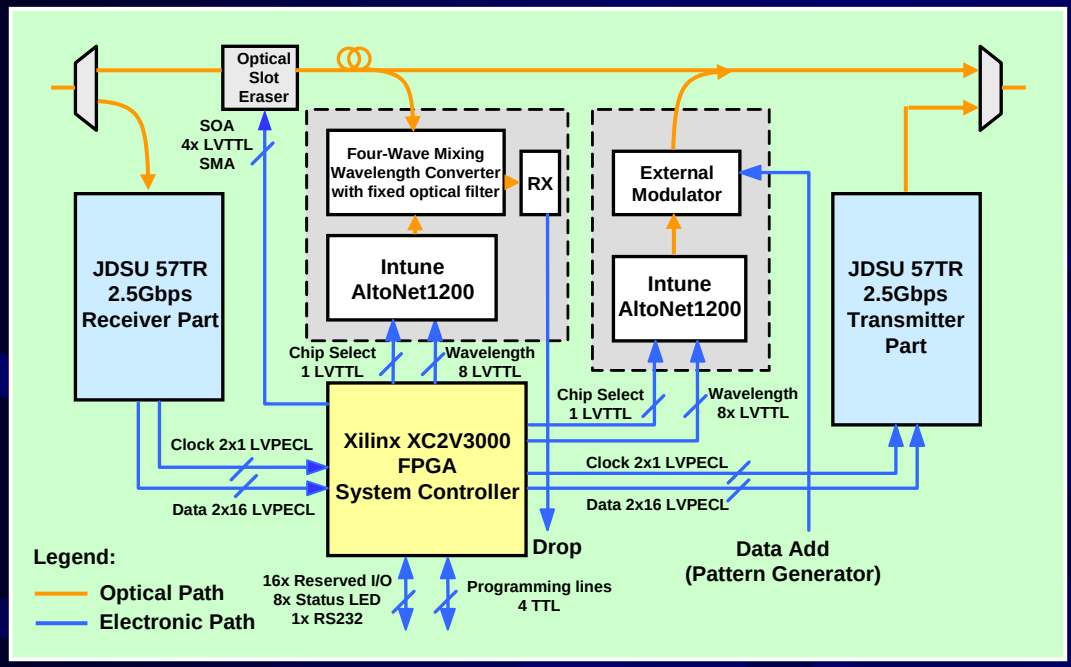
【高速CDR研發】

本計劃已完成 10 Gbps 高速 CDR 電路設計

【實驗網路建置】

本計劃已完成含三個節點之實驗網路建置，每個節點由一 FPGA MAC controller 所控制，並於光層直接進行光封包收送

HOPSMAN Testbed: Central Controller



- Design of optical metro network architecture
- Design of access node architecture and control
  - MAC scheme with QoS
  - Access node architecture
  - Optical subsystems

Part II:

Broadband QoS Technologies

Road Map and Breakthrough

	2000~2004	*2005~2006*	*2007~2008*
Network QoS	Private fairness by TCP rate shaping (PostACK)	Public fairness by TCP-friendliness (WARC)	Private fairness by request scheduling (MSF-RS, MRRS)
Content QoS	Software accelerator (4-in-1 Proxy)	Algorithmic accelerator (BH)	Hardware accelerator (BFAST)

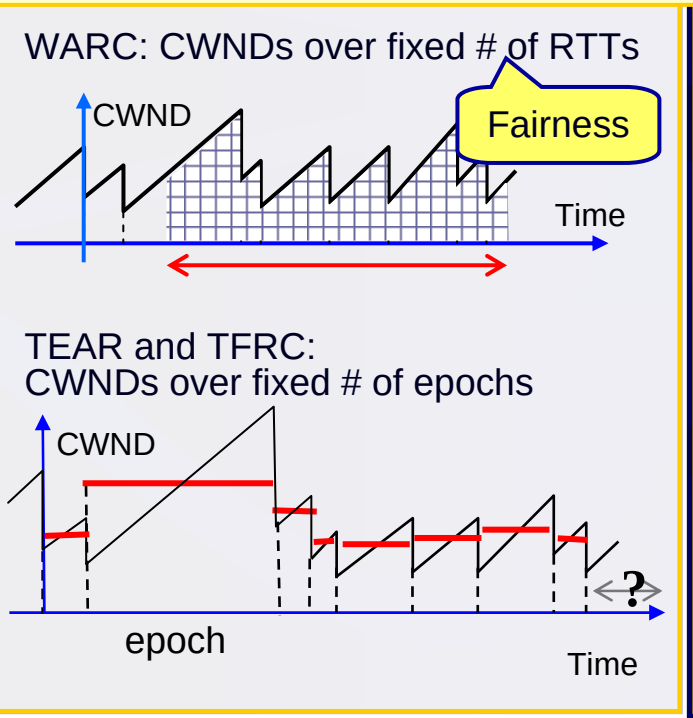
Technology	*State-of-the-art*	*Breakthroughs*
Deep Packet Inspection by BFAST	John Lockwood, Washington Univ., Bloom Filter-based	Scalability (# patterns): 30K (BFAST) v.s. 3K (BF-based) Simplicity (# filiters): O(n) (BFAST) v.s. $O(n^2)$ (BF-based)

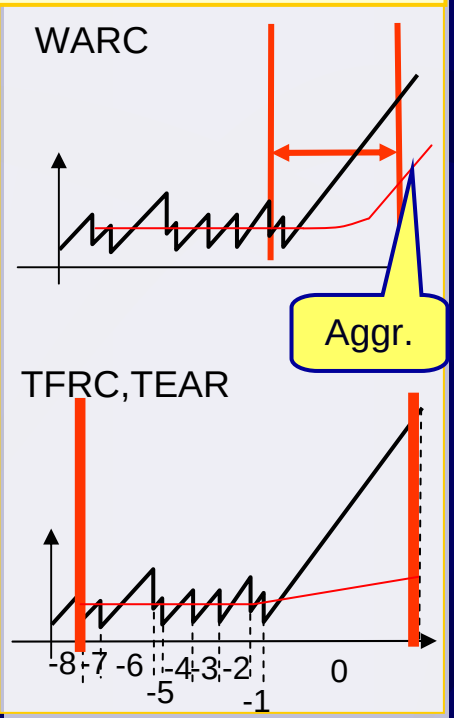
Window-Averaging Rate Control (WARC):

Best TCP-equivalence for streaming traffic

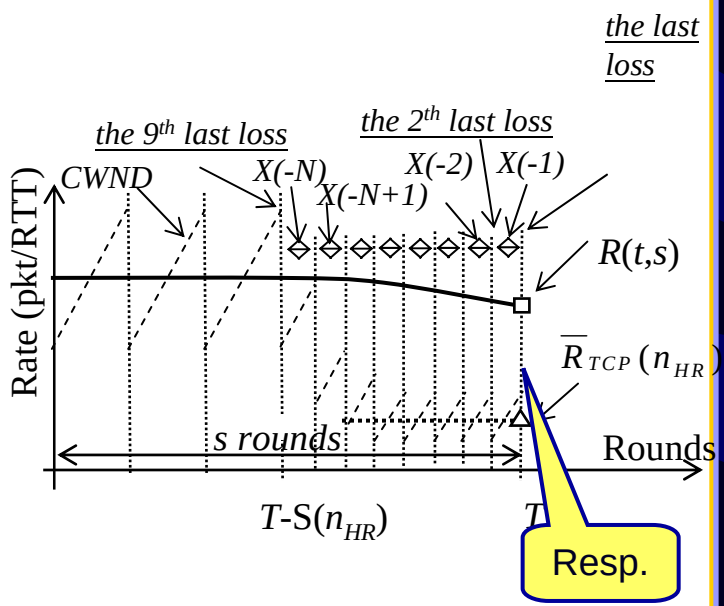
Fixed-CWNDs Real-time estimation (RTE)	- Fairness even under non-periodic losses - Smoothness and Fast aggressiveness
History-reset (HR) procedure	- Fast responsiveness after N losses
Fluid-based TO mechanism	- Fairness under heavy-losses
One-RTT reduction procedure	- Smoothness under a FIFO link

Fixed-CWNDs RTE





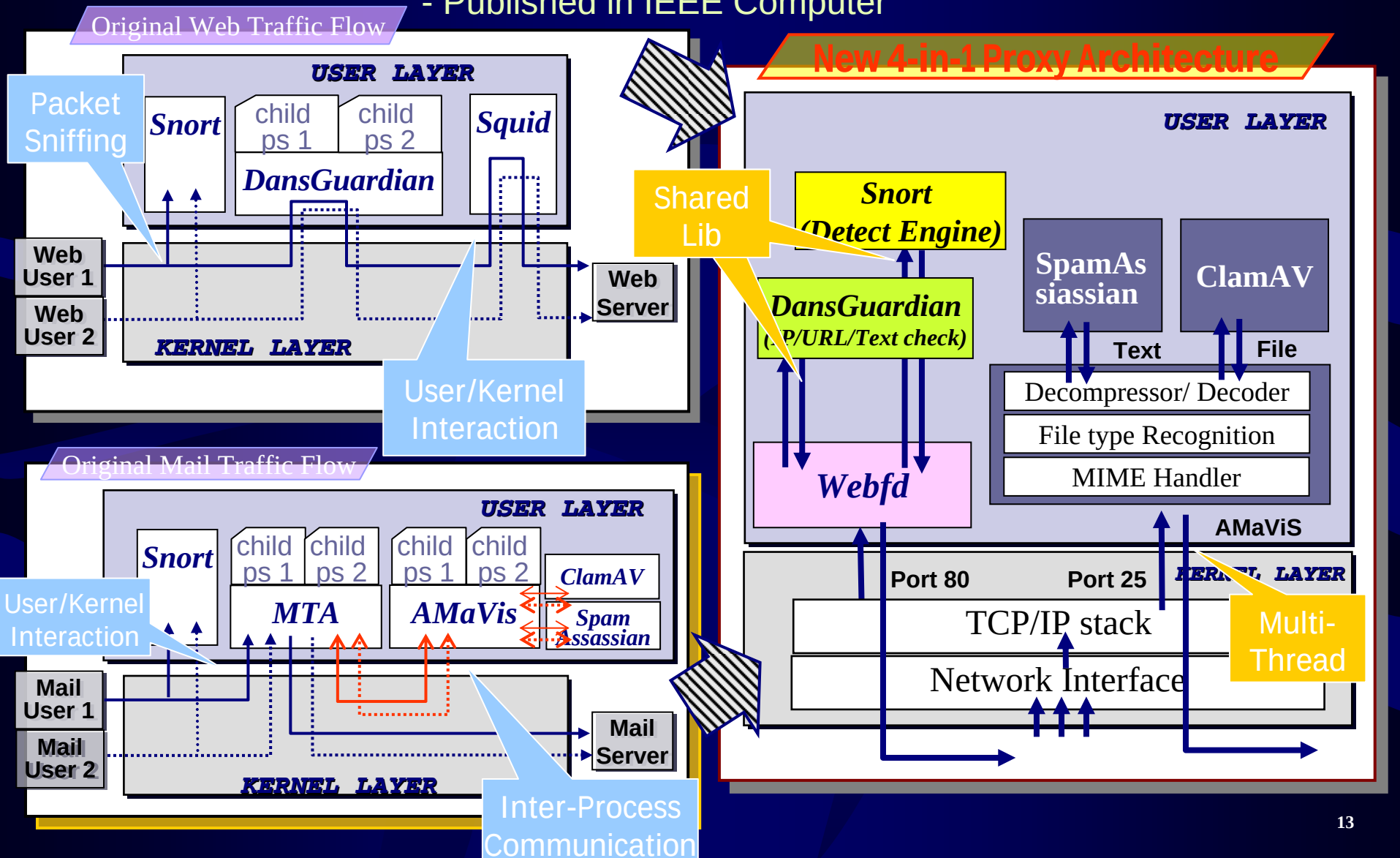
HR Procedure



4-in-1 Proxy Architecture

Improved throughput: 200% for web traffic, 500% for Mail traffic

- Reducing IPC and reusing modules
- Published in IEEE Computer



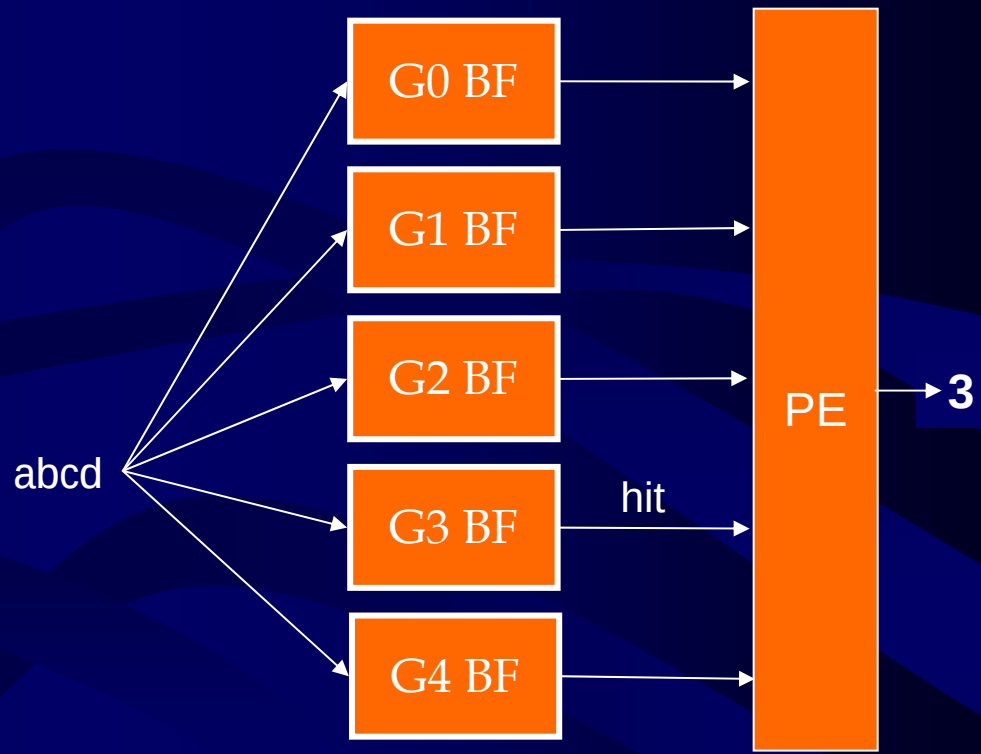
The BFAST algorithm

Most scalable hardware design for deep packet inspection

- **Pattern1: abcdefgh**
- **Pattern2: xyzabcdw**
- **Shift table**

abcd →

block	shift	block	shift
abcd	1	xyza	4
bcde	3	yzab	3
cdef	2	zabc	2
defg	1	abcd	1
efgh	0	bcdw	0
		*	5



- **False positive at a lower group: shift less**
- **False positive at a higher group : the same**

Main features:

1. sub-linear running time
2. less hardware complexity
3. high scalability

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- **Technologies and Significant Contributions**
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- 計畫整體性成果

計畫整體性成果

- 國際交流及學術合作
- 產學合作與成果推廣
- 系統整合成就
- 量化成果

整體性成果:國際交流及學術合作(1/4)

- 與 AT&T Research 技術合作，共同開發 10G Burst Mode Receiver 關鍵技術(2006/11)
- 邀請 IEEE Communication Society's Elect President- Dr. Nim Cheung 於交大作專題討論 (2006/5/31)
- 訪問 Stanford University- Prof. Leonid Kazovsky 並參觀光通訊網路實驗室(2006/6)
- 與 ANDevices光纖公司合作開發 Optical Slot Eraser 關鍵系統技術(2006/6)
- 訪問 University of California- Davis-Prof. Biswanath Mukherjee (2006/6)
- 與美國大學 University of Maryland- Prof. Ray Chen 進行光通訊技術合作

整體性成果:國際交流及學術合作(2/4)

- 參加法國坎城「European Conference on Optical Communication (ECOC2006)」發表論文，並參訪巴黎大學以及 Alcatel company光纖通訊網路實驗室（2006/9）
- 李詩偉博士（本研究團隊工研院研究人員）應邀至 APOC'06 會議發表專題演講: "A 10G QoS-Enabled Optical Packet-Switching System: Technology and Experimentation" (2006/9/5)
- 李詩偉博士應邀至 OECC'06 會議發表專題演講: "OPSINET-II: An Optical Packet-Switched IP-over-WDM Network" (2006/7/5)

整體性成果:國際交流及學術合作(3/4)

- 林盈達教授應資策會邀請專題演講 (題目：台灣往通訊產業總體檢-產品技術面) (2004/7/21)
- 林盈達教授應 Fortinet 公司邀請專題演講(題目: Trends in Network Security Product Development) (2004/8/12)
- 林盈達教授應 IFPI 倫敦總部邀請專題演講(題目: P2P Application Behaviors) (2004/9/2)
- (Industry-oriented)拜訪美國十個單位（2004/9）
  - 三個實驗室(UNH/IOL, ICSA, Veritest) ：國外測試實驗室定位
  - 三個測試設備廠商(Azimuth, IXIA, Spirent)：對測試的重視程度
  - 四個網路設備廠商(Fortinet, Cisco, Juniper, Alcatel)：市場領導廠商產品線發展
- (Academia-oriented)拜訪美國五位知名教授（2004/12）
  - ICIR的Sally Floyd : TCP-Friendly Algorithms, the future of the Internet
  - Caltech CSEE, Steven H. Low : Limit and application of Fast TCP
  - UCLA CS, Mario Gerla : Request Scheduling Algorithm
  - Berkeley EE, Kurt Keutzer : Architecture design for network processors
  - UCLA CS, Peter Reiher : Implementation over network processors

整體性成果:國際交流及學術合作(4/4)

- 二個網路晶片廠商(Cavium, Tarari) : 晶片設計規格參考 (2005/6)
- In scholar.google.com, well-cited paper:
  "Multi-hop Cellular: A new architecture for wireless communications," *Infocom 2000.*
- 拜訪法國 NSS 實驗室及 Alcatel (2006/9)
- 拜訪 Cisco 實驗室及 UC Berkeley (Vern Paxson) (2007/1)

整體性成果:產學合作與成果推廣

- **與工研院(CCL-NCTU 聯研中心)合作建構OPSINET-II及HOPSMAN光纖實驗網路**
- **IEEE Communication Society's Elect President- Dr. Nim Cheung參觀並展示研究成果 (2006/5/30-31)**
- **工研院交大網路測試中心：通訊產業推動計畫中Security, WLAN, Switch, Router, VoIP產品測試**

  合勤科技, 智邦科技, 鑫能興業, 中磊電子, 研華科技, 友旺科技, 遠訊科技, 文佳科技, 亞盛科技, 華邦電子, 菱爾發科技, 展達通訊, 岱昇科技, 星通資訊, 神腦國際, F5Alcatel, 聯合光纖, 台灣電子檢驗中心, 磐儀科技, 明泰科技, 智捷科技, Aruba, 創傑科技, 廣達電腦, 台灣固網
- **Intel: WiMax Base Station & Testing**
- **Cisco: Attack Session Extraction from Real Traffic, Cisco 補助超過10萬美元**
- 成立瑞昱交大聯合研發中心於電資大樓808, 瑞昱半導體每年出資一千萬台幣，由全職工程師與教授及研究生共同開發IEEE 802.11s turnkey solution。

整體性成果:系統整合成就

- **OPSINET-II**：建構國際第一個整合光電硬體以及GMPLS控制之全光IP-over-WDM核心網路平台雛形系統 (phase-II, 10Gbps)（楊啟瑞教授）
- **HOPSMAN** : 建構能提供triple-play之光纖都會型實驗網路（楊啟瑞教授）
- **Content-aware Security and QoS Gateway**：以掃瞄content來達到安全過濾目的十機一體閘道器(林盈達教授)
- **P2PADM** : Pear-to-Pear Administration Package (林盈達教授)
- **Stream-based Anti-Virus Mail Proxy** (林盈達教授)
- **kP2PADM**: In-kernel P2P Administration Package (林盈達教授)
- **SoC Hardware Software Co-Design for Deep Packet Inspection** (FPGA and Linux implementation on Xlinix ML310) (林盈達教授)

整體性量化成果

成果統計時間：2004/04/01～2007/01/08

期刊論文	會議論文	專利	雛型系統	研討會	競賽得獎
20 accepted 3 submitted	23	5 USA patents 7 ROC patents 9（申請中）	6	18	4

主要期刊論文發表(1/6)

Journal papers : (2004/4/1 ~ 2005/3/31)

1. **Maria C. Yuang, Po L. Tien, and J. Shih, "QoS Scheduler/Shaper for Optical Coarse Packet Switching IP-over-WDM Networks," *IEEE Journal on Selected Areas in Communications*, vol. 22, no. 9, Nov. 2004, EI., SCI..**
2. **S. W. Lee, Maria C. Yuang, Po L. Tien, and S. H. Lin, "A Lagrangean Relaxation based Approach for Routing and Wavelength Assignment in Multi-granularity Optical WDM Networks," *IEEE Journal on Selected Areas in Communications*, vol. 22, no. 9, Nov. 2004, EI., SCI..**
3. **D. Z. Hsu, S. L. Lee, P. M. Gong, Y. M. Lin, Steven S. W. Lee, and Maria C. Yuang, "High-Efficiency Wideband SOA-Based Wavelength Converters by Using Dual-Pumped Four-Wave-Mixing and an Assisted Beam," *IEEE Photonic Technology Letter*, vol. 16, no. 8, pp. 1903-1905, Aug. 2004, EI., SCI..**
4. **Jason Jyehong Chen, "Dispersion-compensating optical digital filters for 40Gb/s Metro Add-Drop Application," *IEEE Photonic Technology Letter*, vol. 16, no. 5, May 2004, EI., SCI..**

主要期刊論文發表(2/6)

Journal papers : (2004/4/1 ~ 2005/3/31)

5. **Y. Chang, Y. Lin, Jyehong Chen, and G. Lin, "all optical NRZ-to-PRZ format transformer with an injection-locked Fabry-Perot laser diode at unlasing condition," *Optics Express*., vol. 12, no. 19, Sept. 2004, SCI..**
6. **G. R. Lin, Y. C. Chang, Y. H. Lin, and J. H. Chen, "All Optical Data Format Conversion in Synchronously Modulated Single-Mode Fabry-Perot Laser Diode Using External Injection-Locking Induced Nonlinear Threshold Reduction Effect," *IEEE Photonics Technology Letter*, pp. 1307-1309, March 2005, SCI..**
7. **Huan-Yun Wei, Shih-Chiang Tsao, and Ying-Dar Lin, "Assessing and Improving TCP Rate Shaping Over Edge Gateways, " *IEEE Transactions on Computers*, vol. 53, issue 3, pp. 259-275, March 2004, EI., SCI..**

主要期刊論文發表(3/6)

Journal papers : (2005/4/1 ~ 2006/3/31)

1. **K. M Feng, M. F Huang, C. C. Wei, C. Y Lai, T. Y. Lin, J. H. Chen and S. Chi, "Metro Add/Drop Network Applications of Cascaded Dispersion-Compensated Interleaver Pairs Using a Re-circulating loop," *IEEE Photonic Technology Letter*, pp. 1349-1351, June 2005, SCI..**
2. **C.C Wei, M. F. Huang, and J. H. Chen, "Enhancing the Frequency Response of Cross Polarization Wavelength Conversion," *IEEE Photonics Technology Letter*, pp. 1683-1685, Aug. 2005, SCI..**
3. **Wei-Ren Peng, Yu-Chang Lu, Jason (Jyehong) Chen, and Sien Chi, "Encoding ASK labeled CSRZ-DPSK payload by using only one dual-drive Mach-Zehnder Modulator with enhanced label performance," *IEEE Photonics Technology Letter*, pp. 2227-2229, Oct. 2005, SCI..**
4. **Chia-Chien Wei and Jason (Jyehong) Chen, "Study of Differential Cross-Polarization Modulation in Semiconductor Optical Amplifier," *Optics Express*., vol. 13, no. 21, pp. 8442-8451, Oct. 2005, SCI..**

主要期刊論文發表(4/6)

Journal papers : (2005/4/1 ~ 2006/3/31)

5. **Yu-Chang Lu, Jason (Jyehong) Chen, Kai-Ming Feng, Pao-Chi Yeh, Tzu-Yen Huang, Wei-Ren Peng, Ming-Fang Huang, and Chia-Chien Wei, "Improved SPM Tolerance and Cost-Effective Phase-Modulation Duobinary Transmission over 230 km Standard Single-Mode Fiber Using a Single Mach-Zehnder Modulator," *IEEE Photonics Technology Lett*er, pp. 2754-2756, Dec. 2005, SCI..**
6. **Ming-Fnag Huang, Jason (Jyehong) Chen, Kai-Ming Feng, Chung-Yu Lai, Tse-Yu Lin, and Sien Chi, "210 Km Bidirectional Transmission System with a Novel Four-Port Interleaver to Facilitate Unidirectional Amplification," *IEEE Photonic Technology Letter*, pp. 172-174, Jan. 2006.**
7. **Peng-Chun Peng, Kai-Ming Feng, Ching-Cheng Chang, Hung-Yu Chiou, JyeHong Chen, Ming-Fang Huang, Hung-Chang Chien, and Sien Chi, "Multiwavelength Fiber Laser using S-band Erbium-Doped Fiber Amplifier and Semiconductor Optical Amplifier," *Optics Communications*, vol. 259, pp. 200-203, 2006.**

主要期刊論文發表(5/6)

Journal papers : (2006/4/1 ~ 2007/1/8)

1. **Maria C. Yuang, Po L. Tien, J. Shih, Steven S. W. Lee, Y. M. Lin, F. Tsai, and A. Chen, "Optical Coarse Packet-Switched IP-over-WDM Network (OPSINET): Technologies and Experiments," *IEEE Journal on Selected Areas in Communications*, vol. 24, no. 8, Aug. 2006, EI., SCI..**
2. **Pen-Chun Peng, Wei-Ren Peng, Kai-Ming Feng, Hung-Yu Chiou, Jason (Jyehong) Chen, Hao-Chung Kuo, Shing-Chung Wang and S. Chi, "OCDMA light source using directly modulated Fabry-Pe/spl acute/rot laser diode in an external injection scheme," *IEEE Photonics Technology* Letter, pp. 1103-1105, May 2006, SCI..**
3. **Po-Ching Lin, Tzu-Xiang Li, Ying-Dar Lin, and Yuan-Cheng Lai, "Profiling and Accelerating String Matching Algorithms and Applications," *IEEE Communications Surveys and Tutorials*, 2nd quarter, 2006.**
4. **Ying-Dar Lin, Szu-Hao Chen, Po-Ching Lin and Yuang-Chen Lai, "A Stream-based Mail Proxy with Interleaved Docompression and Virus Scanning," submitted to *Journal of Systems and Software*, in revision, June 2006.**

主要期刊論文發表(6/6)

Journal papers : (2006/4/1 ~ 2007/1/8)

5. **Kuo-Kun Tseng, Ying-Dar Lin, Tsern-Huei Lee, and Yuan-Cheng Lai, "A Parallel Automaton Matching with Pre-Hashing and Root-Indexing Techniques for Content Filtering Systems, " submitted to *ACM Transactions in Embedded Computing Systems*, in revision, July 2006.**
6. **Shih-Chiang Tsao, Ying-Dar Lin, Yuan-Cheng Lai, "Taxonomy and Evaluation of TCP-Friendly Rate-Control Schemes on Fairness, Aggressiveness, and Responsiveness," submitted to *IEEE Network*, in revision, Aug. 2006.**
7. **Ying-Dar Lin, Chih-Wei Jan, Po-Ching Lin, and Yuan-Cheng Lai, "Designing an Integrated Architecture for Network Content Security Gateways," *IEEE Computer*, vol. 39, issue 11, pp. 66-72, Nov. 2006.**
8. **Ying-Dar Lin, Shih-Chiang Tsao, and Un-Pio Leong, "On-the-Fly TCP Path Selection Algorithm in Access Link Load Balancing," *Computer Communications*, vol. 30, issue 2, pp. 351-357, Jan. 2007.**
9. **Yi-Neng Lin, Yaw-Chung Chang, Ying-Dar Lin, Yuan-Cheng Lai, "Resource Allocation in Network Processors for Memory Access Intensive Applications," to appear in the Journal of Systems and Software, 2007.**

主要會議論文發表(1/5)

Conference papers : (2004/4/1 ~ 2005/3/31)

1. **S. W. Lee, Maria C. Yuang, and Po L. Tien, "A Lagrangean Relaxation Approach to Dynamic Routing and Wavelength Assignment for Multi-granularity Optical WDM Networks," *IEEE GLOBECOM*, Nov. 2004, EI..**
2. **Maria C. Yuang, Po L. Tien, J. Shih, Steven S. W. Lee, Yu-Min Lin, Frank Tsai, and Alice Chen, "Optical Coarse Packet Switched IP-over-WDM Network (OPSINET): Technologies and Experiments," *IEEE/SPIE APOC*, Nov. 2004, EI..**
3. **X. Chen, W. Liu, Y. Fang, and Maria C. Yuang, "Support QoS with Location Aware Pre-Reservation in Mobile Ad Hoc Networks," *IEEE ICC*, 2004, EI..**
4. **J. Wang, H. Zhai, Y. Fang, and Maria C. Yuang, "Opportunistic Media Access Control and Rate Adaptation for Wireless Ad Hoc Networks," *IEEE ICC*, 2004, EI..**
5. **Z. Zhu, W. Chen, Y. Chen, J. Sun, D. Huang, and Jyehong Chen, "Cascaded-able Cline-reconfigurable Optical Add-drop Multiplexer," *IEEE ECOC*, 2004, EI..**

主要會議論文發表(2/5)

Conference papers : (2004/4/1 ~ 2005/3/31)

6. **Ying-Dar Lin, Shih-Chiang Tsao, and Un-Pio Leong, "On-the-Fly TCP Path Selection Algorithm in Access Link Load Balancing," *IEEE GLOBECOM*, 2004, EI..**
7. **Iwei Chen, Ying-Dar Lin, and Yineng Lin, "Tunnel Minimization and Relay for Managing Virtual Private Networks," *IEEE GLOBECOM*, 2004, EI..**
8. **Huan-Yun Wei, Shih-Chiang Tsao, Ying-Dar Lin, "On Shaping TCP Traffic at Edge Gateways," *IEEE GLOBECOM*, 2004, EI..**
9. **Yi-Neng Lin, Chiuan-Hung Lin, Ying-Dar Lin, and Yuan-Chen Lai, "VPN Gateways over Network Processors: Implementation and Evaluation," *IEEE Real-Time and Embedded Technology and Applications Symposium (RTAS'05)*, 2005, EI..**

主要會議論文發表(3/5)

Conference papers : (2005/4/1 ~ 2006/3/31)

1. **Maria C. Yuang, Po-Lung Tien, Julin Shih, Steven S. W. Lee, Yu-Min Lin, Yuan Chen, Frank Tsai, and Alice Chen, "QoS Contention Control for Optical Coarse Packet Switched IP-over-WDM Network," *IEEE ITRE'05*, June 2005, Hsinchu, Taiwan, EI..**
2. **Maria C. Yuang, Po L. Tien, J. Shih, Steven S. W. Lee, Yu-Min Lin, and Jason J. Chen, "A QoS Optical Packet-Switching System for Metro WDM Networks," *ECOC'05*, Sept. 2005, Glasgow, Scotland, EI..**
3. **Yu-Chang Lu, Jason (Jyehong) Chen, Kai-Ming Feng, Pao-Chi Yeh, Tzu-Yen Huang, Wei-Ren Peng, Ming-Fang Huang, Chia-Chien Wei, and Sien Chi, "A cost-effective phase-modulation-enhanced duobinary modulation to improved SPM tolerance using only one Mach-Zehnder modulator," *ECOC'05*, Sept. 2005, Glasgow, Scotland, EI..**
4. **Wei-Ren Peng, Yu-Chang Lu, Jason (Jyehong) Chen, and Sien Chi, "ASK/RZ-DPSK labeled signal generation using only one mach-zehnder modulator," *ECOC'05*, Sept. 2005, Glasgow, Scotland, EI..**
5. **M. F Huang, C. Y. Lai, J. H. Chen, K.M. Feng, C. C. Wee, T. Y. Lin and S. Chi, "Using a novel four-port interleaver to enable unidirectional amplification in a 210 km bidirectional transmission system," *LEOS* 2005, TuU1, Sydney, Austrialia.**

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8. **Ying-Dar Lin, Po-Ching Lin, Ming-Dao Liu, and Yuan-Cheng Lai, "An Early Decision Algorithm to Accelerate Web Content Filtering," *Intl. Conf. on Information Networking (ICOIN)*, Sendai, Japan, Jan. 2006.**
9. **Ching-Ming Tien, Cho-Jun Lee, Po-Wen Cheng, and Ying-Dar Lin, "SOAP Request Scheduling for Differentiated Quality of Services," *Web Information Systems Quality Workshop (WISQ)*, New York, Nov. 2005.**

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1. **Maria C. Yuang, Po L. Tien, J. Shih, Steven S. W. Lee, Yu-Min Lin, and Jason J. Chen, "OPSINET-II: An Optical Coarse Packet-Switched IP-over-WDM Network," *OECC'06*, July. 2006, Kaohsiung, Taiwan, EI..**
2. **Maria C. Yuang, Po L. Tien, J. Shih, Steven S. W. Lee, Yu-Min Lin, and Jason J. Chen, "A 10G QoS-Enabled Optical Packet-Switching System: Technology and Experimentation," *SPIE APOC'06*, Sept. 2006, Gwangju, Korea, EI..**
3. **Maria C. Yuang, Steven S. W. Lee, Bird C. Lo, I-Fen Chao, Yu-Min Lin, Po L. Tien, Ching-Yun Chien and Jason J. Chen, "HOPSMAN: An Experimental Optical Packet-Switched Metro WDM Ring Network with High-Performance Medium Access Control," *IEEE/OSA European Conference on Optical Communication (ECOC)*, 2006, EI..**
4. **C. T. Lin, P. C. Peng, J . H. Chen, C. F. Peng, C. C. Chiang, H. C. Kuo, S. C. Huang, and B. S. Chiou, "10 GHz Tunable Slow Light in Multi-Quantum Well Distributed Feedback Laser," *ECOC*, 2006, EI..**
5. **C. C. Wei, J. H. Chen, C. H. Fang and C. Tsao, "20 GBps (2- bit/symbol) DPSK over Inverse-RZ Modulation Format Using a Single MZM," *ECOC*, 2006, EI..**

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2. **Ying-Dar Lin, et al., “Design of scalable techniques for quality of services routing and forwarding,” USA Patent Number: 6,738,387, May 2004.**
3. **Ying-Dar Lin, et al., “Optimal contention region allocation for medium access control in multipoint-to-point networks,” USA Patent Number: 6,754,225, June 2004.**

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1. Ying-Dar Lin, et al., “Streaming-based virus scanning mechanism with on-the-fly interleaved decompression,” ROC and USA pending, 2005.
2. Ying-Dar Lin, et al., “Using dual kernel packet queues to perform content filtering on established connections at the gateway,” ROC and USA pending, 2005.

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1. Maria C. Yuang, et al., “Pdf-based Multi-user Estimator for Wireless LAN (於無線通訊網路中以機率密度函數推估行動台個數之方法),” ROC Patent No. I231721, 4/21/2005-12/3/2022
2. Maria C. Yuang, et al., “QoS-oriented Burstification Method Supporting Various Grades of Burstification Delay Guarantee (支援不同等級叢聚延遲保證之服務品質導向的叢聚方法),” ROC Patent No. I234959, 6/21/2005-9/3/2022.
3. Maria C. Yuang, et al., “Hexanary-Feedback Contention Access for Wireless Local and Access Networks (無線通訊網路之6回饋競入存取方法),” ROC Patent No. I242993, 11/01/2005-12/11/2022.
4. Maria C. Yuang, et al., “QoS-enabled Contention Control System for Wireless Local and Access Networks (無線區域網路上具服務品質保證之競入控制方法與系統),” ROC Patent No. I263427, 10/01/2006-12/24/2023.
5. Maria C. Yuang, et al., “Stepwise Quality-of-Service Scheduling Method in Output-Buffered Switches for Broadband Networks,” received the notice of allowance from USA Patent Office, 2007.

專利申請及獲得(4/4)

專利申請及獲得 (2006/4/1 ~ 2007/1/8)

6. Ying-Dar Lin, et al., “Early Blocking and Bypassing for Accelerating Web Content Filtering,” USA Patent No. 7,082,429 & ROC Patent No. 200515201.
7. Ying-Dar Lin, et al., “Request scheduling for differentiated QoS at access gateway,” ROC Patent No. I269562, 2006.
8. Ying-Dar Lin, et al., “Method of Request Scheduling for Differentiated Quality of Service at Intermediaries,” ROC Patent No. I257216 and USA pending No. 11/222,770 , 2006.
9. Ying-Dar Lin, et al., “Integrating and Accelerating Content Classification and Management at P2P Gateways,” ROC and USA pending.
10. Ying-Dar Lin, et al., “A Hardware Accelerator Using Bloom Filters to Realize a Sub-linear Time String-matching Algorithm,” ROC and USA pending.

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1. OPSINET-II: Optical Packet Switched IP-over-WDM Network (10 Gbps) (楊啟瑞教授)
2. HOPSMAN: High-performance Optical Packet Switching for Metro Area Networks (楊啟瑞教授)
3. P2PADM: P2P及Instant Message管理（軟體套件）(林盈達教授)
4. Stream-based Anti-Virus Mail Proxy (軟體套件) (林盈達教授)
5. kP2PADM: In-kernel P2P Administration Package (軟體套件)(林盈達教授)
6. SoC Hardware Software Co-Design for Deep Packet Inspection (FPGA and Linux implementation on Xlinix ML310) (林盈達教授)

Conferences (會議舉辦) (1/3)

Conferences (2004/4/1 ~ 2005/3/31)

1. **2004/07/09-12 – Dr. Tingye Li, U.S. National Academy of Engineering and WDM Founder**

   Topic：WDM Technologies in Optical Networks
   (Participants：30) (Maria C. Yuang)

2. **2004/10/11-13 – Seminar, Prof. Biswanath Mukherjee, UC Davis**

   Topic：Optical Access Networks / Resilient Mesh Networks / Traffic Grooming in Mesh Optical Networks
   (Participants：40) (Maria C. Yuang)

3. **2004/07/16 – WLAN SOHO Router Benchmarking Workshop**
   (Participants：75) (Ying-Dar Lin)

4. **2004/08/26 – Networking Test Technique Workshop**
   (Participants：115) (Ying-Dar Lin)

5. **2004/12/6~10 – Asia-DSL Plugfest and Forum**
   (Participants：140) (Ying-Dar Lin)

6. **2005/01/27 – Security Products Benchmarking Workshop**
   (Participants：90) (Ying-Dar Lin)

7. **2005/03/22 – 第一次NBL SIG座談會 (Participants：32) (Ying-Dar Lin)**

Conferences(會議舉辦) (2/3)

Conference (2005/4/1 ~ 2006/3/31)

1. **2005/08/03 – IEEE Communication Society's Elect President, Dr. Nim Cheung Topice：Technology and Architecture Trends in Optical Networking (Participants：30) (Maria C. Yuang)**
2. **2005/04/13 – VoIP Plugfest and IOT Lab development panel (Participants：16) (Ying-Dar Lin)**
3. **2005/06/20-24 – VoIP Plugfest and Testing workshop (Participants：125) (Ying-Dar Lin)**
4. **2005/07/27 – VoWLAN performance testing workshop (Participants：52) (Ying-Dar Lin)**
5. **2005/10/06 – Layer 2/3 New Switch testing Spec. and benchmarking workshop (Participants：54) (Ying-Dar Lin)**
6. **2006/01/25 – NBL Workshop on Voice over WLAN Public Benchmarking and Technology Developing (Participants：50) (Ying-Dar Lin)**
7. **2006/03/08 – Switch New Spec. and Benchmarking workshop (Participants：45) (Ying-Dar Lin)**

Conferences(會議舉辦) (3/3)

Conference (2006/4/1 ~ 2007/1/8)

1. **2006/4/11 如何確保10G網路的運作與效能研討會 (58人)**
2. **2006/5/18 網路技術與測試 (Triple Play／路由交換器／網路安全應用)研討會 (223人)**
3. **2006/7/26 Mimo及VoWifi測試技術研討會 (124人)**
4. **2006/8/24 IPS產品公開測試暨網安技術研討會 (55人)**

Contest (競賽得獎)

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3. 工研院-2005年成果貢獻獎-佳作獎:寬頻暨無線通訊產業發展推動計畫
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