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

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後卓越計畫第四年度經費執行狀況

2007/04/01-2007/10/12

	核定金額	實支數	餘額	執行率
業務費	5,881,100	1,968,842	3,912,258	33.48%
研究設備費	2,532,182	669,255	1,862,927	26.42%
國外差旅費	440,000	0	440,000	0%
管理費	683,718	683,718	0	100%
合計	9,537,000	3,321,815	6,215,185	34.83%

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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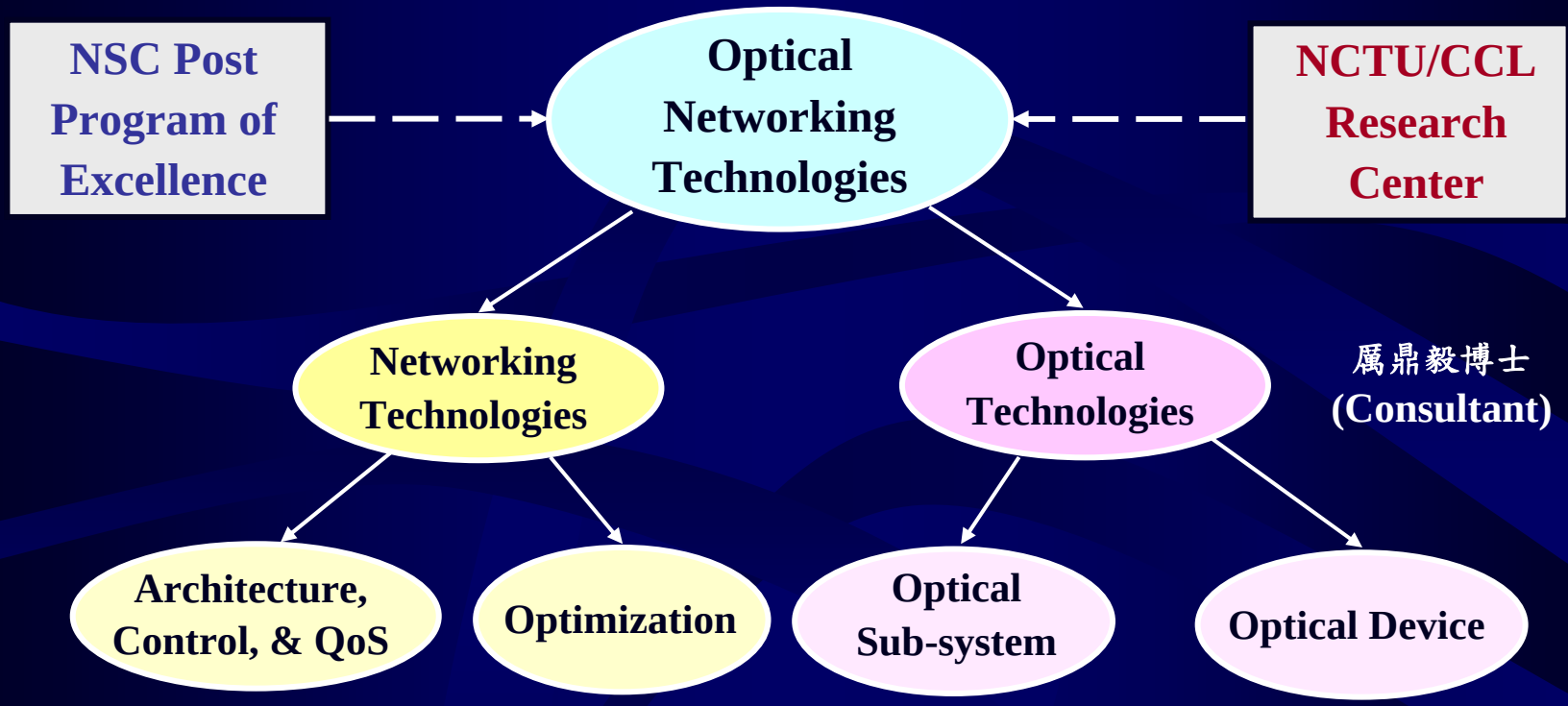
Part I:

Optical Networking Technologies

Project at a Glance



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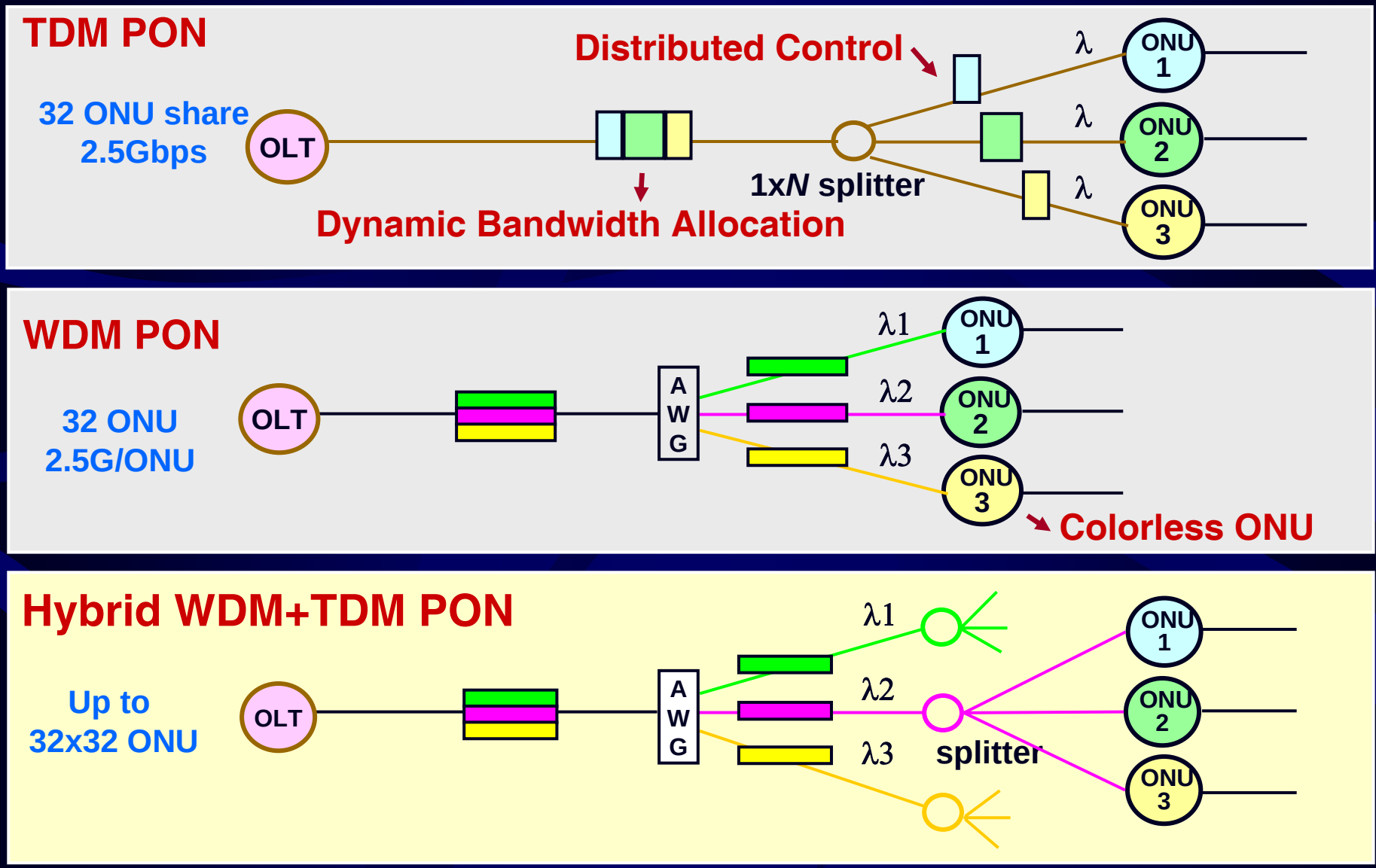
Road Map and Breakthrough

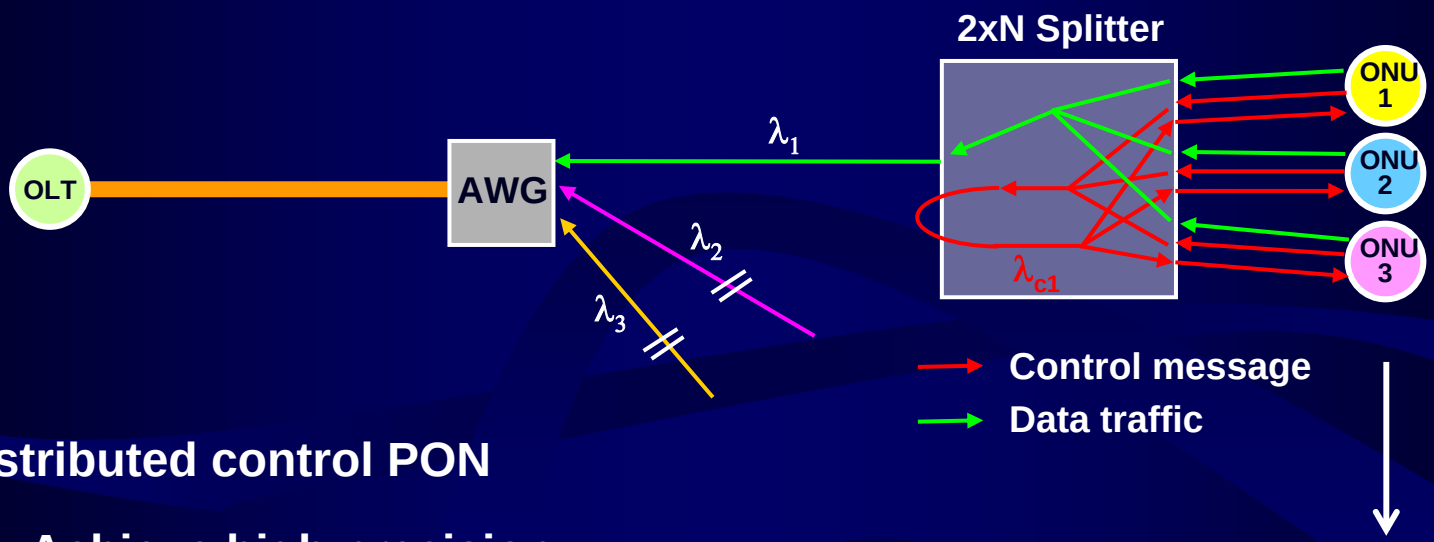
	2000~2004	*2005~2006*	*2007~2008*
Optical Network Testbed	Optical Packet Switched IP-over-WDM Network (OPSINET, OPSINET-II/10G)	High-Performance Optical Packet Switched Metro Area Network (HOPSMAN)	Distributed-control Hybrid Passive Optical Network (DHPON)
Techno-logy	OCPS, QOPS	HOPSMAN MAC and Optical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

Technology	*State-of-the-art*	*Breakthroughs*
Distributed Hybrid Passive Optical Network	Centralized Control TDM-PON, WDM-PON	DHPON v.s. Centralized Control TDM-PON • 32x32 ONUs v.s. 32 ONUs • Precision v.s. out-of-date bandwidth allocation DHPON v.s. WDM-PON • 32x32 ONUs v.s. 32 ONUs • Wavelength sharing v.s. no sharing

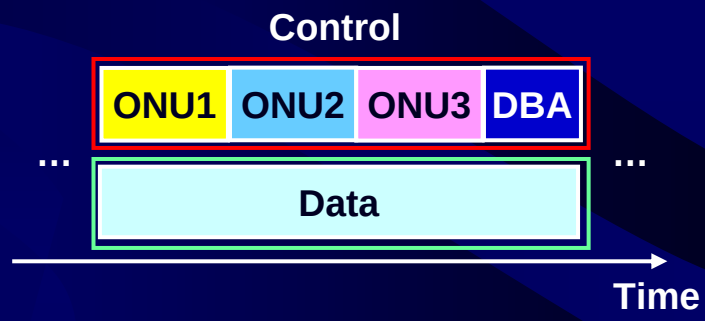
Distributed Hybrid Passive Optical Network Architecture



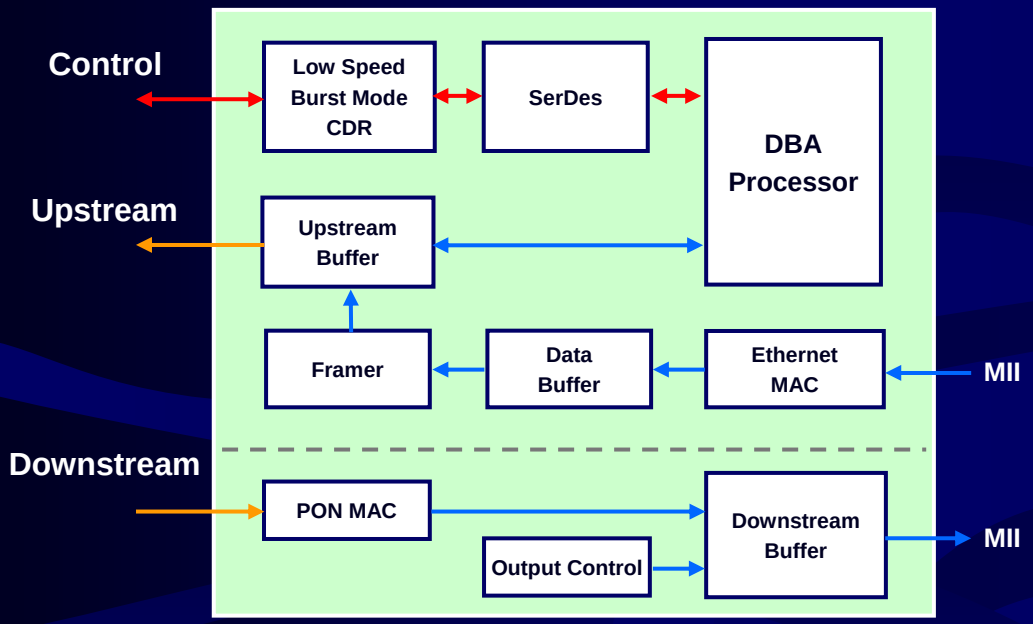
Distributed Control DBA Algorithm

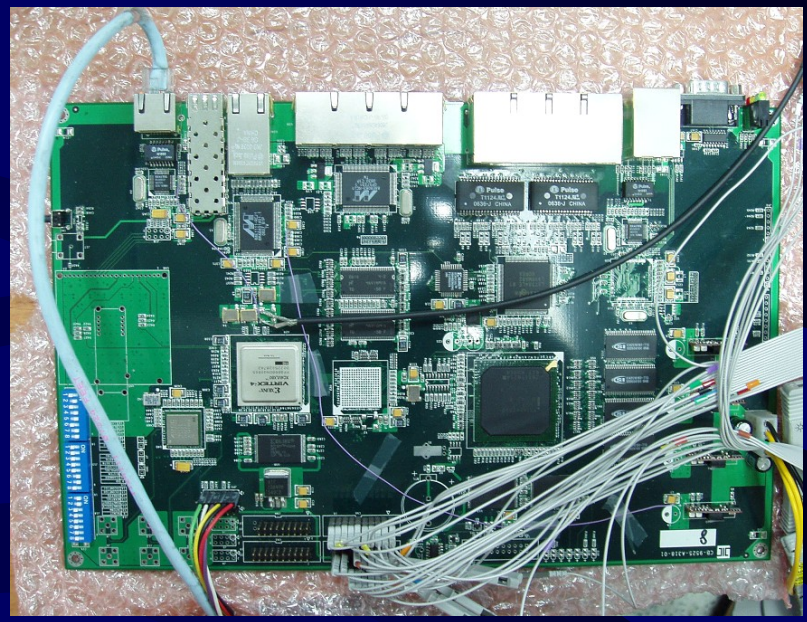


- Distributed control PON
  - Achieve high precision
- Dynamic bandwidth allocation
  - Satisfy different “fairness criteria” for different data services to support triple play



DHPON Testbed: Optical Network Unit





- Individual distributed control module
- A testbed prototype with 4 ONUs and 1 OLT
  - High data rate: 1.25Gbps
  - Low cost control: 125Mbps Burst Mode CDR

Part II:

Broadband QoS Technologies

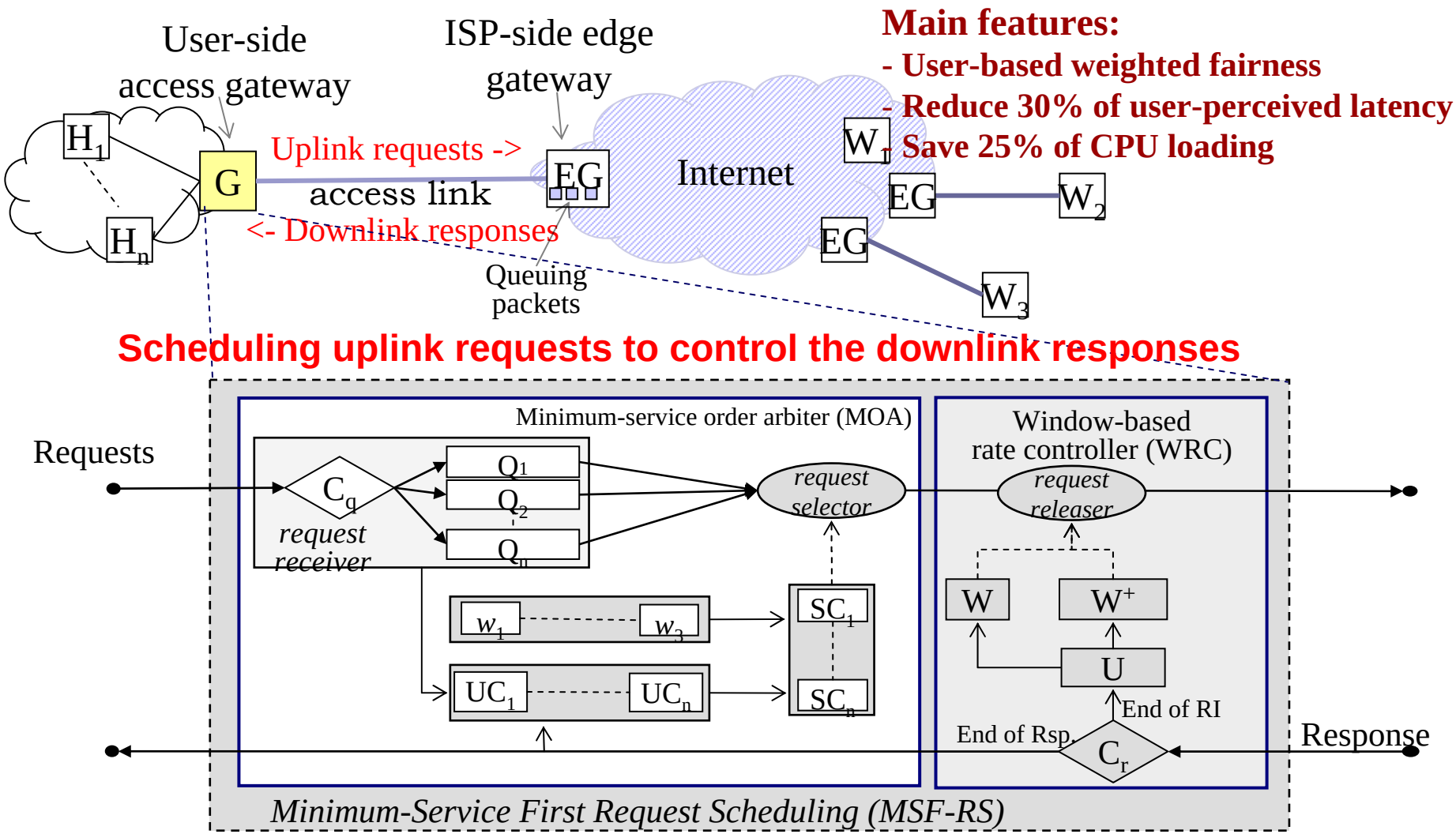
Road Map and Breakthrough

	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)

Private Fairness: Minimum-Service First Request Scheduling

Solve the dilemma of packet scheduling which fails to allocate downlink bandwidth at G meanwhile it cannot classify packets at EG



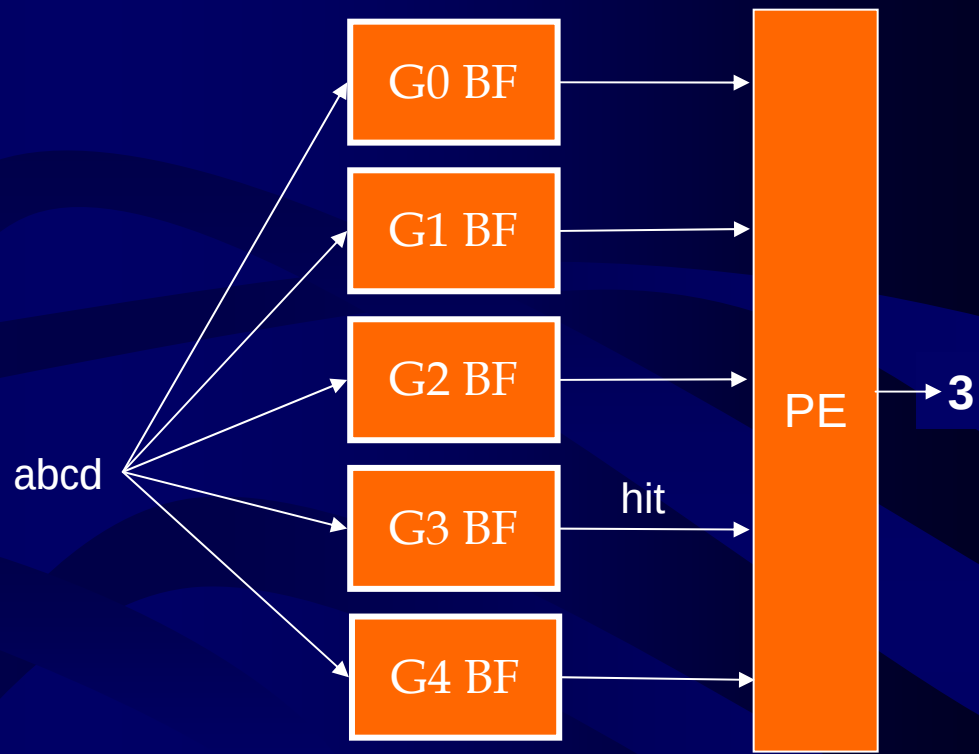
Hardware acceleretor: the BFAST algorithm

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

Outline

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

- 楊啟瑞教授將應邀至APOC'07會議發表專題演講: "Technology and Experimentation of A High-performance Optical Packet-Switched Metro WDM Network "(2007/11)
- 訪問美國Dr. Nim K. Cheung和Stanford University Prof. Leonid Kazovsky進行相互交流，並且拜訪 Opvista光纖通信網路公司 (2007/08)
- 訪問美國Stanford University Prof. Leonid Kazovsky 商討合作計畫，並且參訪美國ANDevices光纖公司 (2007/05)
- 林盈達教授：In scholar.google.com, well-cited paper over 275 citations (2007/10) “Multi-hop Cellular: A new architecture for wireless communications,” Infocom 2000.

整體性成果:產學合作與成果推廣(1/2)

- 與工研院(CCL-NCTU 聯研中心)合作建構OPSINET-II及HOPSMAN光纖實驗網路
- 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:產學合作與成果推廣(2/2)

- 2007年8月成立D-link/NCTU聯合研發中心，循瑞昱交大中心相同的運作方式。主題為D-link 2.0 (Web2.0, Device 2.0, Network 2.0, Service 2.0) technologies.
- 林盈達教授目前Sabbatical於Cisco, San Jose之訪問學者, 深化雙方合作

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：2007/04/01～2007/10/12

期刊論文	會議論文	專利	雛型系統	研討會	競賽得獎
12	6	USA patents 2 ROC patents 5 申請中 6	6	4	3

主要期刊論文發表(1/3)

Journal papers : (2007/4/1 ~ 2007/10/12)

1. **Ming Fang Huang, Jason (Jyehong) Chen, Jianjun Yu, Sien Chi, and Gee-Kung Chang, "A Novel Dispersion-free Interleaver for Bi-directional DWDM Transmission Systems," to appear in *Journal Lightwave Technology*, 2007.**
2. **Peng-Chun Peng, Kai-Ming Feng, Hung-Yu Chiou, Wei-Ren Peng, Jason (Jyehong) Chen, Hao-Chung Kuo, Shing-Chung Wang, and Sien Chi, "Reliable architecture for high-capacity fiber-radio systems," *Optical Fiber Technology*, vol. 13, pp. 236-239, 2007.**
3. **Yu Chang Lu, Chia Chien Wei, Jason (Jyehong) Chen, Kai Ming Feng, Pao Chi Yeh, Tzu Yen Huang, Ching Cheng Chang, Cheng Tsao, and Sien Chi, "Effects of filter bandwidth and driving voltage on optical duobinary transmission systems," *Optical Fiber Technology*, vol. 13, pp. 231-235, 2007.**
4. **C. C. Wei and Jason (Jyehong) Chen, "Convergence of phase fluctuation induced by intrachannel four-wave mixing in differential phase-shift keying transmission systems via phase fluctuation averaging," *Optics Lett.*, no. 10, pp. 1217-1219, May, 2007.**
5. **C. T. Lin, Jason (Jyehong) Chen, P. Peng, C. Peng, W. Peng, B. Chiou, and S. Chi, "Hybrid optical access network integrating fiber-to-the home and radio-over-fiber systems," *IEEE Photon. Technol. Lett.*, vol. 19, pp. 610-612, Apr., 2007.**

主要期刊論文發表(2/3)

Journal papers : (2007/4/1 ~ 2007/10/12)

6. **Ying-Dar Lin, Kuo-Kun Tseng, Tseng-Huei Lee, Chen-Chou Hung, and Yuan-Cheng Lai, "A Platform-Based SoC Design and Implementation of Scalable Automaton Matching for Deep Packet Inspection," to appear in *Journal of System Architecture*, EI., SCI..**
7. **Huan-Yun Wei, Ching-Chuan Chiang, and Ying-Dar Lin, "Co-DRR: An Integrated Uplink and Downlink Scheduler for Bandwidth Management over Wireless LANs," to appear in *IEICE Transactions on Communications*, EI., SCI..**
8. **Yi-Neng Lin, Yao-Chung Chang, Ying-Dar Lin, and Yuan-Cheng Lai, "Resource Allocation in Network Processors for Memory Access Intensive Applications," to appear in *Journal of Systems and Software*, EI., SCI..**
9. **Kuo-Kun Tseng, Ying-Dar Lin, Tsern-Huei Lee, and Yuan-Cheng Lai, "A Fast Scalable Automaton Matching Accelerator for Embedded Content Processors," to appear in *ACM Transactions in Embedded Computing Systems*.**

主要期刊論文發表(3/3)

Journal papers : (2007/4/1 ~ 2007/10/12)

10. **Shih-Chiang Tsao, Ying-Dar Lin, and Yuan-Cheng Lai, "Taxonomy and Evaluation of TCP-Friendly Rate-Control Schemes on Fairness, Aggressiveness, and Responsiveness," to appear in *IEEE Network*, EI., SCI..**
11. **Po-Ching Lin, Ming-Dao Liu, Ying-Dar Lin, Yuan-Cheng Lai, "An Early Decision Algorithm to Accelerate Web Content Filtering," to appear in *IEICE Trans. Information and Systems*, SCI..**
12. **Chi-Heng Chou, Tsung-Hsien Yang, Shih-Chiang Tsao, and Ying-Dar Lin, "Standard Operating Procedures for Embedded Linux Systems," Linux Journal, Issue 160, pp. 88-92, Aug 2007.**

主要會議論文發表(1/2)

Conference papers : (2007/4/1 ~ 2007/10/12)

1. **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, "A High-Performance Optical Packet-Switched Metro WDM Ring Network- Technology and Experimentation," *Asia-Pacific Optical Communications (APOC)*, invited talk, Nov. 2007, EI..**
2. **Maria C. Yuang, Ya-Shian Wang, and Yu-Min Lin, "VMAPS: a ersatile Medium Access Control and Processing System for an Optical WDM Metro Ring Network," *IEEE/OSA European Conference on Optical Communication (ECOC)*, Sept. 2007. EI..**
3. **Chun-Ting Lin, Cheng-Feng Peng, Jyehong Chen, Peng-Chun Peng, Wei-Ren Peng, Bi-Shiou Chiou, and Sien Chi, "Hybrid optical access network integrating baseband and radio signals transmitted on a single wavelength," *CLEO/QELS 2007*, paper CFP4, Baltimore, U.S.A.**
4. **Ming Fang Huang, Jianjun Yu, Gee-Kung Chang, Jason (Jyehong) Chen, and Sien Chi, "bi-directional DPSK transmission over 230-km SSMF employing innovative Bi-directional amplification," *CLEO/QELS 2007*, paper CMH3, Baltimore, U.S.A.**
5. **C. C. Wei and Jason (Jyehong) Chen, "Supression of phase noise induced by intrachannel four-wave mixing using phase noise averagers," *CLEO/QELS 2007*, paper JTuA134, Baltimore, U.S.A.**

主要會議論文發表(2/2)

Conference papers : (2007/4/1 ~ 2007/10/12)

6. **Ying-Dar Lin, Kuo-Kun Tseng, Chen-Chou Hung and Yuan-Cheng Lai, Scalable Automaton Matching for High-Speed Deep Content Inspection, *IEEE AINA*, Niagara Falls, Canada, May 2007.**

專利申請及獲得(1/2)

專利申請及獲得

1. **Maria C. Yuang, et al., “Pdf-based Multi-user Estimator for Wireless LAN,” ROC Patent No. I231721.**
2. **Maria C. Yuang, et al., “QoS-oriented Burstification Method Supporting Various Grades of Burstification Delay Guarantee,” ROC Patent No. I234959.**
3. **Maria C. Yuang, et al., “Hexanary-Feedback Contention Access for Wireless Local and Access Networks,” ROC Patent No. I242993.**
4. **Maria C. Yuang, et al., “QoS-enabled Contention Control System for Wireless Local and Access Networks,” ROC Patent No. I263427.**
5. **Maria C. Yuang, et al., “Stepwise Quality-of-Service Scheduling Method in Output-Buffered Switches for Broadband Networks,” US Patent No. 7,164,686.**

專利申請及獲得(2/2)

專利申請及獲得

6. **Method and Apparatus For Scheduling For Packet-Switched Networks, Shih-Chiang Tsao, Ying-Dar Lin, Hai-Yang Huang, Jun-Yi Tsai, US patent number: 7236491, Jun. 2007.**
7. **System and method for providing differentiated service by using category/resource scheduling, Ying-Dar Lin, Ruo-Hua Feng, Ching-Ming Tien, Yuan-Chen Lai, Cho-Jun Lee, Po-Wen Cheng, Taiwan patent number: I276322, US patent pending number: 20070061464.**
8. **Integrating and Accelerating Content Classification and Management at P2P Gateways , Ying-Dar Lin, Po-Ching Lin, Meng-Fu Tsai, Tsao-Jiang Chang and Yuan-Cheng Lai, Taiwan and US patent applications.**
9 **A hardware accelerator using Bloom filters to realize a sub-linear time string-matching algorithm, Po-Ching Lin, Ying-Dar Lin, Yi-Chun Zheng, Taiwan and US patent applications.**
10. **Latency and Modulation Aware Dynamic Bandwidth Allocation Algorithm in Wireless Broadband Base Stations, Ying-Dar Lin, Yi-Neng Lin, Che-Wen Wu, and Yuan-Cheng Lai, Taiwan patent application, Approved by NCTU.**

雛型系統

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)

Conference (2007/4/1 ~ 2007/10/12)

1. **2007/4/27網路測試技術研討會 (30家廠商, 110人)**
2. **2007/5/23活動：NBL-NCTU Beta Site Testing說明會 (112人)**
3. **2007/7/24 Wireless SIP家用閘道器測試活動研討會 (75人)**
4. **2007/7/1-2007/7/20 Wireless SIP 家用閘道器公開測試活動，本次接受邀約參加測試廠商共有六家，分別是Billion, CyberTan, D-Link, SMC, Soundwin以及ZyXEL。**

Contest (競賽得獎)

1. Hardware Software Co-Design for Deep Packet Inspection with Sublinear –Time String Matching, 教育部95學年度大學院校前瞻晶體系統設計：嵌入式軟體(ESW)製作競賽軟硬體整合組 佳作, 2007/7/11.
2. 第三屆（2007)全國華陀盃網路解或技能大賽」冠軍, 獎金NT15,000元, 2007/8/17.
3. Linux黃金企鵝貢獻獎 from 台北市電腦工會 in August 2007.