



# *COMP9332*

## *Network Routing & Switching*

### *Introduction*

<http://www.cse.unsw.edu.au/~cs9332/>

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## *Lecture Overview*

- ✓ Course management
- Motivation
- Course content and roadmap

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## Teaching Team

### ■ Lecturers

- A/Prof. Wen Hu ([www.cse.unsw.edu.au/~wenh](http://www.cse.unsw.edu.au/~wenh))
  - » [wen.hu@unsw.edu.au](mailto:wen.hu@unsw.edu.au)
- Dr. Amir Hoseini (Amir)
  - » [s.a.hoseini@unsw.edu.au](mailto:s.a.hoseini@unsw.edu.au)

### ■ Tutor

- Xiaowei Zhou
  - » [xiaowei.zhou@student.unsw.edu.au](mailto:xiaowei.zhou@student.unsw.edu.au)

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## Teaching support

- 2 x 2 hour lecture per week (W1-W9)
  - Note that Monday, Week 2 (10 June) is a public holiday
- 2 x 2 hours laboratory/tutorial per week (W3-W9)
- Self-assessed homework (W1-W9)
  - No submission, no formal grading
- 1-hour consultation per week (optional)
  - Weeks 2-9
  - one-to-one interaction on FCFS basis
  - More hours will be added if needed
- Course portal
  - <http://www.cse.unsw.edu.au/~cs9332/>

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## *Pre-requisite*

- COMP9331 / 3331
- Or other introductory networking courses
- Some basic programming knowledge (needed for assignment)

## *Learning objectives*

- Objective 1: Gain good understanding of the role of routing and switching in modern communication networks (lectures+mid-test+exam)

## *Learning objectives (cont'd)*

- Objective 2: Learn generic architectures, protocols, and algorithms for routing and switching (lectures, mid-test, exam);
  - More emphasis on fundamentals
  - No vendor-specific training

## *Learning objectives (cont'd)*

- Objective 3: Learn how to configure, tune, and analyse the performance of popular routing protocols (labs);
- Objective 4: Develop abilities to design routing solutions for new networking requirements (assignment).

## Reference Books

- No prescribed text, but few references
- IBM Redbook (freely available from course portal)
- **Forouzan**: TCP/IP Protocol Suite, McGraw Hill, 3rd Edition, 2003.
- **Kurose and Ross**: Computer Networking, Addison-Wesley
- **Comer**: TCP/IP Principles, protocols and architectures, Prentice Hall, 2000
- **GBC**: P. Goransson, C. Black, and T. Culver. (2017) Software Defined Networks: A Comprehensive Approach,(2nd Edition). Morgan Kaufmann.

## Additional Reading

- Electronic copies on the course website
  - white papers
  - Magazine/journal articles
  - Standard documents (eg IETF RFCs)
- "May be" specific pages from reference or other books

## Assessment

- Mid-Session Test (closed book, MCQ): 15%
  - Monday Week 6 (8 July) in the lecture
  - Negative marking (penalty for incorrect guessing)
- Assignment (due week 10): 25%
- Lab test (week 8): 10%
- Final Exam (open book): 50%
  - You need to understand the subject matter!
  - You need to demonstrate thinking ability

## Final Grade

- To pass the course, you must get
  - at least 40% in the final exam, and
  - a overall 50% (mid-sess test+lab test+assgn+exam)
- If you get less than 40% in the Final Exam (i.e. you fail), maximum 40% will be reported as your overall course mark

## *Special Consideration*

- Must submit fully documented application
- Application does not guarantee a favourable consideration
- Each application is scrutinised thoroughly and your past performance is also considered
- Common flu, sore throat etc. are not considered

## *Supplementary Examination*

- Only available for Final Exam under exceptional cases
  - cold, flu, immigration, travel, job etc not considered
  - You need to have consistence good grades in midterm, lab test, and assignment
  - no supplementary if you attend and fail the final exam (i.e., no 2<sup>nd</sup> chance, sorry!)
- No supplementary for mid-term and lab test

## *Feedback to students*

- Regular feedback throughout the session
  - Weekly homework (self assessment) and mid lecture Quiz
  - Week 8 - Mid-session test results
  - Week 9 - Lab test results
  - Week 10/11 - Assignment results are out
  - Further one-to-one feedback possible during consultation hours

## *Lecture Overview*

- Important course information
  - ✓ Motivation
  - Course content and roadmap
    - What is this course about?
    - How is this course put together?



## Routing Market is Strong and Profitable

- Router giants recorded large revenue growth in recent years
- Smaller competitors are benefiting too
- Investments are being shifted from *software* and *chips* to *networking*
- These investments are expected to drive new jobs in networking in the coming years

### CISCO 2017 Report

Net Income: Increase of 40% in 4 years

|            | 2016           | 2011          |
|------------|----------------|---------------|
| Net Income | \$10.7 billion | \$6.5 billion |

<http://www.marketwatch.com/investing/stock/cisco/financials>

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## Driving Factors

- Internet traffic is doubling since 2002
  - Annual IP traffic will surpass 3.3 zettabyte 2021
- Technology convergence to IP (VoIP, IPTV, Internet of Things/IoT)
  - Music/video streaming (e.g., Spotify, Apple Music)
  - Video will represent 80% of all IP traffic.
- 27 billion connected devices by 2021
  - Half of those (13.7 billion) are IoT devices.



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## *Challenges and Opportunities*

- **Scalability**
  - BGP routing tabling are ballooning fast
  - Design better products and protocols
- **Reliability**
  - Critical businesses now rely on IP networks
  - Design better products and protocols
- **Integration of new services (e.g. VoIP)**
  - Quality of service
  - Design new protocols

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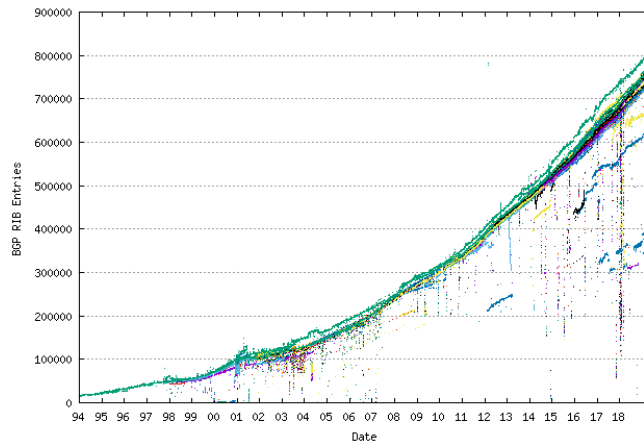
## *The BGP Scalability Problem*

- It is quite serious
- Thousands of devices connected everyday
- Routers need GB memory
- Too many updates
  - Processors will crash
- Multi-homing is a problem
  - one network needs multiple BGP entries

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## BGP Table Growth 1994 to Present (bgp.potaroo.net)



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## New Routing Products



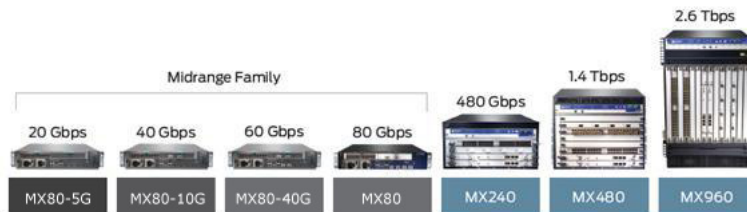
CRS-1 (CISCO carrier router)



Cisco optical switch



Cisco mobile router



Juniper MX Series Routers

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## *So many different types of routers (taken from Cisco products page)*

- Application optimisation
- Branch routers
- Cloud routers
- Data centre interconnect platforms
- Internet routers
- Mobile Internet routers
- Service provider core routers
- Service provider edge routers
- Small business routers
- Virtual routers
- WAN aggregation and Internet edge routers
- WiFi routers

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## Course map



- **Foundation and knowledge refreshment (wks 1-2)**
  - IP Addressing
  - Network Address Translation (NAT)
  - IPv6 basics
- **Routing protocols for wired Internet (wks 3-5)**
  - RIP, BGP, OSPF
- **Advanced routing and switching (wks 6-9)**
  - software defined networking, VPN, Multicast, routing for mobile adhoc networking, geographic Routing, DTN...