Arquitetura da Internet

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I. Objetivos

Este curso é sobre a arquitetura da Internet, uma das invenções mais significativas dos últimos 30 anos e de claro impacto na sociedade. O sucesso da Internet é devido em parte à sua arquitetura, que inclui soluções para problemas complexos de escalabilidade, desempenho, gerência, robustez e custo. Este curso irá cobrir teoria, heurísticas, algoritmos e técnicas utilizadas em várias soluções empregadas na arquitetura da Internet. O conteúdo do curso tem utilidade direta para auxiliar no desenvolvimento de aplicações, operação, gerência e resolução de problemas de rede.

II. Dinâmica e Avaliação

As aulas serão como um *workshop* de discussão. Cada semana terá uma lista de artigos para leitura. O professor irá fazer uma apresentação dos trabalhos em discussão.

A avaliação considerará aspectos como a qualidade de resenhas escritas pelos alunos sobre os artigos discutidos. Os alunos irão apresentar seminários sobre tópicos relacionados à disciplina; a qualidade dos seminários também será considerada na avaliação. Uma prova e participação nas discussões também estão entre as atividades avaliativas. Outras atividades avaliativas incluem trabalhos práticos e projetos orientados.

A. Prerequisitos

O aluno deve ter cursado Redes de Computadores (DCC023) ou disciplina equivalente; em particular o aluno deve conhecer os concentos fundamentais dos protocolos IP, UDP, UDP, DNS e protocolos de roteamento.

III. Programa

Textbooks. We will use Peterson and Davie as textbook for background information on routing and transport protocols [1], as well as other more specific references as shown below.

Design Principles. Internet architecture principles [2], [3], the end-to-end argument [4], [5], provider competition and its impact on the Internet's architecture [6], naming and binding [7]–[9].

Internet Autonomous Systems. Inter-domain routing relationships [10]–[12], routing granularity [13], AS-level topology properties [14], AS-level topology evolution [15], AS-level topology modeling [16].

Internet Exchange Points. Infrastructure [17], [18], impact [19], [20], mapping [21], software-defined traffic engineering [22], [23].

Unicast Routing. Intradomain distance vector and link-state routing; BGP [24].[1] Mechanisms and practices: Layer-2 switching [25], [26], route redistribution [27], intradomain route dissemination [28] hot-potato routing [29]. Properties and consequences: routing convergence [30], [31], routing stability and oscillation [32], path inflation [33], [34], synchronization problems [35], routing outages and causes [36]. Routing Control [37]–[39], software routing [40], [41], policies and composition [42].

Tunneling and VPNs. MPLS [43], [44], VPN label distribution [45], [46].

Internet Hardware. High-speed switching and routing [47]–[49], optical switching [50], programmable routers [51], [52], software routing [53].

Content Distribution. Distributed content delivery [54], [55], request routing [56], [57], traffic engineering [58]–[60], cost- and application-aware bandwidth allocation [61]–[63].

Transport and Congestion Control. Reliable end-to-end transmission and flow control [5], congestion avoidance and control [64]–[71], TCP throughput [72], and transport on low-latency high-throughput datacenter networks [73].

[1] BGP tutorials can be found at: http://www.academ.com/nanog/feb1997/BGPTutorial/ and http://www.ittc.ku.edu/EECS/EECS_800.ira/bgp_tutorial/.

Queue Management. Router buffer sizing [74], random early detection [75], fair queueing [76], [77], queueing delay [78], explicit congestion notification [79], and differentiated services [80], [81].

Multicast and Applications. Multicast routing [82]–[84], application-layer multicast [85], erasure codes and file distribution [86], and on-demand streaming [87].

Network Measurement and Characterization. Network characterization with network support [88], [89]. Measurement methodology [90], reverse engineering [91]. Topology mapping [21], [92]–[95], IP aliasing [96], performance measurements [97], [98], broadband measurements [99], [100], traffic characterization [101], [102], anomaly detection [103]–[105].

Overlay Networks. Overlay networks [106], distributed hash tables [107]–[109], P2P content distribution and incentives [110], [111], content distribution networks [112].

Security and Privacy. Denial-of-service attacks [113], botnets [114], [115], onion routing [116], [117], ethics [118], differentially-private analysis [119], routing security [120], [121], prefix hijacks [122]–[124], network neutrality [125], [126], malicious activity [127].

Alternate Architectures and Solutions. Delay-tolerant networking [128], [129], content-based networking [130], network virtualization [131], extensible architectures [132], flat-label routing [133].

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