

# The 1st UNIST Workshop on Advanced Networking Technology (U-WANT)

U-WANT 워크숍은 첨단 네트워킹 기술을 주제로 최신의 우수 연구결과를 교류함으로써, 네트워킹 분야의 융합과 창조적인 혁신을 이루기 위한 교류의 장을 마련하고자 합니다. 첫 워크숍은 서울대 최성현 교수의 발표를 시작으로, OSU 이주현 박사, 카이스트 신진우 교수, 유니스트 주창희 교수가 최신 네트워킹 연구에 대한 깊이 있는 발표를 해 주실 예정입니다. 많은 참여와 관심을 부탁드립니다.

**일 자:** 2016 년 2 월 23 일(화), 13:00~18:00

**장 소:** 울산과학기술원(UNIST) E104

**등록비:** 무료 (아래 문의처로 참석자들의 성함과 소속을 알려주시기 바랍니다.)

**문 의:** 이경한 교수 [khlee@unist.ac.kr](mailto:khlee@unist.ac.kr)

## 프로그램

12:00 ~ 13:00	등록
13:00 ~ 13:10	개회
13:10 ~ 14:40	표준화 및 최신 연구 결과 기반 Wi-Fi 진화 소개 / 최성현 (서울대)
14:40 ~ 15:40	Context-aware Mobile Computing: Overview and Practical Applications on Smartphone Energy Reduction / 이주현 (OSU)
15:40 ~ 16:00	휴 식
16:00 ~ 17:00	Scheduling using Interactive Optimization Oracles in Communication Networks / 신진우 (KAIST)
17:00 ~ 18:00	Queue-Affectance-based Scheduling in Multi-hop Wireless Networks under SINR Interference Constraints / 주창희 (UNIST)

## 오시는 길

KTX	택시 이용시, 울산역(통도사)에서 약 5 분 / 버스 이용시, 울산역에서 337 버스를 탑승하여 UNIST 에서 하차하거나 327 번, 807 번 버스를 이용하여 유니스트 입구에서 하차
승용차	경부고속도로 -> 서울산 IC -> 울산방면 24 번 국도 -> UNIST (서울산 IC 에서 약 10 분)
항공편	울산공항에서 402,452 번 버스를 이용하여 태화루에서 하차하여 807 번 버스로 환승하여 유니스트 입구에서 하차. / 5003 번 KTX 리무진을 이용하실 경우 굴화 주공아파트 앞에서 337, 733 번 버스로 환승하여 유니스트에서 하차.

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## 초록 (Abstract)

**표준화 및 최신 연구 결과 기반 Wi-Fi 진화 소개:** 1997 년 처음 표준이 완성된 IEEE 802.11 무선랜 (또는 Wi-Fi) 기술은, 이후로 수많은 발전을 거듭하여 현재 널리 사용되고 있는 IEEE 802.11ac 의 경우 MIMO 및 channel bonding 을 사용하여 Gbps 급 전송 속도를 지원하고 있다. 본 발표에서는 전송속도 향상, 전송거리 확대, 사용자 편의성 증대 등 현재 무선랜이 진화하고 있는 방향에 대해서 살펴보고 그 미래를 예측해 본다. 또한, 이동성이 있는 환경에서 무선랜 성능 개선, 전력 소모 절감, 안테나 선택 기법을 사용한 성능 향상, 그리고 Wi-Fi Direct 성능 개선 등 본 연구실에서 개발한 최근 연구 결과를 소개한다.

### **Context-aware Mobile Computing: Overview and Practical Applications on Smartphone**

**Energy Reduction:** As mobile devices have become an essential part of our lives, people expect more capability from them such as longer battery life, ubiquitous access to Internet, nearly infinite storage, and immediate response time. However, mobile OSs inherit Linux or Mac OS mainly designed for stationary computing systems, which are not optimized for resource-hungry mobile systems. Recent studies have shown that mobile systems can enjoy better operating points over conventional computer systems by exploiting "context-awareness." The concept of context-awareness, while still in its infancy, has demonstrated that a mobile device can be highly adaptive, situation dependent and QoE-oriented in managing computing resources. In this talk, two practical context-aware algorithms on smartphone energy reduction will be presented. A context-aware application scheduling framework, ConAS, unloads and preloads background applications based on the deeper understanding of probabilistic nature of human behaviors from large-scale measurement study. ConAS increases battery lifetime by 45% from the default Android scheduler, LMK (Low Memory Killer) over 100 smartphone usage traces. We further develop a mobile content update algorithm that significantly reduces power consumption from background content updates.

### **Scheduling using Interactive Optimization Oracles in Communication Networks:**

Since Tassioulas and Ephremides (1992) proposed the maximum weight scheduling algorithm of throughput-optimality for constrained queueing networks that arise in the context of emerging communication networks, extensive efforts have been devoted to resolving its high complexity issue. We propose a generic framework for designing throughput-optimal and low-complexity scheduling algorithms for constrained queueing networks. Under the framework, an algorithm updates current schedules via an interaction with a given oracle system that can generate a solution to a certain optimization task within a finite number of interactive queries. One can use the framework to design a variety of scheduling algorithms by choosing a different oracle, where in this talk I describe four examples, random search, Markov chain, belief propagation, and primal-dual methods, for wireless and input-queued switch networks. The complexity of the resulting scheduling algorithm is determined by the number of operations required for an oracle to process single query, which is typically small. We prove that an algorithm using such an oracle is throughput-optimal for general constrained queueing network models. This is a joint work with Tonghoon Suk (Georgia Institute of Technology).

### **Queue-Affectance-based Scheduling in Multi-hop Wireless Networks under SINR Interference**

**Constraints:** Most distributed wireless scheduling schemes that are provably efficient have been developed under the protocol model, which describes interference constraints in a binary form. However, the oversimplified interference model imposes fundamental limitations on the performance in practice. The signal-to-interference-plus-noise-ratio (SINR) based interference model is more accurate and realistic accounting for the cumulative nature of the interference signals, but its complex structure makes the design of scheduling schemes much more challenging. In this paper, we focus on the scheduling performance under the SINR model and develop random access scheduling schemes that are amenable to implement in a distributed fashion with only local information. We analytically show that they are provably efficient under the SINR model, and through simulations demonstrate that they empirically perform better than the theoretical performance bound.

## 발표자 약력 (Biography of the Speakers)

 <p>최성현 (서울대)</p>	<p>Sungyun Choi is a professor at the Department of Electrical and Computer Engineering, Seoul National University (SNU), Seoul, Korea. Before joining SNU in September 2002, he was with Philips Research USA, Briarcliff Manor, New York, USA as a Senior Member Research Staff and a project leader for three years. He was also a visiting associate professor at the Electrical Engineering department, Stanford University, USA from June 2009 to June 2010. He received his B.S. (summa cum laude) and M.S. degrees in electrical engineering from Korea Advanced Institute of Science and Technology (KAIST) in 1992 and 1994, respectively, and received Ph.D. at the Department of Electrical Engineering and Computer Science, The University of Michigan, Ann Arbor in September, 1999.</p> <p>His current research interests are in the area of wireless/mobile networks with emphasis on WLAN/WPAN, next-generation mobile networks, and cross-layer approaches. He co-authored over 200 technical papers and book chapters in the areas of wireless/mobile networks and communications. He has co-authored (with B. G. Lee) a book "Broadband Wireless Access and Local Networks: Mobile WiMAX and WiFi," Artech House, 2008. He holds over 130 patents, and numerous patents pending. He has served as a General Co-Chair of COMSWARE 2008, a Program Committee Co-Chair of ACM Multimedia 2007, IEEE WoWMoM 2007 and COMSWARE 2007, and a Co-Chair of IEEE GLOBECOM 2011 Wireless Networking Symposium. He has also served on program and organization committees of numerous leading wireless and networking conferences including ACM MobiCom, IEEE INFOCOM, IEEE SECON, and IEEE WoWMoM. He is also currently serving as an editor of IEEE Transactions on Wireless Communications (TWireless), and served as an editor of IEEE Transactions on Mobile Computing (TMC), IEEE Wireless Communications Magazine (WCM), ACM SIGMOBILE Mobile Computing and Communications Review (MC2R), Journal of Communications and Networks (JCN), Computer Networks, and Computer Communications. He has served as a guest editor for IEEE Journal on Selected Areas in Communications (JSAC), IEEE Wireless Communications, and ACM Wireless Networks (WINET). From 2000 to 2007, he was an active contributor to IEEE 802.11 WLAN Working Group.</p> <p>He has received numerous awards including KICS Dr. Irwin Jacobs Award (2013), Shinyang Scholarship Award (2011), Presidential Young Scientist Award (2008), IEEK/IEEE Joint Award for Young IT Engineer (2007), Outstanding Research Award (2008) and Best Teaching Award (2006), both from the College of Engineering, Seoul National University; the Best Paper Award from IEEE WoWMoM 2008, and Recognition of Service Award (2005, 2007) from ACM. Dr. Choi was a recipient of the Korea Foundation for Advanced Studies (KFAS) Scholarship and the Korean Government Overseas Scholarship during 1997-1999 and 1994-1997, respectively. He was named IEEE fellow in 2014 for the contribution to the development of WLAN protocols.</p>
 <p>이주현 (OSU)</p>	<p>Joohyun Lee is a postdoctoral researcher in the Department of Electrical and Computer Engineering at the Ohio State University. He received his B.S. and integrated M.S./Ph.D degree in the Department of Electrical Engineering from KAIST in 2008 and 2014, respectively. His research interests are in the areas of context-aware networking and computing, energy-efficient mobile networking, protocol design and analysis for delay-tolerant networks, and network economics.</p>
 <p>신진우 (KAIST)</p>	<p>Jinwoo Shin is currently an assistant professor at the Department of Electrical Engineering at KAIST, Korea. His major research interest is to develop advanced algorithms for large-scale data and network analytics. He obtained the Ph.D. degree from Massachusetts Institute of Technology in 2010. After spending two years (2010-2012) at Algorithms &amp; Randomness Center, Georgia Institute of Technology, one year (2012-2013) at Business Analytics and Mathematical Sciences Department, IBM T. J. Watson Research, he started teaching at KAIST in Fall 2013. He received Best Publication Award from INFORMS Applied Probability Society 2013 and ACM SIGMETRICS Rising Star Award 2015.</p>
 <p>주창희 (UNIST)</p>	<p>Chagnhee Joo received his Ph.D degree from Seoul National University, Korea. From 2005, he had been with Purdue University and the Ohio State University, USA. In 2010, he joined Korea University of Technology and Education, Korea, and now he is with Ulsan National Institute of Science and Technology (UNIST), Korea. His research interests include resource allocation in wireless networks, network optimization, wireless sensor networks, and Internet protocols. He is an editor of Journal of Communications and Networks, and has served several primary conferences as a committee member, including IEEE INFOCOM, ACM MobiHoc, and IEEE SECON. Dr. Joo received the IEEE INFOCOM 2008 best paper award and the KICS Haedong Young Scholar Award (2014).</p>