Jin Li

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Career Highlights

Partner Research Manager, Cloud Computing and Storage, Microsoft Research, Redmond, WA.

IEEE Fellow

Microsoft Gold Star Service Award x4

(1999: for contribution in founding Microsoft Research Asia.
2001: for contribution to scalable audio compression.
2006: for contribution to P2P VoD and P2P folder sharing
2010: for contribution to Deduplication in Windows Server.)

Microsoft Technical Community Network (TCN) Storage Technical Achievement Award 2013

Established a highly productive research team with standout productivity

Broad and in-depth technical contribution to a wide array of strategic Microsoft Products, with financial impact in the order of hundreds of millions dollars per annum: WMA9 Lossless (Reversible Transform), Live Messenger (NAT traversal, sharing folder), Live Mesh (NAT traversal), Windows 7 (Teredo), Lync (Bandwidth Estimation & Management, FEC, Media Gateway, DiffServ, QoS monitoring), Windows 8 (RemoteFX for WAN, BranchCache, Miracast), Windows 8 server (Primary Data Deduplication, Erasure Coding in Storage Spaces), Azure (Local Reconstruction Coding), Bing (Global Traffic Management, Bing object store), Xbox Live (Low Delay Message Protocol).

Extensive contribution to multimedia compression standards: JPEG 2000 (sub-bitplane scanning and rate-distortion optimization, visual weighting and progressive visual coding, JPEG Interactive Protocol), MPEG 4 (arbitrary shape wavelet transform), H.264 SVC (motion compensated temporal filtering).

72 issued US patents.

IEEE ComSoc Distinguished Lecturer, 2011-2012.

Extensive Community Service and Organization Committee Involvement

e.g., Packet Video Workshop 2009 General Chair.
ICME 2011 Lead TPC Chair.
CCNC 2013 TPC Chair
ICME Steering Committee Chair
ACM Multimedia 2016 TPC Chair

Associate Editors/Guest Editors served: IEEE Trans. On Multimedia, Journal of Selected Area of Communication, Journal of Visual Communication and Image Representation, P2P networking and applications, Journal of Communications

Ph.D. with honor in Electrical Engineering, Tsinghua University, 1994.

Affiliated Professor, Tsinghua University, from 2000

Demoed to Xiaoping Deng in 1984. The event brought forth the quote "Computer literacy should start with children" (计算机普及要从娃娃抓起), an iconic event in China. The event photo is in display at Shanghai Science Museum and included in the text book of Elementary School in China.

Selected Recent Projects and Personal Contribution

Prajna: Cloud Computing Platform, http://msrccs.github.io/Prajna/ (2013-current) [Fortune press]

- Prajna is a response to fill the vacuum of big data computing on .Net platform, it is open sourced at https://github.com/msrccs/Prajna/.
- Prajna is designed to be a generic distributed computing platform, with core functionality being the execution of an arbitrary closure (C#, F#, native code, etc.) on any remote node, in public cloud or in private cluster.
- Prajna supports interactive big data computing across a cluster with in-memory computation. The programming API is similar to Spark.
- Prajna has a managed web service (Prajna Hub), which can help developer to quickly prototype and host cloud service and run services on mobile Apps.
- Prajna supports distributed machine learning (e.g., distributed neural network trainer using Caffe on each node).
- Jin is the architect and the lead developer, and drives all aspects of the project (feature design, development direction, pitch, marketing/ deployment plan). He has written about 70% of the code on the entire project.

Erasure coded storage (2006-2012) [press]

- In 2006, the pervasive wisdom was that 3-way replication was the golden standard for durability in Cloud storage. Jin foresaw that erasure coding (when performed lazily) could be adopted to significantly save storage to achieve similar durability goal. The challenges included redesigning the storage system, and the need to work out new codes that optimizes performance for common failure scenario in storage systems at the cost of rare failure event.
- Engaging with Azure, the combined team developed a Local Reconstruction Code (LRC). Compared with Reed-Solomon code (used in Google and Facebook), LRC reduced storage overhead from 1.5x to 1.29x. The work went into production around 2012.
- LRC receives a number of awards, include:
  - The best paper at USENIX ATC 2012
  - 2013 Microsoft TCN Storage Technical Achievement Award
- It alone saves Microsoft hundreds of million dollars per annum.
- A slight variation of the code is also deployed in Windows Storage for Windows 8 and Windows Server 2012.
- Jin prototyped the first distributed storage system that used lazy erasure coding. He also led the research team that engaged with Azure and Windows.
- Jin and his group group also owned the implementation of a number of erasure coding implementation in Microsoft, include the code used in Windows Media Server, Skype/Skype for Business, RemoteFX for WAN.

Deduplication (2007-2012) [press]

- In 2007, believing that there were big opportunities for reducing redundancies within primary data, an area that hadn't been examined because of the impact on server managing live data, Jin and Sudipta Sengupta prototyped a tool that can analyze the data for deduplication savings.
- Collaborating with Windows File Server group, he architected and implemented the Primary Data Deduplication feature in Widows Server 2012 [paper] and End-to-End Deduplication for Storage Virtualization in Windows Server 2012 R2. Key contributions include a new data chunking algorithm (Jin implemented and shipped the production code), a low RAM footprint indexing data structure to detect duplicate data (based on ChunkStash), and a data partitioning and reconciliation technique, the latter two for scaling index resource usage with data size. It leads to major saving to customers (20-82%), and is among top 3 features for Windows File Server introduced at Windows Server 2012. The feature has received rave reviews (The Register, IT Pro, Arts Technica, IT World, Tech Republic), and there are evidence that some customers upgrading to WIndows Server 2012 for the primary data deduplication feature only.

SSD (Flash) based storage (2007-current)

- Noticing that the storage engineers care dearly for disk I/O performance, while Solid State Drive (SSD) disrupts Hard Disk Drive (HDD) in term of I/O performance, Jin conducted a series of research to exploit the benefit of SSD for storage applications. "FlashStore" has implemented a SSD optimized, low RAM footprint key-value store that organizes storage on flash in a log-structured manner.
- It was tech transferred to Bing Object Store in Microsoft backend. SkimpyStash has implemented an ultra-low RAM footprint key-value store. The storage layer design of SkimpyStash has been incorporated into BW-Tree, a joint project among CCS, MSR Database group, and Azure DocumentDB team, and is shipping in SQL Server 2014 (Hekaton) and Azure DocumentDB.

Professional experience

2001.1 – Current Microsoft Research Redmond, WA

Partner Research Manager, Cloud Computing and Storage (CCS) Group

Build a multi-disciplinary research team, with broad and extensive contribution to Microsoft product lines

- Prajna is a response to fill the vacuum of big data computing on .Net platform. It is open sourced at https://github.com/msrccs/Prajna/. Designed to be a generic distributed computing platform, with core functionality being the execution of an arbitrary closure (C#, F#, native code, etc.) on any remote node, in public cloud or in private cluster. It supports interactive big data computing across a cluster with in-memory computation. The programming API is similar to Spark. It has also a managed web service (Prajna Hub), which can help developer to quickly prototype and host cloud service and run services on mobile Apps. It also supports distributed machine learning (e.g., distributed neural network trainer using Caffe on each node).

- Bing (Global Traffic Management): developed a set of tools to evaluate global data center performance, select new potential data center for deployment, and direct client traffic to the data center with best performance.
- Bing (Pegasus SSD): developed high performance SSD based object store solution with tight memory footprint and intelligent cache management strategy.
- Azure (Erasure Coding based Storage): developed advanced erasure coding algorithm, failure recovery and storage performance tuning tool that provides cost effective, reliable and high performance storage cluster. The work reduces the data replication rate in Windows Azure Storage from 3x to 1.33x, results in hundreds of millions dollars saving per year, and a capital and operating cost advantage for Microsoft Azure. Please refer to http://research.microsoft.com/en-us/news/features/erasurecoding-090512.aspx for details.
- Windows 8 server (Primary Data Deduplication): architected the primary data deduplication feature in windows 8 server. Please refer to: http://research.microsoft.com/en-us/news/features/deduplication-101311.aspx for details.
- Windows 8 (RemoteFX for WAN): developed RemoteFX for WAN, which uses a new UDP/FEC transport. This results in a very large positive shift in customer and analyst reception of RDP and its appropriateness for WAN use (which was previously a key product gap).
- Windows 8 (BranchCache): developed the content aware chunking algorithm for Windows 8 BranchCache, a server-less P2P sharing protocol.
- Live Messenger/Live Mesh/Windows 7 (NAT traversal): developed an algorithm that can intelligently guess the port number used by a computer in a P2P communication behind a symmetric NAT. It raises NAT traversal success rate from 60% to 85% across Microsoft product line.
- Xbox Live (Low Delay Message Protocol): developed an adaptive erasure correction protocol that improves the responsiveness of Xbox Live games.
- Lync (Bandwidth Estimation & Management): responsible for Lync's bandwidth management protocol that will intelligently manage the bandwidth of an audio/video conferencing session under complex network conditions.
- Lync (FEC): developed forward error correction (FEC) for Lync to protect against network packet loss in a video conferencing session.
- Lync (QoS monitoring): architect the Quality of Service monitoring and diagnosis platform for Lync.
- WMA9 Lossless (Reversible Transform): developed reversible integer-to-integer transform that enables WMA 9 Lossless codec

1999.4 – 2000.12 Microsoft Beijing, China

Researcher/Project Leader, Internet Media Group, Microsoft Research Asia

- Invented motion compensated temporal filtering, in which wavelet

decomposition in the temporal direction is applied in hierarchical B-frame fashion. This technology integrates motion compensation into the temporal wavelet filtering direction, and is fundamental to maintaining high quality while scaling video over a large range of bit rates. It is incorporated to H.264/SVC.

- Developed Vmedia, a protocol that breaks scalable coded JPEG 2000 image into small pieces, and streams the pieces over the Internet according to the resolution and region that the user is viewing. It initiated the JPIP standards activity, which became part 9 of the JPEG 2000 suite of standards.
- Pioneered multi-view video coding and depth plus color video coding, leading up to the H.264/MVC standard

1996.11 – 1999.4 Sharp Laboratories of America Camas, WA

Member of Technical Staff, Digital Video Department

- Represent Sharp in MPEG4 and JPEG 2000 standard activity
- Invented a visual weighting tool and progressive visual coding tool for JPEG 2000. Both tools are crucial to boost the subjective quality of image.
- Developed the arbitrary shape wavelet transform for wavelet coding of non-rectangular objects in MPEG4

1994.8 – 1996.11 University of Southern California Los Angeles, CA

Research Associate, Integrated Media Systems Center

- Inventing sub-bitplane scanning, a key ingredient in modern image codecs, and was incorporated into JPEG 2000. Previously, scalable coding scanned by bitplane. Dr. Li showed that additional coding gain can be realized by sequencing the transmission in sub-bitplanes, according to context, using a rate-distortion criterion.

Professional memberships & activities

IEEE Fellow

Associate Editor/Guest Editor: IEEE Trans. On Multimedia, Journal of Selected Area of Communication, Journal of Visual Communication and Image Representation, P2P networking and applications, Journal of Communications

Organization Committee Members and TPCs of Major International Conferences, such as:

ICME 2011 Lead TPC Chair.
CCNC 2013 TPC Chair
ICME Steering Committee Chair
ACM Multimedia 2016 TPC Chair

Honors and Awards

Gold Star service award x4 (1999, 2001, 2006, 2010), Microsoft
(1999: for contribution in founding Microsoft Research Asia.

2001: for contribution to scalable audio compression.
2006: for contribution to P2P VoD and P2P folder sharing
2010: for contribution to Deduplication in Windows Server.)

Microsoft Technical Community Network (TCN) Storage Technical Achievement Award 2013.

Microsoft Member Bench Program, 2007.

Best paper award, USENIX ATC 2012.

Best paper award, ICME 2009.

The Young Investigator Award from SPIE/IS&T, 1998

The Best Ph.D. Thesis Award, Tsinghua University, 1994

Various prestigious scholarships of Tsinghua Univ. during year 1987-1994, such as "Tsinghua Ten Stars", the Supreme Guanghua Scholarship(1993), the Supreme Scholarship of Tsinghua (1991), the Best M.S. Thesis Award (1991), etc..

Championship (ranked 1st) of National Youth Computer Programming Competition, China, 1987.

Education

Mar. 1991 - Jun. 1994 Tsinghua University Beijing, China
Ph.D. in Electrical Engineering, **graduated with honor**
Thesis advisor: Prof. Xinggang Lin and Prof. Youshou Wu

Sep. 1990 - Mar. 1991 Tsinghua University Beijing, China
M.S. in Electrical Engineering, **graduated with honor**
Thesis advisor: Prof. Rensheng Liu

Sep. 1987 - Sep. 1990 Tsinghua University Beijing, China
B.S. in Electrical Engineering, **graduated with honor**
(Complete 5 year undergraduate program with only 3 years.)

Patents Issued

[1] J. Li and S. Lei, "Arbitrary shape wavelet transform with phase alignment", US 6,233,357. [Provisional filed Jul. 14, 1997, US1997000052450, Issued May. 15, 2001, cited by 18]
[2] J. Li, "Method of visual progressive coding", US6,327,392, [Filed Jan. 28, 1999, Issued Dec. 4, 2001, cited by 58]
[3] S. Lei and J. Li, "Quad-tree embedded image compression and decompression method and apparatus", US6,356,665, [Filed Dec. 9, 1998, Issued Mar. 12, 2002, cited by 15]
[4] J. Li and S. Lei, "Dynamic management of embedded coded images in a digital storage device", US6,463,177, [Filed Nov. 4, 1998, Issued Oct. 8, 2002, cited by 11]
[5] W. Zeng, S. Lei and J. Li, "Re-indexing for efficient compression of palettized images", US6,522,783, [Filed Nov. 23, 1999, Issued Feb. 18, 2003, cited by 6]
[6] W. Zeng, J. Li, and S. Lei, "Joint coding method for images and videos with multiple arbitrarily shaped segments or objects", US6,553,148,

[Filed May. 21, 2001, Issued Apr. 22, 2003, cited by 24]
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[8] J. Li and S. Lei, "Embedded image coder with rate-distortion optimization", US6,625,321, [Filed Jan. 30, 1997, Issued Sept. 23, 2003, cited by 57]
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[10] J. Li and J. Zhou, "System and method for delivery of dynamically scalable audio/video content over a network", US 6,789,123 [Filed Dec. 28, 2001, Issued Sept. 7, 2004, cited by 17]
[11] J. Li, H. Sun, H. Li, Q. Zhang and X. Lin, "Methods and systems for providing random access to structured media content", US 6,807, 550 [Filed Dec, 1, 1999, Issued Oct. 19, 2004, cited by 7]
[12] C. Zhang, J. Li and Y. Wu, "Rebinning methods and arrangments for use in compressing image-based rendering (IBR) data", US 6,959,120[filed Oct. 27, 2000, Issued Oct. 25, 2005, cited by 4]
[13] C. Zhang and J. Li, "Methods and arrangements for handling concentric mosaic image data", US 6,993,074[filed Mar. 19, 2001, Issued Jan. 31, 2006, cited by 1]
[14] C. Zhang, J. Li and Y. Wu, "Rebinning methods and arrangements for use in compressing image-based rendering (IBR) data", US 6,996,294, [filed Oct. 18, 2004, Issued Feb. 7, 2006]
[15] C. Zhang, J. Li and Y. Wu, "Rebinning methods and arrangements for use in compressing image-based rendering (IBR) data", US 7,065,260, [filed Oct. 13, 2004, Issued June. 20, 2006]
[16] C. Zhang, J. Li and Y. Wu, "Rebinning methods and arrangements for use in compressing image-based rendering (IBR) data", US 7,110,617, [filed Oct. 18, 2004, Issued Sept. 19, 2006]
[17] J. Li, "System and method for embedded audio coding with implicit auditory masking", US 7,110,941, [filed Mar. 28, 2002, Issued Sept. 19, 2006, cited by 5]
[18] J. Li, "System and method for receiver-driven streaming in a peer-to-peer network", US 7,174,385, [filed Sept. 28, 2004, Issued Feb. 6, 2007, cited by 39]
[19] J. Li, H. Sun, H. Li, Q. Zhang, and X. Ling, "Methods and systems for providing random access to structured media content", US 7,236,988, [filed Apr. 30, 2004, Issued June. 6, 2007, cited by 7] (related to JPIP protocol in JEPG 2000)
[20] J. Li "System and method for a media codec employing a reversible transform obtained via matrix lifting", US 7,315,822, [filed Feb. 20, 2004, Issued Jan. 1, 2008, cited by 5] (related to MPEG-4 ALS)
[21] J. Li "Progressive to lossless embedded audio coder (PLEAC) with multiple factorization reversible transform", US 7,395,210, [filed Nov. 21, 2002, Issued Jul. 1, 2008, cited by 3]
[22] J. Li "Efficient implementation of reed-solomon erasure resilient codes in high-rate applications", US 7,418,649, [filed Mar. 15, 2005, Issued Aug. 26, 2008]
[23] J. Li "Serverless peer-to-peer multi-party real-time audio

communication system and method", US 7,460,495, [filed Feb. 23, 2005, Issued Dec. 2, 2008, cited by 1]
[24] J. Li, H. Sun, H. Li, Q. Zhang, and X. Ling, "Methods and systems for providing random access to structured media content", US 7,490,104, [filed May. 10, 2004, issued Feb. 10, 2009] (related to JPIP protocol in JEPG 2000)
[25] J. Li, "System and method for seamless multiplexing of embedded bitstreams", US 7,496,234, [filed Jun. 20, 2003, issued Feb. 24, 2009, cited by 2]
[26] J. Li and Y. Cui, "Random access read/write media format for an on-demand distributed streaming system", US 7,536,470, [filed Mar. 12, 2005, issued May. 19, 2009, cited by 4]
[27] J. Li, "Coordination of client-driven media streaming from a cluster of non-cooperating peers in a peer-to-peer network", US 7,539,767, [filed Feb. 5, 2007, issued May. 26, 2009]
[28] J. Li and C. Zhang, "Distributed hosting of web content using partial replication", US 7,546,342, [filed May. 14, 2004, issued Jun. 9, 2009, cited by 8]
[29] J. Li, "Metadata structures for mass P2P file sharing", US 7,558,797, [filed Jun. 30, 2006, issued Jul. 7, 2009, cited by 1]
[30] J. Li, C. Zhang and P. A. Chou, "Efficient one-to-many content distribution in a peer-to-peer computer network", US 7,593,333, [Filed Jul. 7, 2004, issued Sept. 22, 2009, cited by 8]
[31] J. Li, "On-demand file transfers for mass P2P file sharing", US 7,613,770 [filed Jun. 30, 2006, issued Nov. 3, 2009, cited by 3]
[32] J. Li, S. Sengupta, M. Ponec, M. Chen, P. A. Chou, "Rate-controllable peer-to-peer data stream routing", US 7,636,789 [filed Nov. 27, 2007, issued Dec. 22, 2009]
[33] J. Li, and Y. Cui, "Digital rights management scheme for an on-demand distributed streaming system", US 7,639,805 [filed Mar. 12, 2005, issued Dec. 29, 2009, cited by 1]
[34] D. Teodosiu, P. A. Chou, A. Heron, C. Huang, "Scheduling connections between peers in a peer-to-peer file sharing environment", US 7,643,491[filed Dec. 16, 2005, issued Jan. 5, 2010]
[35] J. Li, "System and method for distributed streaming of scalable media", US 7,664,109, [filed Sept. 3, 2004, issued Feb. 16, 2010]
[36] P. Y. Simard, P. A. Viola, and J. Li, "Credit-based peer-to-peer storage", US 7,707,248, [filed Jun. 25, 2007, issued Apr. 27, 2010]
[37] S. Liu, S. Sengupta, M. Chiang, J. Li and P. A. Chou, "Models for routing tree selection in peer-to-peer communications", US 7,738,406, [filed Oct. 8, 2008, Issued Jun. 15, 2010]
[38] J. Li and Y. Sun, "Distributed source coding with context", US 7,743,309, [filed Mar. 17, 2006, Issued Jun. 22, 2010]
[39] J. Li "Receiver driven streaming in a peer-to-peer network", US 7,752,327, [filed Feb. 5, 2007, Issued Jul. 6, 2010]
[40] J. Li, J. Johnston, W. Y. Chan, "Perceptual, scalable audio compression", US Patent 7,835,904, [filed Mar. 3, 2006, Issued Nov. 16, 2010]
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maximally recoverable property", US Patent 7, 904, 782 [filed Mar. 9, 2007, issued Mar. 8, 2011]

[44] C. Huang, M. Chen, and J. Li, "Erasure resilient codes having multiple protection groups", US Patent 7, 930, 611 [filed Mar. 9, 2007, issued Apr. 19, 2011]

[45] J. Li, D. Teodosiu, P. A. Chou, C. Huang, E. Schwartz, J. T. Spivey, Y. Wu, A. K. Heron, "Content synchronization in a file sharing environment", US Patent 7, 953, 785 [filed Jun. 2006, issued May. 31, 2011]

[46] J. Li, L. He and J. Liang, "Distributed data storage using erasure resilient coding", US Patent 8,051,362 [filed Jun. 15, 2007, Issued Nov. 1, 2011]

[47] J. Li, S. Sengupta and V. Vasudevan, "Proximity guided data discovery", US Patent 8, 073, 978 [filed Jun. 24, 2009, Issued Dec. 6, 2011]

[48] J. Wang, C. Huang, S. Sengupta, and J. Li, "ISP-friendly rate allocation for P2P applications", US Patent 8, 082, 358 [filed Sep. 30, 2008, Issued Dec. 20, 2011]

[49] M. Chen, C. Huang, and J. Li, "Optimizing XOR-based codes", US Patent 8,209,577 [filed Dec. 20, 2007, Issued Jun. 26, 2012]

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[51] C. Huitema, W. A. S. Buxton, J. E. Paff, Z. Liu, R. Hedge, Z. Zhang, K. Quinn, J. Li, M. Pahud, "Ambulatory presence features", US Patent 8,253,774, [filed Mar. 30, 2009, Issued Aug. 28, 2012]

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[53] S. Sengupta, M. Chen, J. Li, P. A. Chou, M. Ponec, "Multi-rate peer-assisted data streaming", US Patent 8,260,952, [filed Jan. 31, 2008, Issued Sep. 4, 2012]

[54] J. Li, J-H. Lin, Aravind Krishnamachari, "Cuckoo hashing to store beacon reference data", US Patent 8,305,271 [filed Mar. 17, 2010, Issued Nov. 6, 2012]

[55] C. Huang, N. Holt, A. Greenberg, and J. Li, "Using DNS reflection to measure network performance", US Patent 8,326,980 [filed Apr. 28, 2010, Issued Dec. 4, 2012]

[56] Z. Zhang, X.-D. Huang, J. Li, R. Hedge, K. Quinn, M. Pahud, J. Dalal, "Force-feedback within telepresence", US Patent 8,332,755, [filed May. 27, 2009, issued Dec. 11, 2012]

[57] J. Li, C. Huang, Y. Wang, R. Yang, "Quality of service (QoS) based systems, networks, and advisors", US Patent 8,335,163, [filed Oct. 27, 2009, issued Dec. 18, 2012]

[58] J. Li and Y. Cui, "Digital right management scheme for an on-demand distributed streaming system", US Patent 8,375,456 [filed Nov. 12, 2009, Issued, Feb. 12, 2013]

[59] J. Li, H. Khan, G-W. Shieh, M. Jain, "Estimating communication conditions", US Patent 8,441,930 [filed Dec. 21, 2009, Issued May. 14, 2013]

[60] S. Mehrotra, T. L. Wynn, J. Li, S. Sengupta, "Congestion control for delay sensitive applications", US Patent 8,553,540 [filed Apr. 16, 2010, issued Oct. 8, 2013]

[61] J. Li, H. Chen, S. Jain, S. Mehrotra, "Kernel awareness of physical environment", US Patent 8,570,864 [filed Dec. 17, 2010, issued Oct. 29, 2013]

[62] S. K. Cunnington, J. Li, M. Pahud, R. K. Hedge, Z. Zhang, "Universal translator", US Patent 8,600,731 [filed Feb. 4, 2009, issued Dec. 3, 2013]

[63] P. Gopalakrishnan, J. Li, C. H. Wittenberg, "Network address translation traversals for peer-to-peer networks", US Patent 8,631,144 [filed Jun. 29, 2007, issued Jan. 14, 2014]

[64] J. Li, V. Cadambe, C. Huang, "Storage codes for data recovery", US Patent 8,645,799, [filed Dec. 31, 2010, issued Feb. 4, 2014]

[65] Y. Wu, Y. Zhao, B. Li, M. Chen, J. Li, P. A. Chou, "Multiparty real time content delivery", US Patent 8,824,470 [filed Jun. 2, 2010, issued Sep. 2, 2014]

[66] J. Li, C. Huang, and K. W. Ross, "Smart pre-fetching for peer assisted on-demand media", US Patent 8,832,290 [filed Feb. 23, 2007, issued Sept. 9, 2014]

[67] S. K. Cunnington, R.K. Hedge, K. Quinn, J. Li, P. A. Chou, Z. Zhang and D. S. Tan, "Detecting reactions and providing feedback to an interaction", US Patent 8,670,018 [filed May. 27, 2010].

[68] C. Huang, I. I. Batanov, J. Li, "Global traffic management using modified hostname", US Patent 8,732,268 [filed Apr. 19, 2011]

[69] Y. Wu, Y. Zhao, B. Li, M. Chen, J. Li, P. A. Chou, "Multiparty real time content delivery", US Patent 8,824,470 [filed Jun. 2, 2010]

[70] C. Huang, D. A. Maltz, J. Li, M. Zhang, C. Zhang, K. W. Ross, "Determination of unauthorized content source", US Patent 8,898,292 [filed Aug. 26., 2011]

[71] S. Sengupta, B. Debnath, J. Li, R. N. Desai, P. A. Oltean, "Fast and low-RAM-footprint indexing for data deduplication", US Patent 8,935,487 [filed Dec. 28, 2010]

[72] C. Huitema, W. Buxton, J. Paff, Z. Liu, R. Hedge, Z. Zhang, K. Quinn, J. Li, M. Pahud, "Ambulatory presence features", US 8,941,710 [filed: Aug. 13, 2012]

Journal Papers

[1] H. Shen, Y. Lin, and J. Li, "A social-network-aided efficient peer-to-peer live streaming system", IEEE/ACM Trans. On Networking, Vol. 23, No. 3, pp.987-1000, Apr. 2014.

[2] X. Chen, M. Chen, B. Li, Y. Zhao, Y. Wu and J. Li, "Celebrity, a low-delay multi-party conferencing solution", IEEE Journal of Selected Areas in Communications, Vol. 31, no. 9, Sep. 2013.

[3] H. Shen, Z. Li, Y. Lin and J. Li, "SocialTube: P2P-assisted Video Sharing in Online Social Networks", IEEE Trans. On Parallel and Distributed Systems, May. 29, 2013.

[4] C. Huang, M. Chen and J. Li, "Pyramid Codes: Flexible Schemes to Trade Space for Access Efficiency in Reliable Data Storage Systems," ACM Transactions on Storage, 9(1), March, 2013.

[5] H. Shen, Z. Li and J. Li, "A DHT-aided chunk-driven overlay for scalable and efficient peer-to-peer live streaming", IEEE Trans. On Transactions on Parallel and Distributed Systems, Issue: 99, Oct. 22, 2012.

[6] X. Chen, M. Chen, B. Li, Y. Zhao, Y. Wu and J. Li, "Celebrity: a low-delay multi-party conferencing solution", IEEE Journal on Selected Areas in Communications - 2012 Special Issue on Emerging Technologies in Communications.

[7] M. Chen, M. Ponec, S. Sengupta, J. Li, and P. A. Chou, "Utility Maximization in Peer-to-Peer Systems with Applications to Video Conferencing", IEEE/ACM Transactions on Networking, vol. 20, no. 6, Dec. 2012.
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