Unapproved Minutes

IEEE 802.3 100 Gb/s Wavelength Short Reach PHYs Study Group Meeting

During IEEE 802.3 Interim Meeting Week
January 23-24, 2020
Geneva, Switzerland
Prepared by Mabud Choudhury

Group Name: IEEE 802.3 100 Gb/s Wavelength Short Reach PHYs Study Group
Date/Location: Thursday, January 23 and Friday, January 24, 2020. Geneva, Switzerland
Chair: Robert Lingle, Jr, affiliated with OFS
Recording Secretary: Mabud Choudhury, affiliated with OFS
Meeting Participants: Attendance is listed in Appendix A (57 attendees on January 23; 40 attendees on January 24)

Call to order:
IEEE 802.3 100 Gb/s Wavelength Short Reach PHYs (100GSR) Study Group (SG) during IEEE 802.3 Geneva Interim meeting was convened at 8:30 AM Central European Time (CET/ UTC +1), Thursday, January 23, 2020 by David Law, 802.3 Working Group Chair.

Mr. Law welcomed attendees to the IEEE 802.3 100 Gb/s Wavelength Short Reach PHYs Study Group.

David Law appoints Mabud Choudhury as the recording secretary for the IEEE 802.3 100 Gb/s Wavelength Short Reach PHYs Study Group.

As announced at the November 2019 Plenary meeting, David Law intended to appoint Robert Lingle, Jr. as the Chair of the IEEE 802.3 100 Gb/s Wavelength Short Reach PHYs Study Group.

Motion #1:
Confirm Robert Lingle, Jr. as IEEE 802.3 100 Gb/s Wavelength Short Reach PHYs Study Group Chair

- Moved by: John Abbott 2nd: Mabud Choudhury
- Y: 33 N: 0 A: 0 (>= 75% by rule)
- Motions Passes!

Mr. Law turned the meeting over to Study Group Chair Robert Lingle, Jr.

The Chair thanked the Study Group, and then called for introductions and affiliations. The participants introduced themselves.

Presentation #1:
Title: "Agenda and General Information"
Presenter: Robert Lingle, Jr. (OFS)
lingle_100GSR_01b_0120.pdf

Mr. Lingle then proceeded with reviewing the **Agenda** and asked if there any modifications, additions or deletions? There were none.

Motion #2:
Move to approve the Agenda for Geneva Interim SG meeting, Slide 2 of lingle_100GSR_01b_0120.pdf

- Moved by: Ray Nering 2nd: Rick Pimpinella
- Motion approved by voice vote without objection. (Procedural > 50%)

Chair covered Task Force decorum, which includes noting that there should be no recording or photography.

Chair then reviewed the goals for the meeting:

- Develop a set of objectives for the Study Group
- Develop responses for the CSD (Criteria for Standards Development)
- Develop PAR
- Review presentations substantiating the above
- Lay the groundwork for the next meeting

Chair provided access information for SG reflector and website, and ground rules for the meeting.

Attendance: Mr. Lingle reminded everyone to sign-in via IMAT on-line attendance (Interim meeting password provided) http://imat.ieee.org/ and to sign-in on Attendance Sheet.

Chair reviewed the IEEE structure for standards development and the bylaws by which the Study Group is governed. Chair reviewed the Guidelines for IEEE SA Meetings.

IEEE SA Copyright Policy: Mr. Lingle reviewed slides 12-13 of lingle_100GSR_01b_0120.pdf entitled "IEEE SA Copyright Policy" at 8:46 AM CET/ UTC +1.

IEEE SA Participation Policy: Mr. Lingle showed the participation policy slides 14-16 of lingle_100GSR_01b_0120.pdf .

The Chair reviewed Overview of IEEE 802.3 Standards Process and showed that we are first phase of the process: Study Group Phase.

Mr. Lingle reviewed Study Group chartering motion and role of Study Group, emphasizing that we are choosing objectives and not solutions.

Chair announced that he intends to use the Thursday Noon to 1:30 PM US Eastern Standard Time (EST/UTC -5) slot that IEEE P802.3cm used for 100GSR SG ad hoc telecons. Ad hoc telecons are scheduled biweekly for 1/30, 2/13, 2/27, and 3/12.

Chair reviewed meeting logistics and meeting schedule for Thursday, January 23 and Friday, January 24.
Mr. Lingle reminded everyone to check:
– Geneva Daily Schedule: https://www.itu.int/en/events/Pages/Genevaschedule.aspx?date=2020-01-20
– Or Daily Schedule (mobile friendly): http://www.itu.int/today
For latest/updated room assignments. Scheduled presentation times were subject to change.
Chair indicated that there was a request for a late contribution from Ray Nering and asked if SG would accept late contribution – there were no objections to making late presentation.

Future 802.3 plenary and interim meeting dates and locations were reviewed.

Presentation #2:
Title: "The Path Forward"
Presenter: Robert Lingle, Jr. (OFS)
lingle_100GSR_02_0120.pdf

- Presentation included "Crash course on Study Group goals" based on slides - created by Wael Diab, Howard Frazier, updated by George Zimmerman – that have been used in past and current 802.3 projects.
- Schedule possibilities. Desirable timeline to consider.
- Proposed foundational objectives. Proposed possible objectives.
- Discussion on balancing moving project forward and ensuring that Study Group has adequate time to consider and study all lower cost objectives.

Presentation #3:
Title: "PCS, FEC and PMA Overview"
Presenter: Mark Gustlin (Cisco)
gustlin_100GSR_01a_0120.pdf

- Presentation describes the PCS/FEC/PMA architectures that are in use at 100 Gb/s per lane today for re-use by 100GSR SG.
- Recommendation to re-use major investment in the 802.3bs/cd architectures in the industry.
- Clarifying questions asked and answered.
- Slide 11 updated, after presentation, to show existing 100G per lane BER budget for 100GbE along with for 200/400GbE.

Break at 10:23 AM. Resumed at 10:45 AM.
Presentation #4:
Title: "SMF for Short Reach Interconnects"
Presenter: Brian Welch (Cisco)
welch_100GSR_01_0120.pdf

- Proposal for SMF PMD based on translating lower connector loss budgets on Server to Switch interconnects into cost reduction for SMF short-reach. Reductions in loss budget may allow for incremental improvement of switch side optics cost.
- Additional potential advantages of SMF for cost sensitive short reach listed.
- Proposed 200GbE objective for 100G per lane (e.g. 200G-DR2), if 200GbE objective is adopted for MMF for 100G per lane short-reach.
- Discussion about SMF PMD objectives for this project. Clarifying questions asked and answered.

Presentation #5:
Title: "Proposed objectives for 100 Gb/s short-reach PMDs"
Presenter: David Lewis (Lumentum)
lewis_100GSR_01_0120.pdf

- Proposed two short-reach MMF PMD objectives:
    - PMD that supports 100 Gb/s operation over a single pair of MMF with lengths of up to at least 50 m and with a single wavelength in the peak EMB region of OM4/OM5 fiber (840-860 nm).
    - PMD that supports 100 Gb/s operation over a single pair of MMF with lengths of up to at least 30 m and with a single wavelength in the VCSEL back-emitting region (940 nm).
- Provided potential cost advantages/economic feasibility and technical reasons/technical feasibility for using 940 nm VCSELs
- Discussion about 940 nm VCSELs. Clarifying questions asked and answered.

Presentation #6:
Title: "Applications of 100GBASE-SR"
Presenter: Ali Ghiasi (Ghiasi Quantum)
ghiasi_100GSR_01_0120.pdf

- Presentation provided Ethernet, server to switch, technology, architecture, data center, cloud trends that are driving market need/Broad Market Potential for 100G-SR.
- Recommended two short-reach MMF PMD objectives:
    - An ultra-low-cost SR PMD objective with reach of 15 m addressing TOR to server applications. Consider lower latency FEC optimized for lowest cost.
    - A 50 m SR PMD objective addressing TOR-EOR and MOR-EOR applications.
- Discussion about potential lower latency FEC vs. maintaining existing FEC. Clarifying questions asked and answered.

Lunch break at 11:56 AM. Resumed at 1:06 PM.

Presentation #7:
Title: "Proposed Objectives for 100Gb/s Short Reach"
Presenter: Robert Lingle, Jr. (OFS) on behalf of Leon Bruckman (Huawei)
bruckman_100GSR_01_0120.pdf

- Presentation proposed foundation objectives and PHY objectives for:
    - 100 Gb/s operation over at least 30 m of single-lane MMF.
    - 400Gb/s operation over at least 50m of 4-lane parallel MMF.
- Presentation demonstrated Broad Market Potential and Economic Feasibility for 100 Gb/s per wavelength VCSEL-MMF PMDs based on Ethernet trend of reducing optic lanes to provide lower cost and higher density, matching ASIC IO, and survey of DC connections in China for both Server to ToR connection and ToR to T1 switch connection.
- Clarifying questions asked and answered.

Presentation #8:
Title: "Use cases for 100G per lane MMF PMDs"
Presenter: Rick Pimpinella (Panduit)
pimpinella_100GSR_01b_0120.pdf

- Presented evolution of switch ASICs, evolution of Switch Radix, 100Gbps per lane Radix options, logical progression of MMF PMDs, and TIA 942 Data Center Standard architecture.
- Provided estimated application channel reaches of 75 m and 20 m.
- Discussion about MMF vs. SMF solutions. Clarifying questions asked and answered.
- Presentation updated to correct minor typos.

Presentation #9:
Title: "Technical feasibility of 100 Gb/s per lane MMF PMDs using VCSELs"
Presenter: Jonathan Ingham (Broadcom)
ingham_100GSR_01_0120.pdf

- Reported development of 50 GBd PAM4 VCSEL with link simulations suggesting feasibility of a 50 m OM4 link, supporting Technical Feasibility and Economic Feasibility.
- Recommended the following objectives:
    - a single-lane 100 Gb/s PHY over duplex MMF with lengths up to at least 50 m.
    - a four-lane 400 Gb/s PHY over four pairs of MMF with lengths up to at least 50 m.

- Proposed objectives would be expected to use RS(544, 514) FEC in Clause 91 and Clause 119, and would utilize Clause 138 and Clause 150, particularly the TDECQ and SECQ methodology.
- Clarifying questions asked and answered.

Presentation #10:
Title: "Multimode Fiber for use with 100 Gb/s per Wavelength Short Reach PHYs"
Presenter: Earl Parsons (CommScope)
parsons_100GSR_01_0120.pdf

- Contribution reviewed fiber bandwidths, reaches, and wavelengths used by recent 100G and 400G standards and MSAs.
    - Reviewed EMB for OM3, OM4, and OM5.
    - Reviewed recent MMF PMDs that have used wavelengths from 850 – 950 nm.
- Clarifying questions asked and answered.

Presentation #11:
Title: "Bandwidth Requirements for 30m 100G SR"
Presenter: John Abbott (Corning)
abbott_100GSR_01_0120.pdf

- Using the methodology outlined by Jonathan King king_3cm_adhoc_01_062818.pdf and Jonathan Ingham ingham_3cm_02a_0918.pdf, estimated the EMB requirements for distances being considered for this study group and the resulting head-room for higher data rate links at 100Gbs/lane.
- Presented Technical Feasibility of 100Gb/s 30m on OM3. Methodology can be used for other lengths (i.e. OM4).
- Clarifying questions asked and answered.

Presentation #12:
Title: "Initial considerations for 100G VCSEL-MMF reaches"
Presenter: Jose Castro (Panduit)
castro_100GSR_01a_0120.pdf

- Presentation addressed technical feasibility for 100G MMF channels. Extensive preliminary theoretical and experimental study to evaluate reaches for next-generation 100G per lane MMF interconnects was presented.
- Investigation indicates that for OM4 max. reaches in the range of 75m should be considered.
- Discussion about theoretical and experimental results. Clarifying questions asked and answered.
- Presentation updated, after meeting, to change figure in slide 5 for the OM3 case.

Break at 3:00 PM. Resumed at 3:41 PM.

Presentation #13:
Title: "Broad market potential, economic feasibility, and distinct identity for objectives based on 100 Gb/s lanes over MMF"
Presenter: Robert Lingle, Jr. (OFS)
lingle_100GSR_03c_0120.pdf

- Presentation demonstrates Broad Market Potential, Economic Feasibility, and Distinct Identity for 100 Gb/s per wavelength VCSEL-MMF PMDs for applications in the cloud.
- Proposed 100GbE and 400GbE PMD MMF with lengths up to at least 50m objectives. Recommended investigating 200GbE objective based on BMP.

- Presentation updated, prior to meeting, with authors and supporter list.
- Discussion about MMF PMD objectives for this project. Clarifying questions asked and answered.

Presentation #14:
Title: "Considerations for 100G-SR"
Presenter: Ray Nering (Cisco)
nering_100GSR_01_0120.pdf

- Presentation outlines key considerations for 100G-SR.
- Emphasizes clear focus on low-cost solution for high-volume optical greenfield opportunity to replace copper for server interconnects. Target market is technology agnostic, but highly cost focused.
- Recommends that Study Group consider all options – MMF and SMF – that provide best low-cost option for optical server interconnects.
- Clarifying questions asked and answered.

Straw Polls and Motions

Straw Poll #1:
I support the 100GSR Study Group adopting at least one objective for:
A. 100 Gb/s operation
B. 200 Gb/s operation
C. 400 Gb/s operation

- Results:
  - A: Yes: 33 No: 0 Need more information: 0
  - B: Yes: 27 No: 0 Need more information: 5
  - C: Yes: 35 No: 0 Need more information: 1

Straw Poll #2:
For operation at 200 Gb/s MAC rate, I support adopting objectives for:
A. 200 Gb/s operation over 2 pairs of MMF
B. 200 Gb/s operation over 2 pairs of SMF

- Results:
  - A: Yes: 22 No: 0 Need more information: 9
  - B: Yes: 7 No: 2 Need more information: 20

Straw Poll #3:
For operation at 100 Gb/s MAC rate, I support adopting an objective for:
A. 100 Gb/s operation over MMF up to at least 50m
B. 100 Gb/s operation over MMF up to at least 30m
C. Need more information

- Results:
  - A: 21
  - B: 8
  - C: 6

Straw Poll #4:
For operation at 100 Gb/s MAC rate, I support adopting an objective for:
A. 100 Gb/s operation over MMF up to at least 50m
B. 100 Gb/s operation over MMF up to at least 30m
C. Need more information

- Results:
  - A: 20
  - B: 18
  - C: 9
  - Chicago Rules

Straw Poll #5:
For operation at 400 Gb/s MAC rate, I support adopting an objective for:
A. 400 Gb/s operation over MMF up to at least 50m
B. 400 Gb/s operation over MMF up to at least 30m
C. Need more information

- Results:
  - A: 21
  - B: 6
  - C: 6
  - NOT Chicago

Motion #3:
Move to adopt the following objectives:

- Define a physical layer specification that supports 100 Gb/s operation over 1 pair of MMF with lengths up to at least 50 m
- Define a physical layer specification that supports 400 Gb/s operation over 4 pairs of MMF with lengths up to at least 50 m

Moved by: Dave Chalupsky 2nd: Jose Castro

- Technical: >= 75%
- Results: Yes: 21 No: 5 Abstain: 12
- Motion Passes!

Chair announced that Friday start time changed to 9:00 AM instead of 8:30 AM.

Break for the day at 5:58 PM.

Friday, January 24, 2020
Call to order:
Robert Lingle, Jr., Study Group Chair, convened second day of meeting at 9:04 AM CET/ UTC +1.

Chair recapped key items from Thursday's meeting. Study Group discussion about key topics.

Resumed Straw Polls and Motions

Motion #4:
Move to adopt the following objective:

- Define a physical layer specification that supports 200 Gb/s operation over 2 pairs of MMF with lengths up to at least 50 m

Moved by: Mike Dudek 2nd: Kent Lusted

- Technical: >= 75%
- Results: Yes: 23 No: 1 Abstain: 6
- Motion Passes!

Motion #5:
Move to adopt the following objective:

- Define a physical layer specification that supports 200 Gb/s operation over 2 pairs of SMF with lengths up to at least 500 m

Moved by: Earl Parsons 2nd: Dave Lewis

- Technical: >= 75%
- Results: Yes: No: Abstain:
- [Motion eventually withdrawn by Mover and Seconder after discussion noted below, following withdrawal of Motion #6]

During discussion of Motion #5, the Mover and Seconder expressed willingness to withdraw the motion. There was procedural discussion in the room regarding withdrawal vs. motions to postpone or table.

Motion #6:
Move to postpone Motion #5 to the March agenda

- Mover: Mike Dudek 2nd: Ali Ghiasi
- [Motion Withdrawn by Mover and Seconder after discussion noted below]

During discussion of Motion #6, there was further discussion of procedure. No one in the room objected to allowing Movers and Seconders of Motions #6 and #5 to withdraw the motions, in that order. The Movers and Seconders of both motions did so.

Request made by Steve Swanson for Ray Nering to re-present his Thursday presentation "Considerations for 100G-SR" http://www.ieee802.org/3/100GSR/public/Jan20/nering_100GSR_01_0120.pdf for those attendees who were not at Thursday meeting. The room agreed to this request, time permitting. [Eventually, the meeting ran late in the day and this item was possibly postponed to an Ad Hoc call.]

Break at 10:23 AM. Resumed at 10:47 AM.

Straw Poll #6:
I support the 100GSR Study Group adopting objective for:

A. 200 Gb/s operation over 2 pairs up to at least 50 m SMF

- Results:
  - Y: 10
  - N: 10
  - Need more information: 8

Motion #7:
Move to adopt the following objectives:

- Support a MAC data rate of 100 Gb/s, 200 Gb/sand 400 Gb/s
- Support full-duplex operation only
- Preserve the Ethernet frame format utilizing the Ethernet MAC
- Preserve minimum and maximum FrameSize of current IEEE 802.3 standard
- Provide appropriate support for OTN
- Support a BER of better than or equal to 10^-12 at the MAC/PLS service interface (or the frame loss ratio equivalent) for 100 Gb/s operation
- Support a BER of better than or equal to 10^-13 at the MAC/PLS service interface (or the frame loss ratio equivalent) for 200 Gb/s and 400 Gb/s operation

Moved by: Kent Lusted 2nd: Steve Swanson

- Technical: >= 75%
- Results: Yes: 30 No: 0 Abstain: 0
- Motion Passes!

PAR and CSD

Presentation #15:
Title: "Draft PAR 100GSR SG"
Presenter: Mabud Choudhury (OFS)
Draft PAR_100GSR SG

- Study Group reviewed, discussed, updated/improved Draft responses to major PAR form questions.

Presentation #16:
Title: "Draft CSD Responses_100GSR SG"
Presenter: Mabud Choudhury (OFS)
Draft CSD Responses_100GSR SG

- Study Group reviewed, discussed, updated/improved Draft CSD Responses

Lunch break at 12:22 PM. Resumed at 1:36 PM.

Resumed review and update of Draft PAR and Draft CSD Responses.

Motion #8:
Move to adopt the PAR as shown in P802_3db_PAR_Detail.pdf

Moved by: Vipul Bhatt 2nd: Steve Swanson

- Technical: >= 75%
- Results: Yes: 22 No: 0 Abstain: 0
- Motion Passes!

Motion #9:
Move to adopt the CSD responses for "Managed Objects", "Coexistence", "Broad Market Potential", "Compatibility", "Distinct Identity", "Technical Feasibility" and "Economic Feasibility" as written in choudhury_100GSR_04_0120.pdf

Moved by: Mabud Choudhury 2nd: Mike Dudek

- Technical: >= 75%
- Results: Yes: 24 No: 0 Abstain: 0
- Motion Passes!

Chair requested Ray Nering to re-present his presentation at future ad hoc meeting.

Straw Poll on Attendance for future 100GSR Study Group Meetings:
Attend 802.3 plenary, March 2020, Atlanta, GA, USA:
–Y: 17 N: 1 M: 5

Attend 802.3 interim, May 2020, Pasadena, CA, USA:
–Y: 16 N: 0 M: 8

Motion #10:
Move to Adjourn Plenary TF Meeting

- Moved by: Paul Vanderlaan 2nd: Earl Parsons
- Motion approved by voice vote without objection. (Procedural > 50%)

The Study Group meeting was adjourned at 3:22 PM CET/ UTC +1, Friday, January 24, 2020.

Next Meeting:
Next in-person IEEE 802.3 100GSR Study Group meeting is scheduled for week of March 16-19, 2020 for IEEE 802.3 Plenary, Atlanta, GA, USA.

Appendix A: Attendees at the IEEE 802.3 100 Gb/s Wavelength Short Reach PHYs Study Group during Geneva Interim Meeting, 23-24 January 2020.

57 individuals signed in on Thursday, 23 January 2020, 8:30 AM – 5:58 PM HST/UTC -10
40 individuals signed in on Friday, 24 January 2020, 9:04 AM – 3:22 PM HST/UTC -10

Last Name	First Name	Employer	Affiliations	Thu 23 Jan	Fri 24 Jan
Abbott	John	Corning	Corning	x	x
Amezcua	Adrian	Prysmian	Prysmian	x	
Aono	Michikazu	Yazaki	Yazaki	x	
Araki	Nobuyasu	Yazaki	Yazaki	x	
Bhatt	Vipul	II-VI	II-VI	x	x
Brillhart	Theo	Fluke	Fluke	x	
Castro	Jose	Panduit	Panduit	x	
Chalupsky	David	Intel	Intel	x	
Chen	Chan Chih (David)	AOI	AOI	x	x
Choudhury	Mabud	OFS	OFS	x	x
D'Ambrosia	John	Futurewei	Futurewei	x	
Dawe	Piers	Mellanox	Mellanox		x
Dudek	Mike	Marvell	Marvell		x
Emsia	Ali	Tektronix	Tektronix	x	
Ferretti	Vince	Corning	Corning	x	
Ghiasi	Ali	Ghiasi Quantum	Ghiasi Quantum	x	x
Gong	Zhigang	O-Net	O-Net	x	x
Grow	Robert	RMG Consulting	RMG Consulting	x	x
Guedes	Marcelo	IDEA	IDEA	x	x
Gustlin	Mark	Cisco	Cisco	x	
Haasz	Jodi	IEEE	IEEE SA		x
Healey	Adam	Broadcom	Broadcom		x
He	Xiang	Huawei	Huawei	x	x
Heck	Howard	Intel	Intel		x
Hyakutake	Yasuhiro	Adamant Namiki Precision Jewel	Adamant Namiki Precision Jewel	x	x

Ingham	Jonathan	Broadcom	Broadcom	x	x
Isono	Hideki	Fujitsu Optical Components	Fujitsu Optical Components	x	
Jackson	Ken	Sumitomo	Sumitomo	x	
Jones	Peter	Cisco	Cisco	x	
Kimber	Mark	Semtec	Semtec	x	x
Kondo	Taiji	Megachips	Megachips	x	
Klingensmith	William	USG	USG	x	x
Law	David	HPE	HPE		x
Le Cheminant	Greg	Keysight Technologies	Keysight Technologies	x	x
Lewis	Dave	Lumentum	Lumentum	x	x
Lingle, Jr	Robert	OFS	OFS	x	x
Lusted	Kent	Intel	Intel		x
Mahesh	Gopika	Prysmian	Prysmian	x	
Maki	Jeff	Juniper Networks	Juniper Networks	x	x
Maniloff	Eric	Ciena	Ciena	x	
Masuda	Takeo	OITDA/PETRA	OITDA/PETRA	x	
Nering	Ray	Cisco	Cisco	x	x
Nowell	Mark	Cisco	Cisco	x	
Ogura	Ichiro	Petra	Petra	x	
Palkert	Tom	Macom	Macom		x
Parsons	Earl	CommScope	CommScope	x	x
Perez-Aranda	Ruben	KDPOF	KDPOF	x	x
Pimpinella	Rick	Panduit	Panduit	x	x
Radhamohan	Rajesh	MaxLinear	MaxLinear	x	x
Rechtman	Zvi	Mellanox	Mellanox	x	
Rodenkirchen	Robert	Yazaki	Yazaki	x	
Sambasivan	Sam	AT&T	AT&T	x	
Sayre	Ed	North East Systems Associates, Inc.	North East Systems Associates, Inc.	x	
Shiino	Masato	Furukawa Electric	Furukawa Electric	x	x
Sorbara	Massimo	Global Foundries	Global Foundries	x	x

Stassar	Peter	Huawei	Huawei	x	x
Swanson	Steve	Corning	Corning	x	x
Takahara	Tomoo	Fujitsu	Fujitsu		x
Takayama	Kazuya	Nitto Denko Corp.	Nitto Denko Corp.	x	x
Tartagua	Antonio	Ericsson	Ericsson	x	
Thompson	Lance	II-VI	II-VI	x	x
Trowbridge	Steve	Nokia	Nokia	x	x
Vanderlaan	Paul	UL	UL	x	x
Wang	Xinyuan	Huawei	Huawei	x	
Welch	Brian	Cisco	Cisco	x	
Xu	Yu	Huawei	Huawei	x	
Zivny	Pavel	Tektronix	Tektronix		x