Cloud Computing 2021
Keynote Speaking

ISO/IEC Joint Standards for Linux Standard Base
to Support Cloud Computing, IoT, Smart Cities
and 4th Industrial Revolution.

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Leader, ISO/IEC JTC1 SC22 WG24 World Linux Standard Group
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2021.4.22, Porto, Portugal
About the keynote speaker

- Yong (Young) Woo Lee
- Ph.D. from University of Edinburgh, UK
- B.Sc from Seoul National University, Korea
- Best researcher awards in KIST, Korea
- Senior researcher, KIST, Korea
- Principle researcher, KERIS, Korea
- Professor, University of Seoul, Korea,
- Vice president, Korea Internet Society
- President, Institute of Information Tech. UOS
- A Steering Committee Member of “IARIA Cloud Computing Conference” from the first conference till now since 2010.
New ISO/IEC Joint Linux Standards (20) for the Linux Standard Base (LSB)

- 20 = Nineteen standards & One Technical Specification.
- Based on Linux Foundation (LF) 's LSB 5.0.
- Will be published soon.
- ISO = International Organization for Standardization
- IEC = International Electro-technical Commission
- JTC 1 = Joint Technical Committee 1
- SC22 = For Programming Language & Operating system
- WG24 = For Linux Standards
New ISO/IEC Joint Linux Standards

- Linux can be divided into two parts. One is the Kernel and the other is user interface.
- There are more than three hundred Linux Distros. Their kernels are identical (same) but their user interfaces are different from each other. So, it was required to have a common standard user interface for compatibility.
- The user interface has been made into the Linux Standard Base (LSB) by Linux Foundation (LF).
- The nineteen ISO/IEC standards and one TS have been made based on LF’s LSB.
- They will replace the old eight ISO/IEC LSB standards which were published in 2006.
New ISO/IEC Joint Linux Standards

- The standards will make many kinds of Linux distros compatible.
- Virtual Machine and Docker Container method can be alternative ways to use different Linux distros.
Linux Standard Base (LSB)

“The goal of the LSB is to develop and promote a set of open standards that will increase compatibility among Linux distributions and enable software applications to run on any compliant system even in binary form. “

“In addition, the LSB will help coordinate efforts to recruit software vendors to port and write products for Linux Operating Systems.”
Linux Standard Base (LSB)

- “The Linux Standard Base (LSB) is a joint project by several Linux distributions under the organizational structure of the Linux Foundation to standardize the software system structure, including the Filesystem Hierarchy Standard used in the Linux kernel.” - wiki

- “The LSB is based on the POSIX specification, the Single UNIX Specification (SUS), and several other open standards, but extends them in certain areas.” - wiki

- “The LSB compliance may be certified for a product by a certification procedure.” - wiki
# Linux Standard Base (LSB) -wiki

<table>
<thead>
<tr>
<th>Linux kernel-to-userspace</th>
<th>Linux kernel-internal</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓ API stability is guaranteed, source code is portable!</td>
<td>✗ API stability is not guaranteed, source code portability is not given</td>
</tr>
</tbody>
</table>

### API
![System Call Interface](about 380 system calls)

- **MotionBuilder**
- **Siemens NX**
- **BricsCAD**
- **CATIA5**
- **Maya et al.**

- compiled against LSB 5.0 for x86-64

### ABI

- **Linux OS "Alpha"**
- **Linux OS "Bravo"**
- **Linux OS "Charlie"**

- compiled against LSB 5.0 for x86-64

- **binary device driver**

- in Linux kernel 3.0

- **DRM**

- in Linux kernel 3.14

- **DRM**

- in Linux kernel 3.7
Linux Standard Base (LSB)
Linux Standard Base (LSB)

- **06/2001**: LSB 1.0 Initial Release
  - Added specs for PowerPC 32bit.
- **06/2002**: LSB 1.2
  - Added Itanium.
- **07/2002**: Certification Began
  - Added specs for IA32
- **10/2002**: LSB 1.2
  - Certification Began
  - Added specs for Itanium, Enterprise System Architecture/390, z/Architecture.
- **09/2004**: LSB 2.0
- **09/2004**: LSB 2.0.1
  - ISO version of LSB 2.0 is now available.
- **03/2005**: LSB 2.1
- **07/2005**: LSB 3.0
  - Update C++ to gcc 3.4
  - Add data definitions for Classes in libstdc++
  - Complete ElfUpdate3
  - Remove commands and interfaces deprecated in LSB 2.x
  - POSIX Alignment
  - Examine library symbol versions and decide whether to uplift

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Linux Standard Base (LSB)

1) The integration of the ISO standard LSB Core (ISO/IEC 23360)
2) The addition of the LSB Desktop platform

10/2005: LSB 3.1

1) glibc 2.4
2) Binary compatibility with LSB 3.x
3) Easier to use SDK
4) Support for newer versions of GTK & Cairo
5) JAVA (Optional)
6) Simpler ways of creating LSB-compliant RPM packages
7) Crypto API (via the Network Secure

11/2008: LSB 4.0

1) FHS 3.0 Released
2) Qt 3 Removed
3) Modularization
4) Trial Use Components
5) new and upgraded libraries
6) new interfaces

06/2018: LSB 5.0

01/2008: LSB 3.2

1) Support for the interpreted languages Perl and Python
2) Support for printing
3) Support for libasound, the API for the ALSA sound system
4) Core Module Changes
5) C++ Module Changes
6) Desktop Module Changes

03/2011: LSB 4.1

1) Support for ALSA
2) Expansion for printing support
3) Uplift to GTK+ standard
4) Additional test suites
5) Enhancements to the Core specs
6) JAVA removed

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New ISO/IEC Joint Linux Standards

1. ISO/IEC 23360-1-1 Information technology — Programming languages and their environment — Operating systems — Linux Standard Base common definitions

2. ISO/IEC 23360-1-2 Information technology — Programming languages and their environment — Operating systems — Linux Standard Base core specification, generic part

3. ISO/IEC 23360-1-3 Information technology — Programming languages and their environment — Operating systems — Linux Standard Base desktop specification, generic part

4. ISO/IEC 23360-1-4 Information technology — Programming languages and their environment — Operating systems — Linux Standard Base languages specification, generic part

5. ISO/IEC 23360-1-5 Information technology — Programming languages and their environment — Operating systems — Linux Standard Base imaging specification, generic part

6. ISO/IEC 23360-1-6 Information technology — Programming languages and their environment — Operating systems — Linux Standard Base graphics and Gtk3 specification (A technical Specification)
New ISO/IEC Joint Linux Standards

7. ISO/IEC 23360-2-2 Information technology — Programming languages and their environment — Operating systems — Linux Standard Base core specification for IA32

8. ISO/IEC 23360-2-3 Information technology — Programming languages and their environment — Operating systems — Linux Standard Base desktop specification for IA32

9. ISO/IEC 23360-3-2 Information technology — Programming languages and their environment — Operating systems — Linux Standard Base core specification for IA64

10. ISO/IEC 23360-3-3 Information technology — Programming languages and their environment — Operating systems — Linux Standard Base desktop specification for IA64

11. ISO/IEC 23360-4-2 Information technology — Programming languages and their environment — Operating systems — Linux Standard Base core specification for AMD64

12. ISO/IEC 23360-4-3 Information technology — Programming languages and their environment — Operating systems — Linux Standard Base desktop specification for AMD64
New ISO/IEC Joint Linux Standards

13. ISO/IEC 23360-5-2 Information technology — Programming languages and their environment — Operating systems — Linux Standard Base core specification for PPC32

14. ISO/IEC 23360-5-3 Information technology — Programming languages and their environment — Operating systems — Linux Standard Base desktop specification for PPC32

15. ISO/IEC 23360-6-2 Information technology — Programming languages and their environment — Operating systems — Linux Standard Base core specification for PPC64

16. ISO/IEC 23360-6-3 Information technology — Programming languages and their environment — Operating systems — Linux Standard Base desktop specification for PPC64

17. ISO/IEC 23360-7-2 Information technology — Programming languages and their environment — Operating systems — Linux Standard Base core specification for S390

18. ISO/IEC 23360-7-3 Information technology — Programming languages and their environment — Operating systems — Linux Standard Base desktop specification for S390

19. ISO/IEC 23360-8-2 Information technology — Programming languages and their environment — Operating systems — Linux Standard Base core specification for S390X

20. ISO/IEC 23360-8-3 Information technology — Programming languages and their environment — Operating systems — Linux Standard Base desktop specification for S390X
Why? => To support the following

2. Smart Devices : Embedded system.
3. Internet of Things (Internet of Everything).
4. Mobile computing and systems
5. The 4th Industrial Revolution
6. Smart Society.
   ❖ Smart Home, Smart Building, Smart City.
Consideration (1)

- There are explosive need for the open source free operating system to make the smart society, which has been and will be accelerated by cloud computing, smart devices, Internet of Things, the 4th industrial revolution, smart home, smart city, etc. toward the smart society.

- Thus, there has been strong thirstiness toward the free open source operating system and now we see many children of Linux for them.
Consideration (2)

- For example, when we see the case of smart phones, there are Google's Android which is based on Linux, yet we have Tizen and some others that are also based on Linux.

- What I want to say regarding the matter is "Let them go as they want. We will prepare proper and useful Linux standards as a minimal care to the children of Linux and Linux society."

- ISO and IEC standards in Linux can be the very attractive, reliable and useful to Linux end users, Linux industry, Linux market, Linux based convergence industry, and Linux based convergence market.
Current position of Linux

A market based analysis
Cloud Computing

- The size of cloud market is larger than 100 billion US dollars now.
- More than 90% of cloud systems use Linux.
- We can say that all Clouds lead to Linux.
Starting in 2017, every top 500 fastest supercomputer uses Linux as its supercomputer operating system.
Top 500 supercomputers on 2003 June

https://www.top500.org/system/169344/

P4 CLUSTER 2.0 GHZ - GIGE

Site: University of Seoul - Seoul GRID Center
Manufacturer: Self-made
cores: 224
Memory: 0 GB
Processor: Pentium 4 2GHz
Interconnect: Gigabit Ethernet

Performance
Linpack Performance (Rmax) 0.3104 TFlop/s
Top 500 supercomputers on 2003 June

https://www.top500.org/system/169344/

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Operating System:
- Pentium 4 2GHz
- Gigabit Ethernet
- 0.3104 TFlop/s
- 0.448 TFlop/s
- 106,900
- 41,900
- Linux

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List | Rank | System | Vendor | Total Cores | Rmax (GFlops) | Rpeak (GFlops) | Power (kW)
--- | --- | --- | --- | --- | --- | --- | ---
06/2003 | 378 | P4 Cluster 2.0 GHz - GigE | Self-made | 224 | 310.40 | 448.00 |
Linux distributions have become increasingly popular on mainframes in the last decade partly due to pricing and the open-source model. [2013 wiki]

IBM announced its investment of one billion US dollars to Linux in 2000.

In December 2009, computer giant IBM reported that it would predominantly market and sell mainframe-based Enterprise Linux Server. [2013 wiki]

As of March 2016, Red Hat is the second largest corporate contributor to the Linux kernel version 4.14 after Intel. On October 28, 2018, IBM announced its intent to acquire Red Hat for $34 billion. The acquisition closed on July 9, 2019.

The most common operating system for mainframes is IBM's z/OS. Operating systems for IBM Z generation hardware include IBM's proprietary z/OS, Linux on IBM Z, z/TPF, z/VSE and z/VM.
In 2019, Microsoft released Window 10 Linux.

Microsoft released its Windows 10 Update on May 2020.
- A “major” update to Windows 10,
- The biggest change to the May 2020 Update is that it includes the Windows Subsystem for Linux 2 (WSL 2), with a custom-built Linux kernel.
Smartphone OS: wiki.
Linux Based OS for Smart Devices

- Android : Google
- Tizen : Samsung, Intel, ...
- WebOS : LG, ...
- ...........
Embedded System

Please select ALL of the operating systems you are currently using.

- Embedded Linux: 22%
- FreeRTOS: 20%
- In-house/custom: 19%
- Android: 13%
- Debian (Linux): 13%
- Ubuntu: 11%
- Microsoft (Windows Embedded 7/Standard): 8%
- Texas Instruments RTOS: 5%
- Texas Instruments (DSP/BIOS): 5%
- Micrium (uC/OS-III): 5%
- Microsoft (Windows 7 Compact or earlier): 5%
- Keil (RTX): 4%
- Micrium (uC/OS-II): 4%
- Wind River (VxWorks): 4%
- AnalogDevices (VDK): 3%
- Express Logic (ThreadX): 3%
- Freescale MQX: 3%
- Angstrom (Linux): 3%
- Green Hills (INTEGRITY): 2%

Only Operating Systems with 2% or more are shown.

2017 Embedded Markets Study

http://linuxgizmos.com/files/aspencore_os.jpg

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The ISO/IEC Standards for Linux Standard Base are to support the followings.

1. Cloud Computing
2. Internet of Things (Everything).
3. Smart Devices: Embedded system.
4. Mobile Computing and Mobile Systems
5. The 4th Industrial Revolution.
6. Smart Society
   - Smart Home, Smart Building, Smart City
1. The New ISO/IEC standards for Linux standard base are to support cloud computing
Very Useful to Cloud Computing

- For migration in clouds.
  - Migration is moving from one cloud to another.
  - Migration among different clouds.
  - Migration in a hybrid cloud.

- For compatibility

- For portability
Very Useful to Cloud Computing

- Domestic Cloud = Cloud systems inside the smart city
- Foreign Cloud = Cloud systems outside the smart city
Who works for cloud standards?
Who works for cloud standards?

- [https://cloud-standards.org/?title=Main_Page](https://cloud-standards.org/?title=Main_Page)
Cloud Computing is essential for smart devices, IoT, mobile systems, the 4th industrial revolution, smart home, smart cities, and smart society.

https://www.kipost.net/news/articleView.html?idxno=108210
Cloud Computing is essential for the E-government.

Information systems of government agencies integrated and managed together

Seamless & Flawless Operation Achieved
- Stable integrated IT management for 24 / 7
- Monthly system failure time: 67min ➔ 1.15min

IT Management Improved
- 67% of employees licensed for ITIL (IT Infra. Lib.)
- Number of systems managed per person: 1.8 ➔ 13

Security Environment Consolidated
- 8-layer protection/ 4-step analysis against intrusion
- Cyber attack / intrusion detection system equipped
- Dual system for natural disaster relief

※ NCIA: National Computing & Information Agency

Korea’s E-government Best Practices
Cloud Computing is essential for mobile computing.

http://aceadvt.in/2018/10/23/5g-mobile-network/
Cloud Computing is essential for mobile computing.

http://aceadvt.in/2018/10/23/5g-mobile-network/

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Cloud Computing is essential for mobile computing.

https://5gmf.jp/en/about-5g/
Cloud Computing is essential for smart cities
Cloud Computing is essential for the 4th Industrial Revolution.

https://innovate.ieee.org/innovation-spotlight-ieee-fueling-fourth-industrial-revolution/
2. The New ISO/IEC standards for Linux standard base are to support smart devices.
Linux Drives the Open Source Car


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A Linux-powered smart truck by Tesla

“It's not just Tesla with Linux under the hood. Audi, Mercedes-Benz, Hyundai, and Toyota, to name a few, all rely on Linux.”

http://linuxgizmos.com/files/aspencore_os.jpg
Linux Drives Hyundai Smart Cars.

Hyundai Joins AGL and Other Automotive News from CES

By Eric Brown - January 10, 2019

This week’s Consumer Electronics Show (CES) in Las Vegas has been even more dominated by automotive news than last year, with scores of announcements of new in-vehicle development platforms, automotive 5G services, self-driving concept cars, automotive cockpit UIs, assisted driving systems, and a host of electric vehicles. We’ve also seen numerous systems that provide Google Assistant or Alexa-driven in-vehicle interfaces such as Anker’s Google Assistant based Roav Bolt.

Here we take a brief look at some of the major development-focused CES automotive announcements to date. The mostly Linux-focused developments range from Hyundai joining the Automotive Grade Linux project to major self-driving or assisted ADAS platforms from Baidu, Intel, and Nvidia.

Hyundai jumps on AGL bandwagon

Just prior to the launch of CES, the Linux Foundation’s Automotive Grade Linux (AGL) project announced that South Korean automotive

It's a Linux-powered car world

By Steven J. Vaughan-Nichols | January 4, 2019

Linux is everywhere including your car. While some companies, like Tesla, run their own homebrew Linux distros, most rely on Automotive Grade Linux (AGL). AGL is a collaborative cross-industry effort developing an open platform for connected cars with over 140 members.

Figure from https://www.zdnet.com/article/its-a-linux-powered-car-world/

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Drones and unmanned flights

Robots
Robots

Smart Ships

Korea's Competition for Remote Technology of Ships Development

5G Digital Transformation
HYUNDAI HEAVY INDUSTRIES
kt

Remote Technology of Ships Test Operation
SAMSUNG HEAVY INDUSTRIES
SK Telecom

- Smart Ship Start-up Center in Ulsan
  - Improved offshore start-up network
  - Securing Marine Communications Coverage

- 5G-based Smart Shipyard System
  - Secure 360° Wearable Neckband
  - 5G based UHD CCTV
  - 5G based Large Crane Control
  - 5G Kiosk / Download 3D drawings

- Successful test operation 5G-based
  - Construction of 5G Network in Gaoje Shipyard
  - Operate from Daejeon Remote Control Center 250km away

- Autonomous - remote Navigation Model Ship 'Easy go'
  - SHI Independent Development
  - 5G based Lidar
  - Video Control Solution ‘T Live Castor’
  - Cloud based IoT solutions

http://www.maritimekr.org/2020/03/30/korea-jumps-into-developing-the-remote-technology-of-ships/
3. The New ISO/IEC standards for Linux standard base are to support Internet of Things (IoT)

https://sites.google.com/site/theinternetofthingscourse/
Internet of Things (IoT)

• The Internet of Things (IoT) refers to uniquely identifiable objects and their virtual representations in an Internet-like structure.

• Smart Devices + Virtual Representations
Internet of Things (IoT)

• Internet of things is connecting smart things through Internet and making them available through Internet.

• “Companies and organizations explain the Internet of Things in various ways, but the Internet of Things, or IoT, is most commonly described as an ecosystem of technologies monitoring the status of physical objects, capturing meaningful data, and communicating that information through IP networks to software applications.”

• “The recurring themes in all definitions of the Internet of Things include smart objects, machine to machine communication, RF technologies, and a central hub of information. “

• See more at http://blog.atlasrfidstore.com/internet-of-things-and-rfid#sthash.maX6z58Z.dpuf
IoT by Intel
IoT by Intel

The figure: https://www.intel.co.kr/content/www/kr/ko/policy/policy-internet-of-things-iot.html
Cisco & Beecham Research

The Internet of Things

Cisco & Beecham Research

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4. The New ISO/IEC standards for Linux standard base are to support the 4th Industrial Revolution.
The 4th Industrial Revolution

https://innovate.ieee.org/innovation-spotlight.ieee-fueling-fourth-industrial-revolution/

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5.1 The New ISO/IEC standards for Linux standard base are to support Smart Home.
5.2 The New ISO/IEC standards for Linux standard base are to support Smart Buildings
Smart Building

IoT for Smart Buildings

- Security
- Fire Safety
- Lighting
- 24/7 Monitoring
- HVAC
- Energy Management

HVAC (Heating, Ventilation, & Air Conditioning)
5.3 The New ISO/IEC standards for Linux standard base are to support Smart City
Smart City

- is a future city,
- converges ICT & City,
- allows the citizens to use the services anytime, anywhere and with any accessing devices
- and includes smart factories.
Smart Cities
Conference will focus on Scotland’s part in the smarter cities revolution
Posted on: January 8th, 2014 by Will Peakin

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Smart Cities
6. The New ISO/IEC standards for Linux standard base are to support smart society.
Conclusion
The ISO/IEC Standards for Linux Standard Base are to support the following.

1. Cloud Computing
2. Smart Devices: Embedded system.
3. Internet of Things (Everything).
4. Mobile Computing and Mobile Systems
5. The 4th Industrial Revolution
6. Smart Society
   - Smart Home, Smart Building, Smart City
Thank You

Dankie
Gracias
Spasibo
Köszönjük
Grazie
Dziekujemy
Đakujeme
Vielen Dank
Paldies
Kiitos
Tänne teid
谢谢
Obrigado
Σας Ευχαριστούμε
Bedankt
Děkujeme vám
ありがとうございます
Tack