Ubuntu MD April 2021 Meeting

NASA and Open Source Innovations

1. "*Linux started as a hobby operating system and now it's the defacto platform for mobile computing, cloud computing, automobiles, and so much more. Now it's an interplanetary operating system as well*" Jim Zemlin, Executive Director of Linux Foundation 2021

2. Ingenuity Mars Helicopter 2nd Flight April 22, 2021, https://www.youtube.com/watch?v=N9HHH_H5KoU
(https://github.com/readme/nasa-ingenuity-helicopter)

3. Curosity Rover to Mars in 2012 was controlled by NASA with a Linux computer using Xfce on Redhat. Also used Scientific Linux, Debian, Ubuntu and other distros which was determined by the individual scientists.

4. NASA has used open-source programs in it's research and development projects for more than 15 years. (400+ open-source projects https://code.nasa.gov)

5. Open-source programs use in space exploration has been rare, until recently.

6. The International Space Station which is a partnership with other government space agencies is using open-source programs in it's operation and research projects.

7. Open-source technologies used by NASA:
- C+/C++ language
- Python language
- Linux OS
- Java language
- Javascript
- Perl
- HTML
- CSS
- Raspberry Pi (simulations and robotics, Jet Propulsion Lab JPL Hack https://www.pcmag.com/news/nasa-hack-used-a-raspberry-pi)
- Chromium browser

8. SpaceX engineers shared the programming languages they code in are: "C & C++ for flight software, HTML, JavaScript & CSS for displays and python for testing," adding that they "use HTML, JavaScript & CSS. We use Web Components heavily."

9. NASA developed applications that can be used in business (https://software.nasa.gov/) for example:
- Air Traffic Simulator (https://software.nasa.gov/software/ARC-16433-1)
- AI Autonomous Systems (https://software.nasa.gov/software/ARC-14725-1)
- Wiring Fault Detection (https://software.nasa.gov/software/ARC-17046-1)
- 3D Damage Simulation (https://software.nasa.gov/software/LAR-19000-1)

- Complex Practical Engineering Analysis (https://software.nasa.gov/software/DRC-011-003)
- Virtual Reality Training (https://software.nasa.gov/software/KSC-14010)
- Data Set Anomaly Detection (https://software.nasa.gov/software/ARC-16462-1)

10. NASA Data for Developers (https://nasa.github.io/data-nasa-gov-frontpage/)

11. SpaceX the NASA contractor has also embraced open-source applications. SpaceX's Dragon spacecraft runs Linux with flight software written in C++, while the ship's touchscreen interface is rendered using Chromium and JavaScript.
SpaceX starlink Internet satellites use Linux (RT Redhat distro modified for their hardware)

12. Great article on How Open-Source is Fueling Space Exploration, https://www.cxotoday.com/news-analysis/how-open-source-is-fueling-space-exploration/ (Ingenuity Mars helicopter – First powered launch on another planet and it is using an embedded Linux distribution on it's navigation system system)

13. F´ fprime (Software framework for rapid development of embedded systems and spaceflight applications using C++ and Python install)

14. NASA, Raspberry Pi and Mini-Rover https://www.raspberrypi.org/blog/nasa-raspberry-pi-and-a-mini-rover/

15. NASA Software https://software.nasa.gov/ listed by category.
- Business Systems and Project Management
- Design and Integration Tools
- Propulsion
- Data and Image Processing
- System Testing
- Operations
- Vehicle Management
- Autonomous Systems
- Etc…

16. https://iss-sim.spacex.com/ SpaceX simulator docking at Space Station.

All the information in this presentation is from public records and references are provided.