

# Rapid Development using Tyvak's Open-Source Software Approach

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# What is Open-source Development?

- **Development Philosophy**

- Source code is made available to users under license(s)
- Users are developers
- Developers have the freedom to use, study, modify, and redistribute as desired within license rights

- **A Few Supporting Organizations**

- Free Software Foundation
- GNU project collaboration that led to open-source operating systems
- Open-source Initiative

- **Open-source Development Can Apply Both to Hardware and Software**

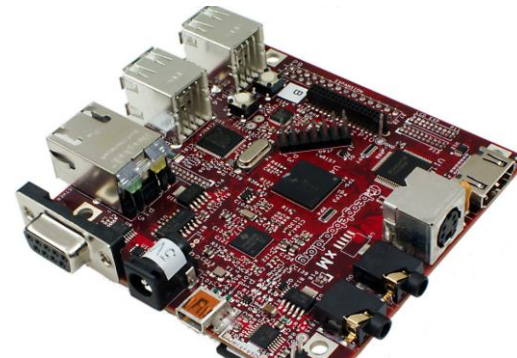
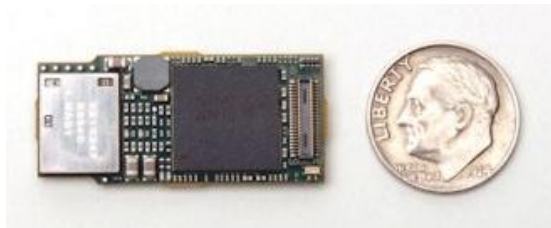
- Computing platforms with large support communities are abundantly available to utilize on CubeSats



# Open Platforms Available for CubeSat Development

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- **Open Platforms Can Be An Advantageous Starting Point for Development**
  - Pre-existing software and hardware support packages
  - Active support communities
  - Solutions to existing problems with popular development platforms
    - Gumstix System-on-Module
    - BeagleBoard Development Kit
    - LogicPD System-on-Module
  - System-on-Module integrates high-performance processing and peripherals into low-volume package



# Development Tradeoffs to Consider using Open Platforms

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- **Hardware Bring-up Timeline**

- Initial mission hardware will require much more bring-up time than expected

- **Software Development Timeline**

- Many open platforms have inexpensive development kits to begin immediate software development
- Required development time will typically reduce after hardware bring-up

- **Pre-existing Software and Modifications**

- Consider development time to implement optimizations and additions to existing software packages
- Research whether a solution already exists and if it fits

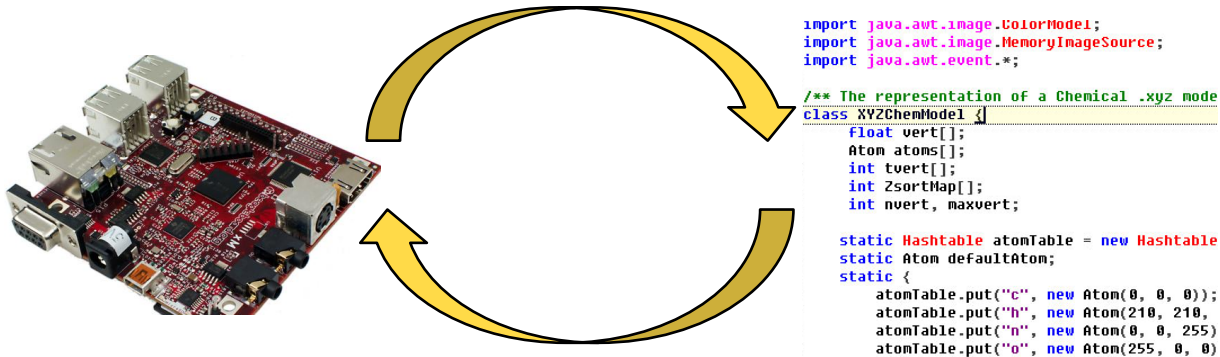
- **Developing Abstractions, Features, and Adding Complexity**

- Heavily consider team's development experience and learning curves
- Abstractions should be implemented wisely
  - Is it extensible, maintainable, necessary?

# Lessons Learned During Project Development

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- **Software and Hardware Teams Should Continue to Collaborate Often**
  - Developing with open platforms doesn't remove the need for frequent hardware and software collaboration



- **Community Support with Open Platforms Varies Significantly**
  - Quality and quantity of support will differ depending on platform
  - Support can range from forums to one-on-one



# Lessons Learned Continued

- **Software Teams Need to Consider**

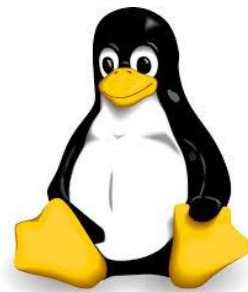
- Development tool preference and learning curves
- Features gained and resulting performance; does an operating system make sense?
- Mixture of high and low-level talents of software personnel; are abstractions necessary?

- **Be Aware of Licensing**

- A number of existing software packages are distributed under GPL, LGPL, etc., which may inherently apply to your software



Development Tool(s)



Linux OS



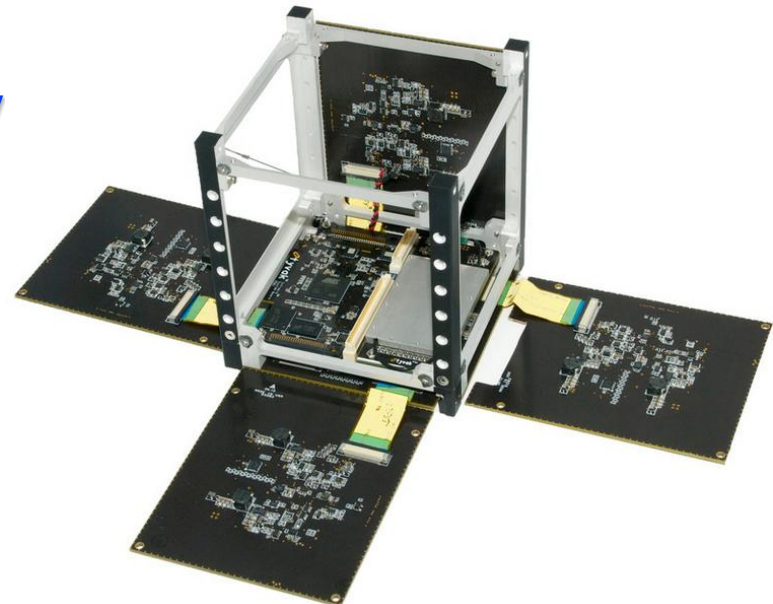
Chibi OS/RT



# Tyvak's Solution using an Open Platform Approach

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- **Intrepid Hardware and Software Solution Implemented Using an Open Platform as a Starting Point**
  - This approach will significantly reduce future development time
  - Support and upgrades of open-source software are available
- **Software Robustness and Reliability Improved**
  - Extensive use of existing software that's been tested over time by developers
  - Reinventing the wheel has reduced for each mission
- **Pre-existing Software Solutions that Directly Apply to CubeSat Missions**
  - Data compression, such as for raw imagery
  - Communication protocols
  - Common hardware peripheral drivers



# Questions

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- **Contact Information**

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