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

- **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

Image of Gumstix System-on-Module and LogicPD System-on-Module
Development Tradeoffs to Consider using Open Platforms

• **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

- **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
Tyvak’s Solution using an Open Platform Approach

• **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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