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FPGA Mission Assurance Center

Satellite Advances in New Mexico

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PTi The POWER of 3
Phillips Technology Institute
Academia | Industry | Government

UNM

Sandia National Laboratories

CubeSat Workshop

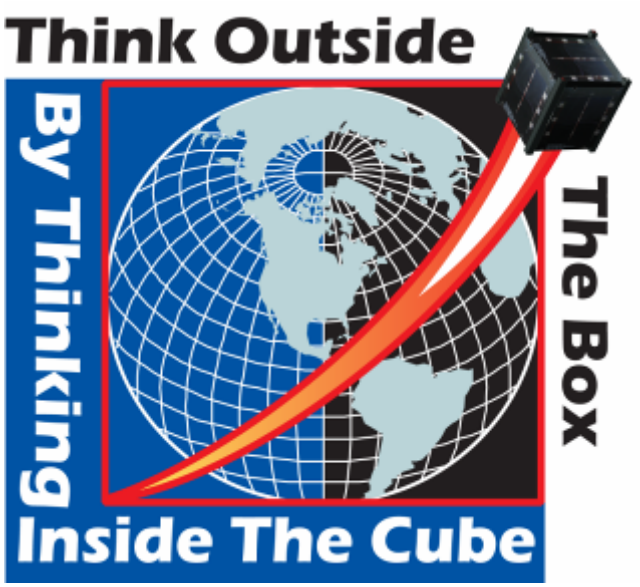
April 2009

Los Alamos NATIONAL LABORATORY EST.1943

SES Consultants, Inc.

Outline

- Why FPGAs and CubeSats fit so well together
- CubeSatCam
- AFRL Space Plug n Play



Courtesy NRO

Out-of-the-box in a Related Industry

Approved Solution:
Newest/cheapest type-certified jet

Seats: 6
Cost: > 2M
Speed: ~400 mph
Efficiency: ~8 mpg
Business: FAILED

http://gulfstreamresale.com/p2index.php?id=77

Out-of-the-Box Solution:
Homebuilt (amateur) 4-place

Seats: 4
Cost: ~200-400K
Speed: ~380 mph
Efficiency: ~25 mpg
Business: Bought by Cessna

http://www.lancair.com/Main/secondary_page_images/ivp_lrg.jpg

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Big contributions can come from seemingly laughable beginnings

Cheap airplanes
Built in garages
Led to …

http://en.wikipedia.org/wiki/Pietenpol_Air_Camper

- Ballistic recovery systems
- Winglets
- Affordable aircraft composite manufacture
- Much lighter weight aircraft engines
- Aviation-safe electronic ignition
- Even private “spacecraft”!

http://www.eaa.org/news/2008/2008-08-29_ab3.asp

http://www.youngeagles.org/photos/gallery.asp?action=viewimage&categoryid=17&text=&imageid=1124&box=&shownew=

http://www.scaled.com/projects/tierone/gallery/X-Prize_1/XPrize_X1_0138

http://www.aero-news.net/news/genav.cfm?ContentBlockID=8ff5714f-6c12-4057-adbd-12e8e1ad4168&Dynamic=1

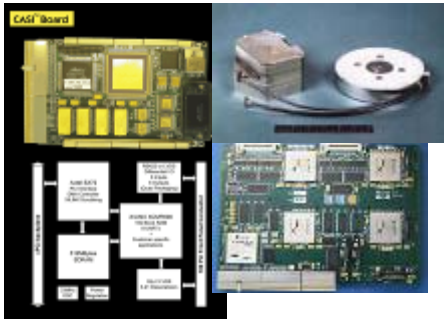
Revolutionizing Space For National Benefit

Cut Launch Cost

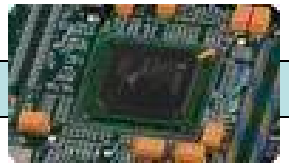
Make Better Use of Launch Capacity

Standardize & Optimize

Miniaturize



Reconfigurable Electronics target highest payoff directly



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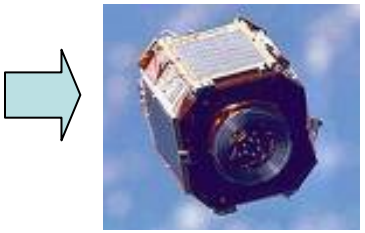
Why FPGA's are so Desirable

- "System on a Chip" -- Reduce parts count/complexity
- Design few rad-hard parts for space and reuse them over and over!
  - Can embed interfaces, CPU's, …
- Speed up processing for time critical functions



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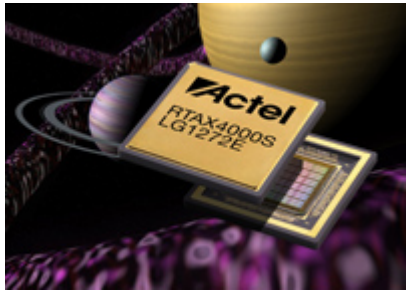
Three Broad Classes of FPGA Contribution

- Low-power, rad-hard, one-time programmable parts



- Low-power, small, reprogrammable parts

- Very large, SoC parts, embedded µP, DSP, etc.

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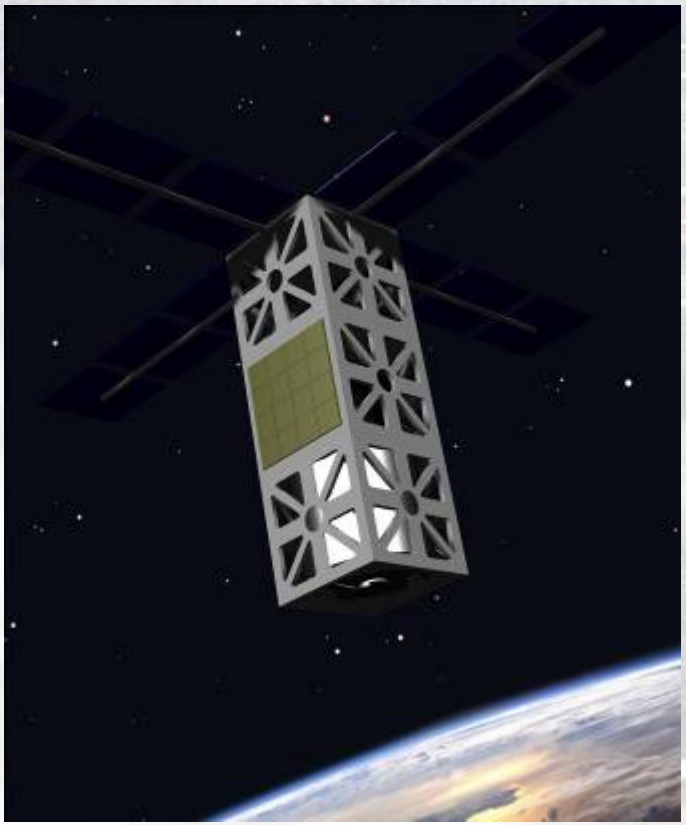
General Idea: CubeSatCam assembles team to test new space philosophy



- Goal: Make the highest resolution space-based camera in a 10cmx10cmx30cm package
- Potential Team:
  - AFRL
  - Aerospace Corporation
  - NASA (Goddard, Ames, JPL)
  - Companies: Xilinx, Dalsa, ATA, Seakr
  - UNM / FPGA Mission Assurance Center (FMAC)
  - Los Alamos Lab
- Proves key FPGA-based electronic capabilities and their benefits

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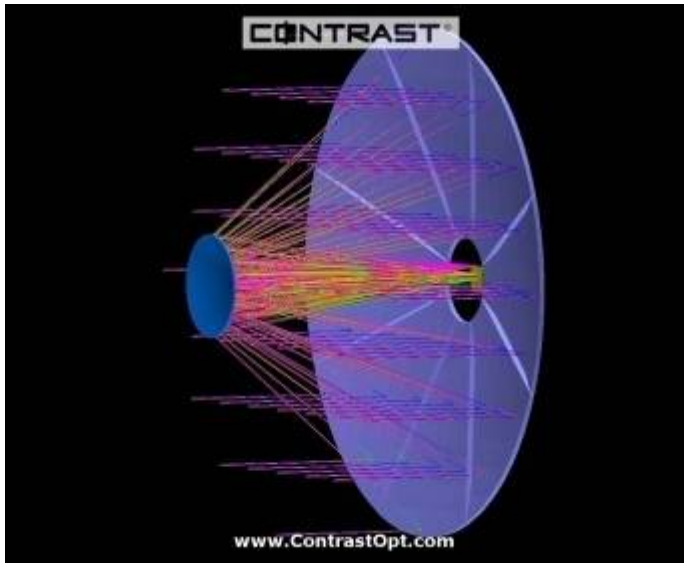
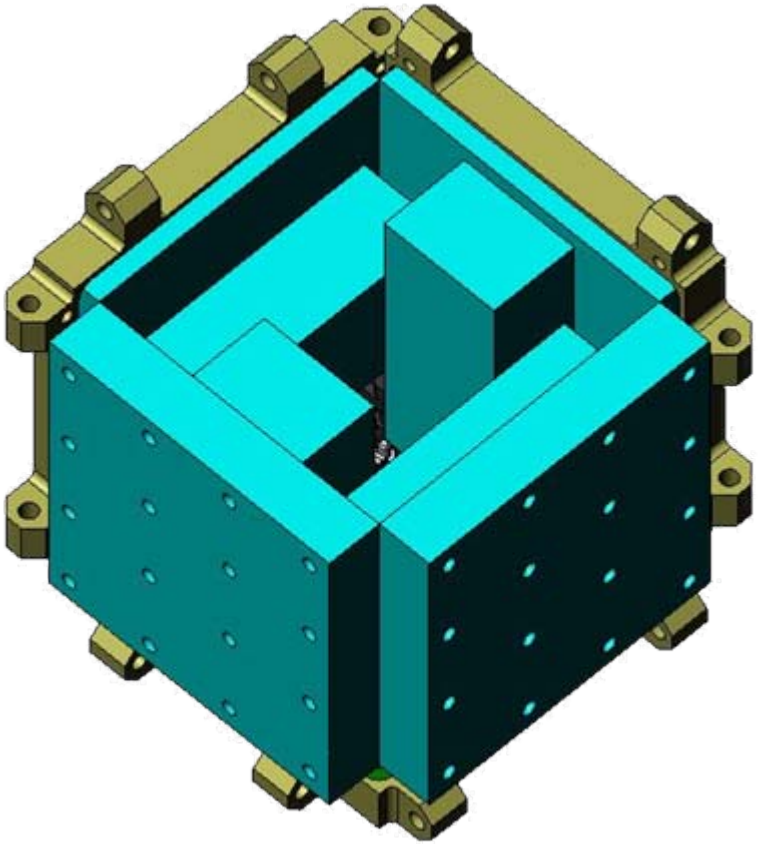
CubeSatCam brings Together a Larger, Agile NM Aerospace Community

- R&D Pulls together with Workforce Development
  - AFRL Power System Engineering Team
  - UNM effort in electronics
  - Possible NMSU effort to prototype and test
- Business Partnerships
  - ATA
  - TransEl
  - Trex
  - Contrast Optical
  - …
- Government/Not-For Profit
  - AFRL, CHOP Shop
  - NM Optics Association
  - NASA Goddard



Contrast Optical concept for CubeSat deployable telescope capable of sub-meter imaging

AFRL CubeFlow



Supporting AFRL's new revolutionary way to do rapidly responsive space with a Plug and Play type of system. This Plug and Play paradigm attempts to bring rapid easy interface to space

The plan is to train 100 organizations in one year. If your organization is interested, contact me!

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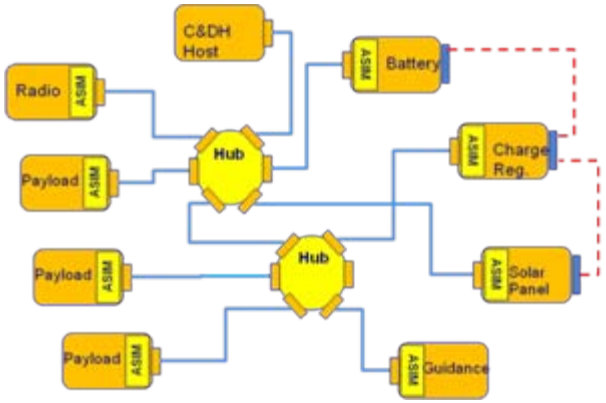
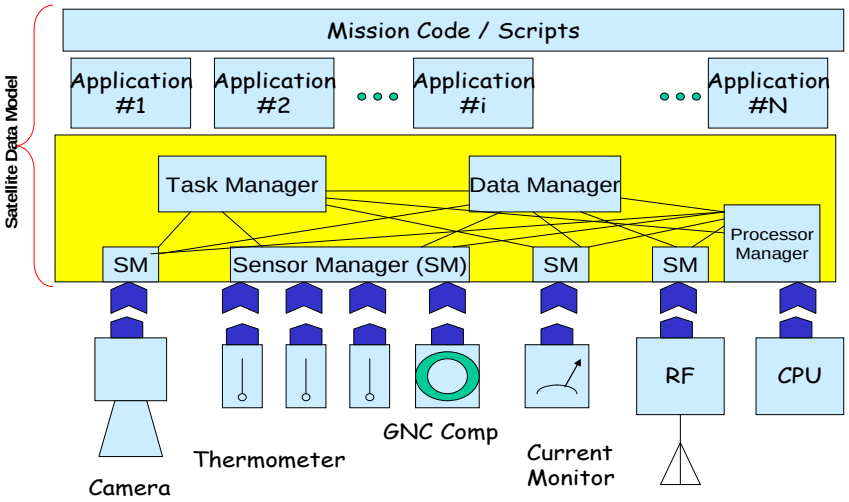
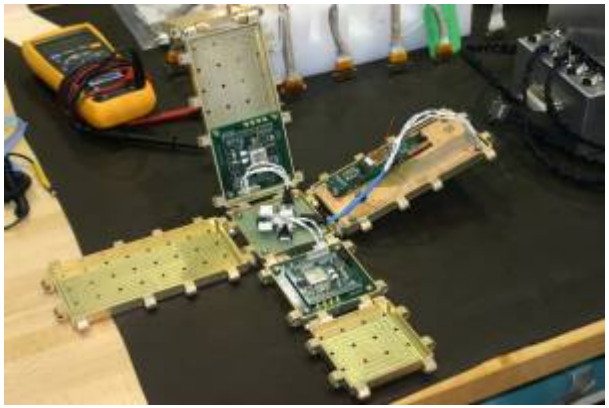
CubeFlow, SDM and ASM

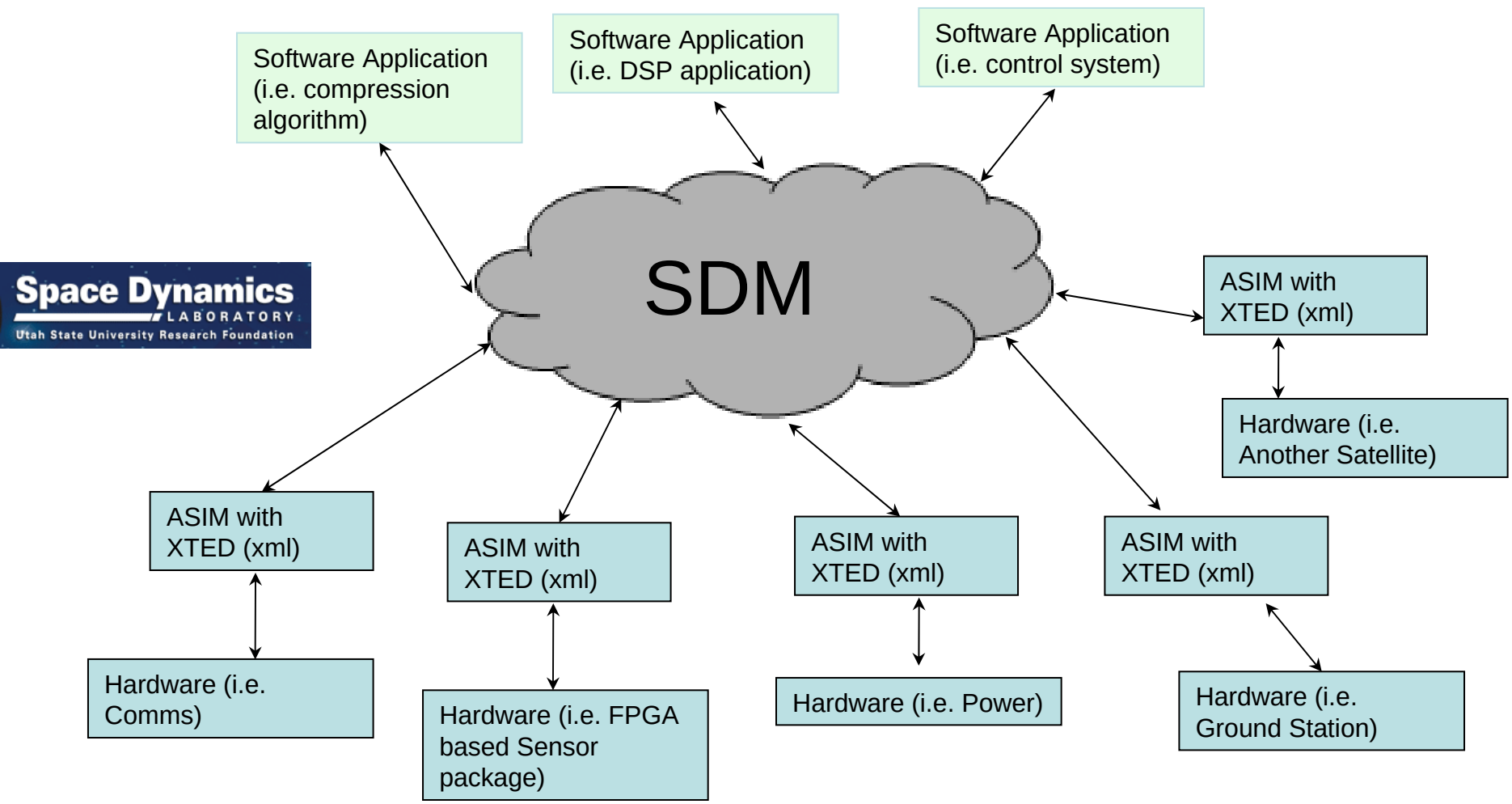






SDM – Satellite Data Module
ASIM – Applique Sensor Interface Module
XTED – eXtended Transducer Electronic Datasheets

SDM Operation (PnP Initialization)



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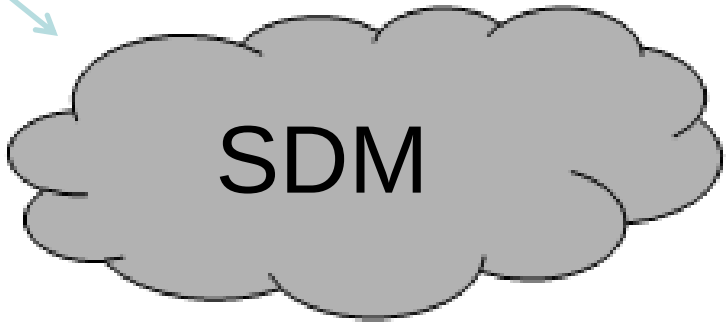
SDM Self-discovery: step 1

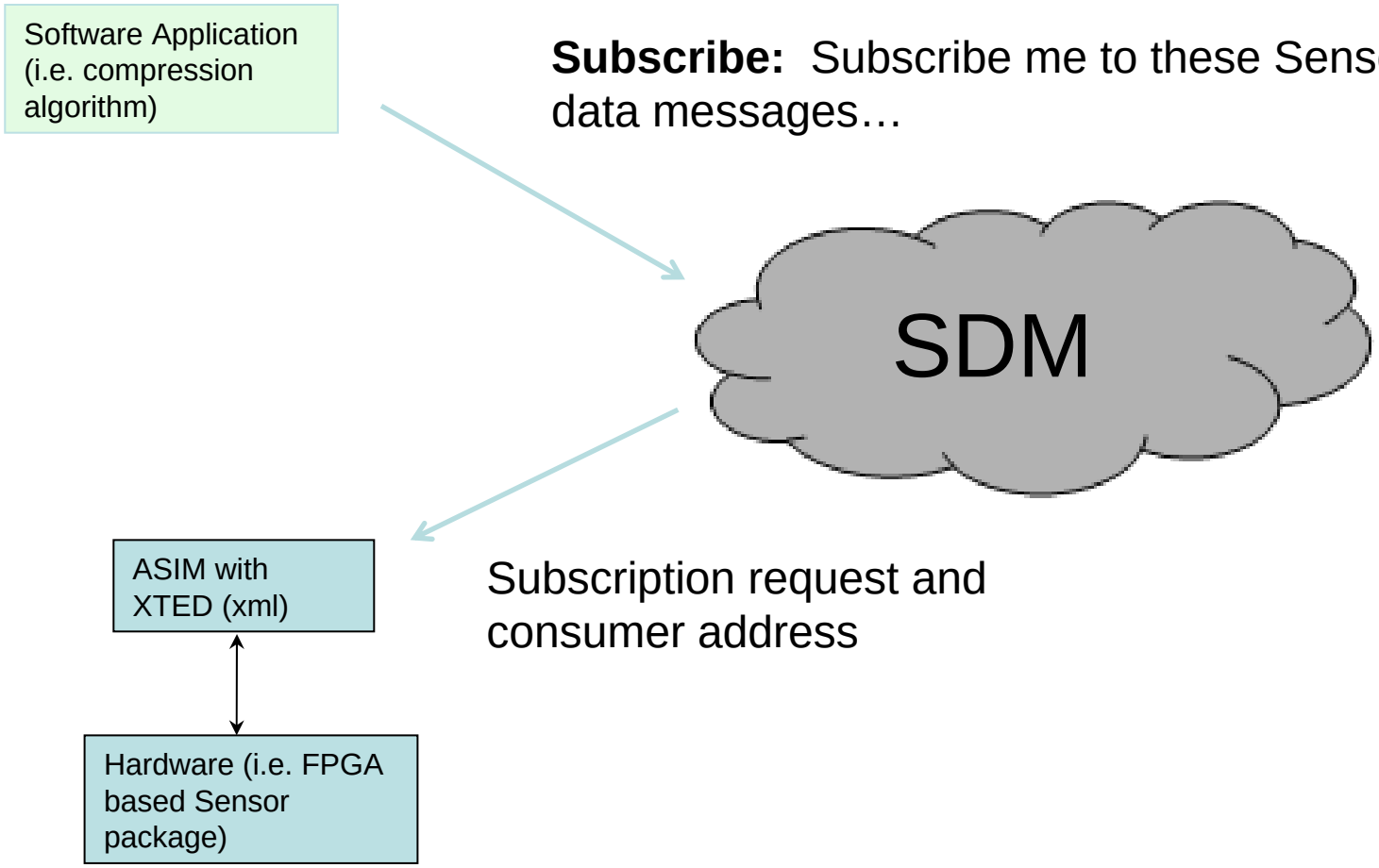
Software Application (i.e. compression algorithm)

Query: Where is the Sensor hardware, how do I control it, and what do the data messages look like? Where is the COM hardware and how do I control it?

Reply info



SDM Self-discovery: step 2



CubeFlow Tools

SDM component software is supported by SDL CubeFlow Tools;

- xTEDs writing, verification, and emulation
- ASIM program development
- Application skeleton development

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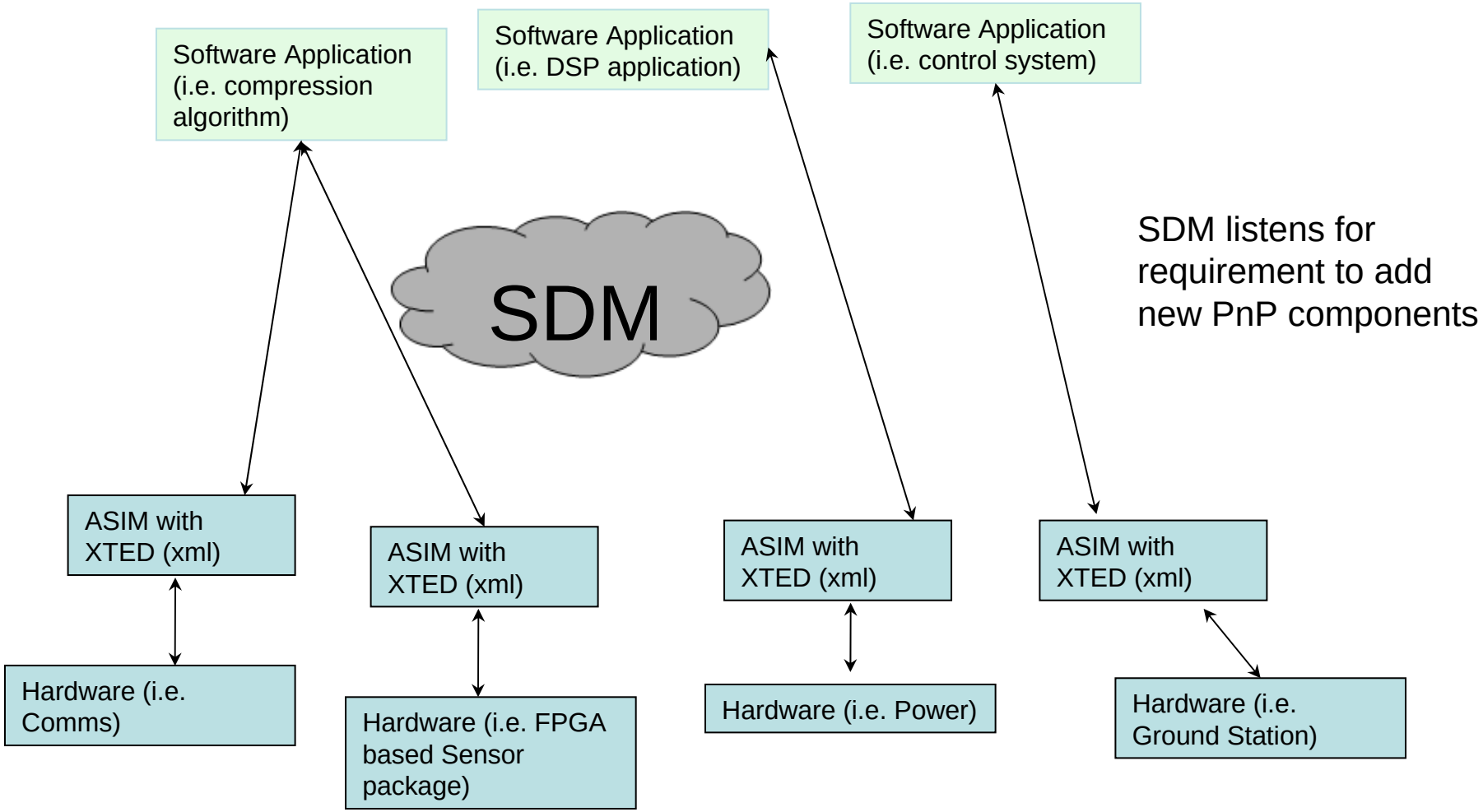
SDM Operation (Normal Ops)



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