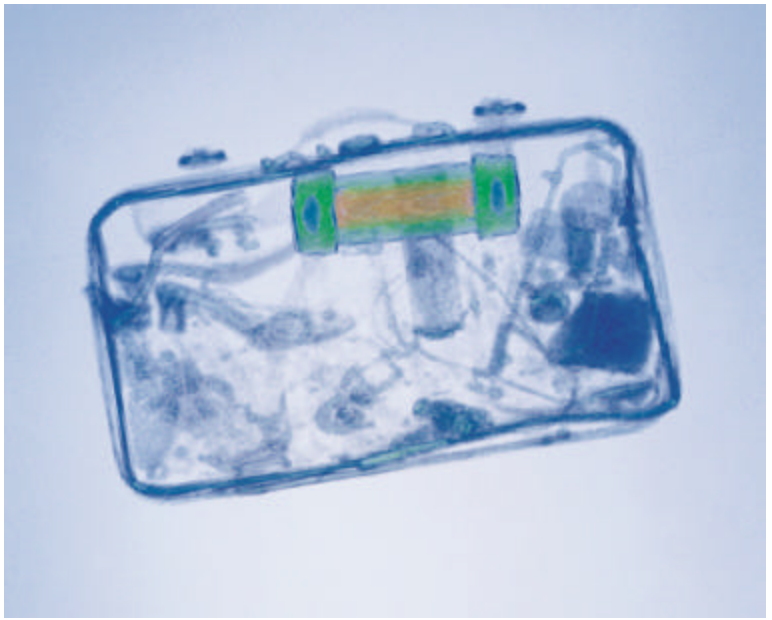
EXACT™ CT Scanner

EXACT: The heart of an FAA-certified Explosives Detection Scanner



3-D Image

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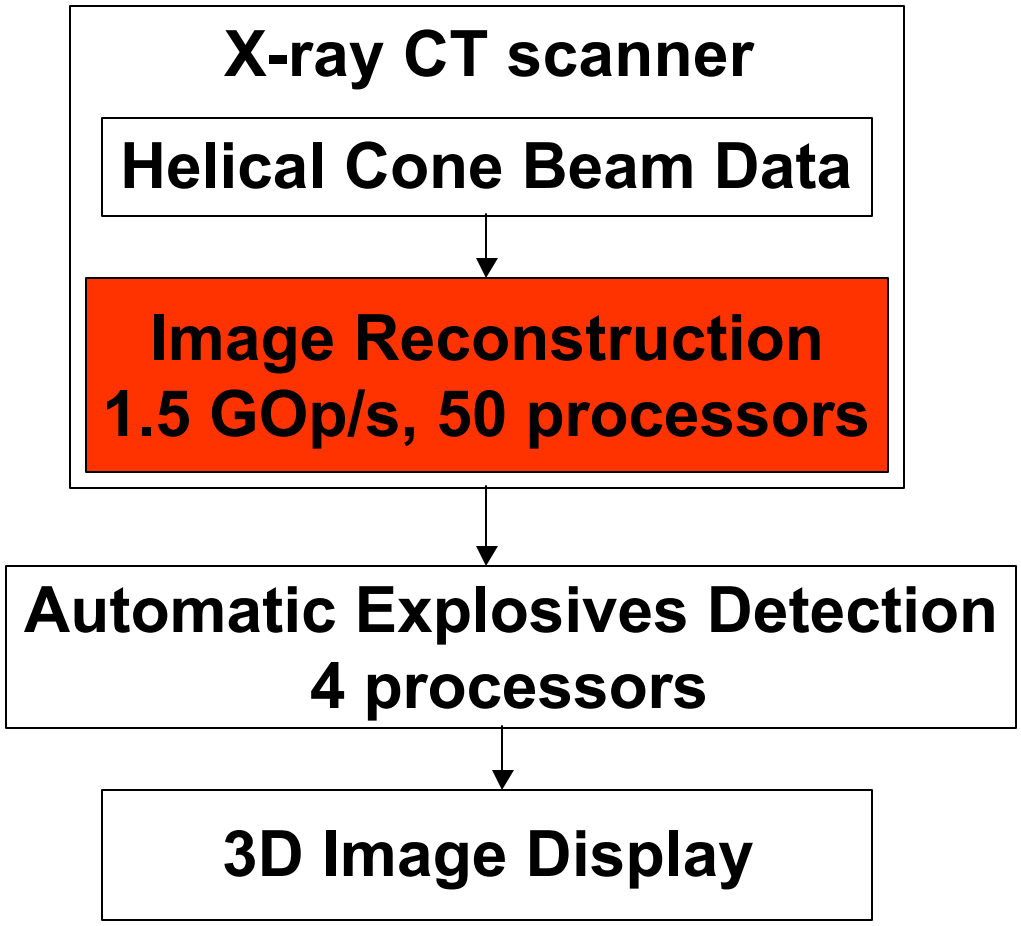
System Block Diagram



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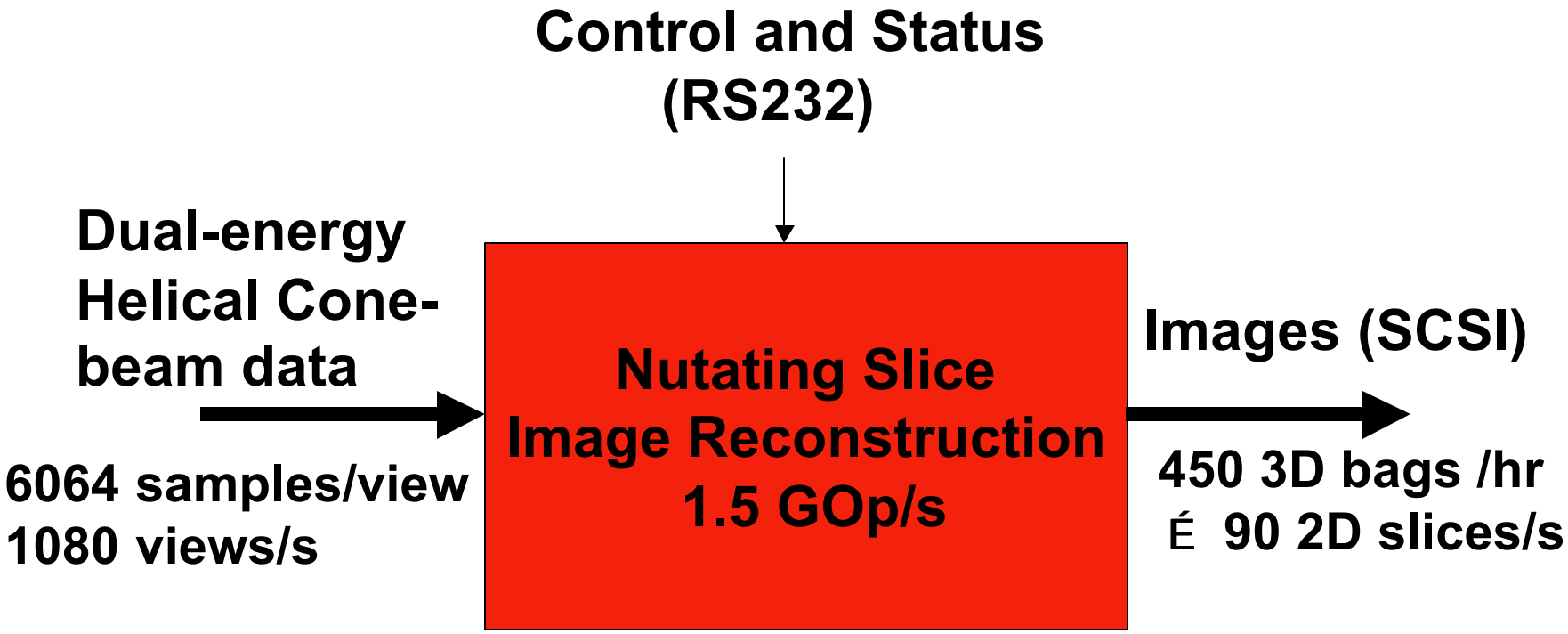
Reconstruction Engine Requirements



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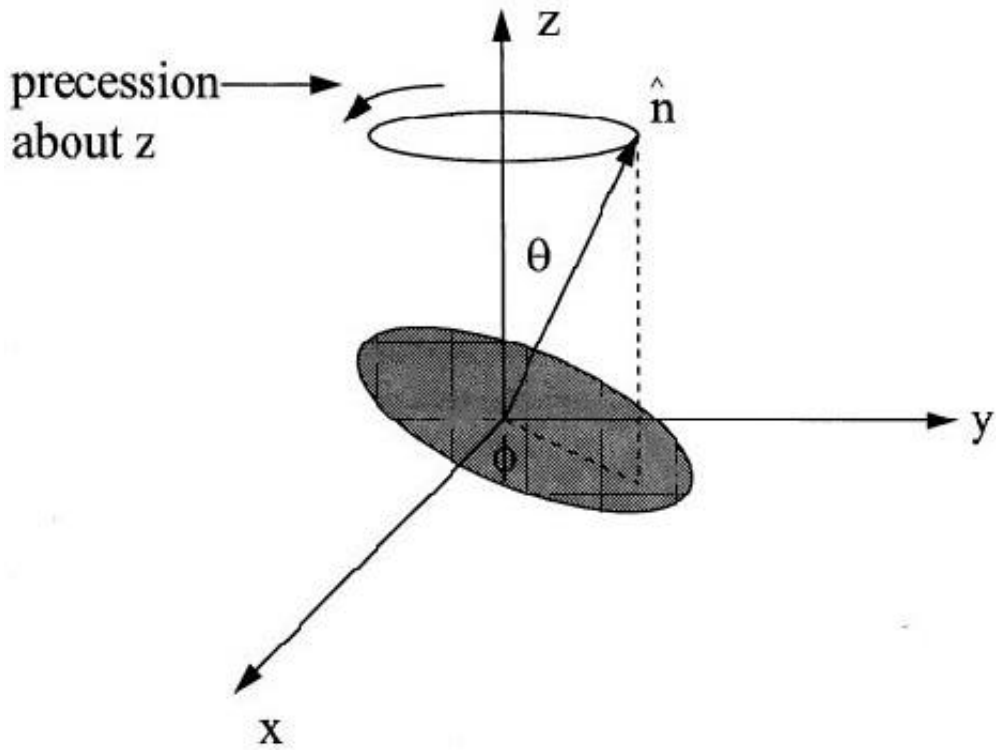
Reconstruction Algorithm

- **Nutating Slice Reconstruction**
- **Prerequisite: cone beam data corrected for detector imperfections**



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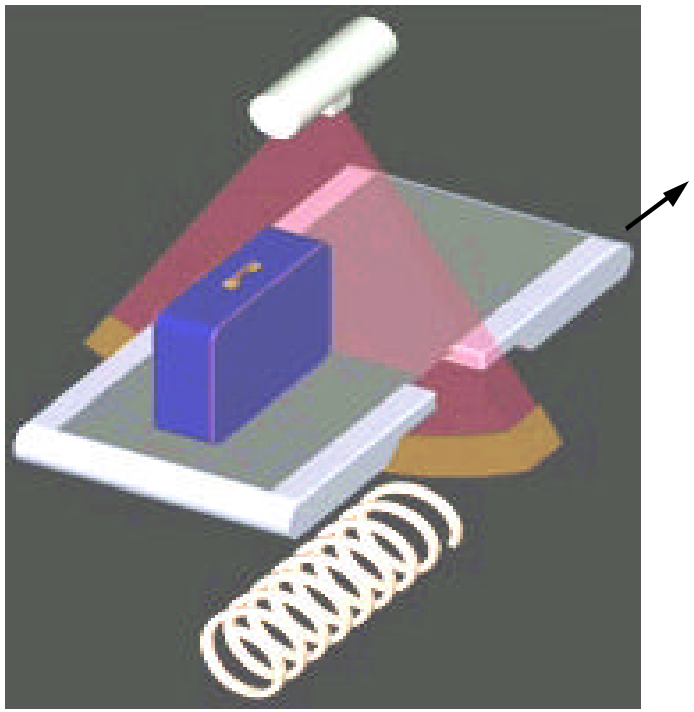
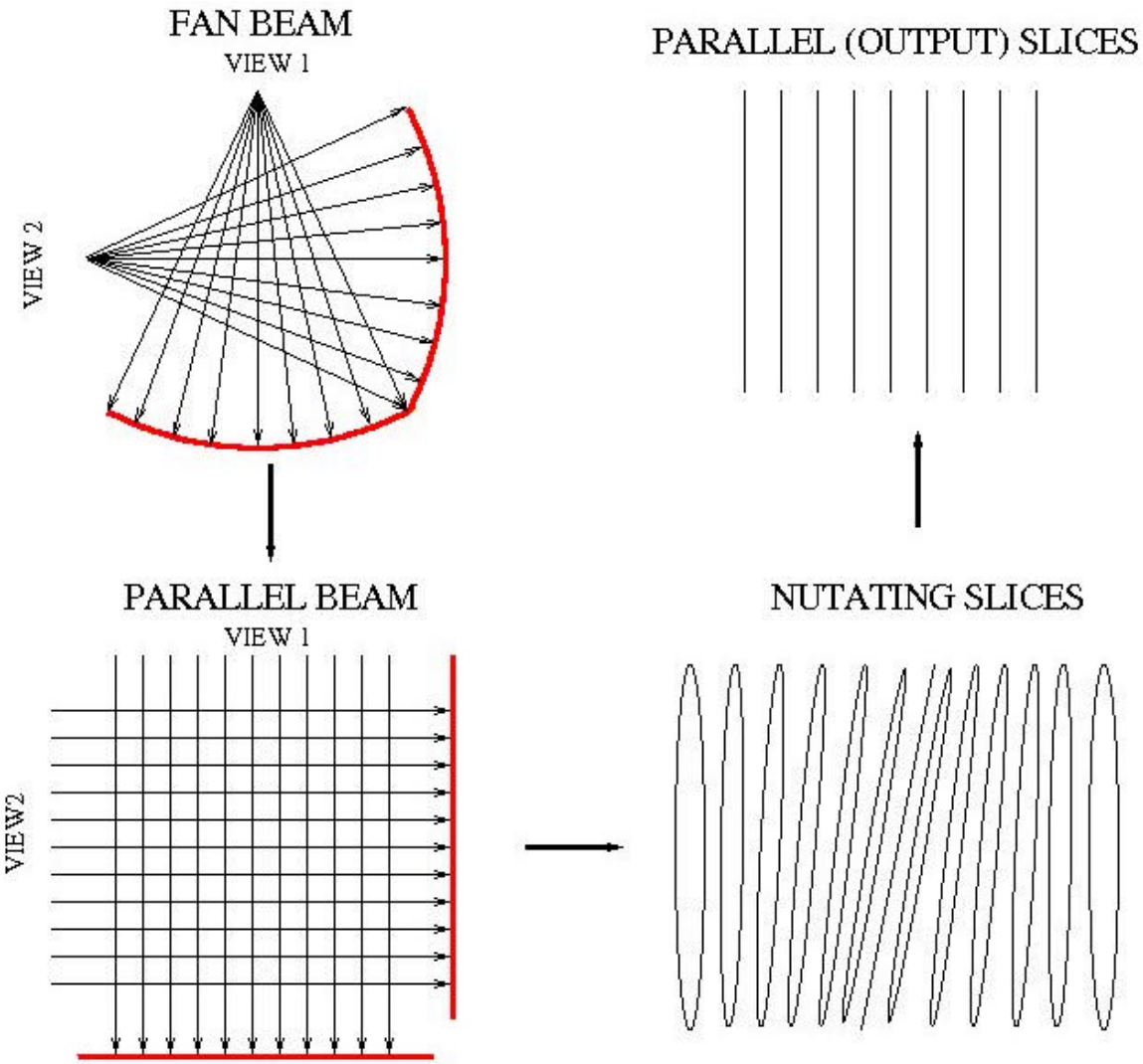
Nutating Slice Reconstruction

HELICAL CONE-BEAM





SKYpack* Computer

- Application-specific repackaging of standard 6U VME product
  - originally developed for DARPA SAST program
- Dual use in commercial applications
  - explosives detection
  - medical CT image reconstruction

*SKY Computers, Chelmsford, MA

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SKYpack Components

- 1 RISC processor for I/O control
- 12 RISC processors for compute processing
  - Labeled AP0-11 in diagram
- 6 SHARC processors
- 6 ASIC processors
- Shared Bus: SKYchannel

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SKYpack Partitioning

- High and low energy images reconstructed on different SKYpacks
- Processes are data driven and asynchronous

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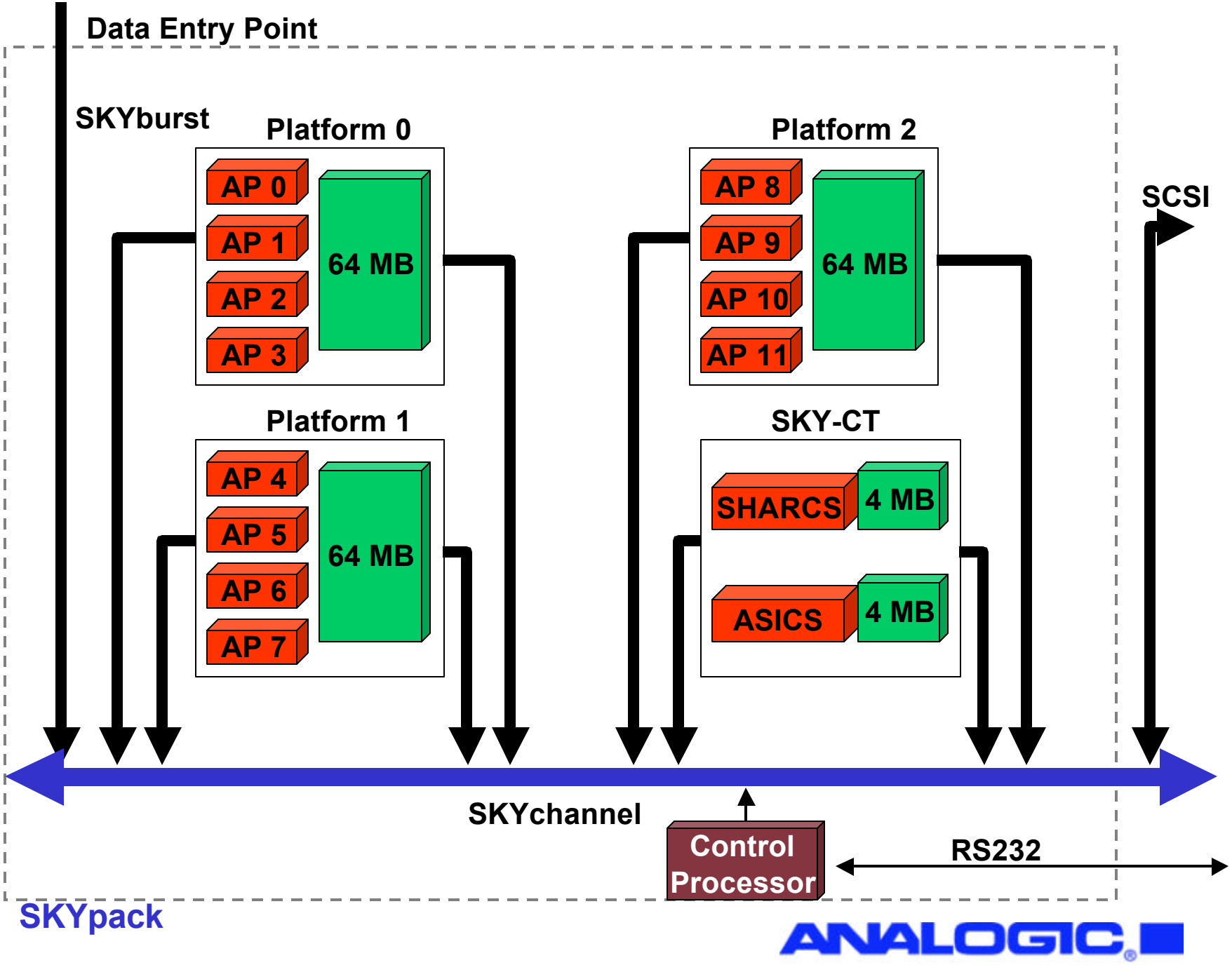
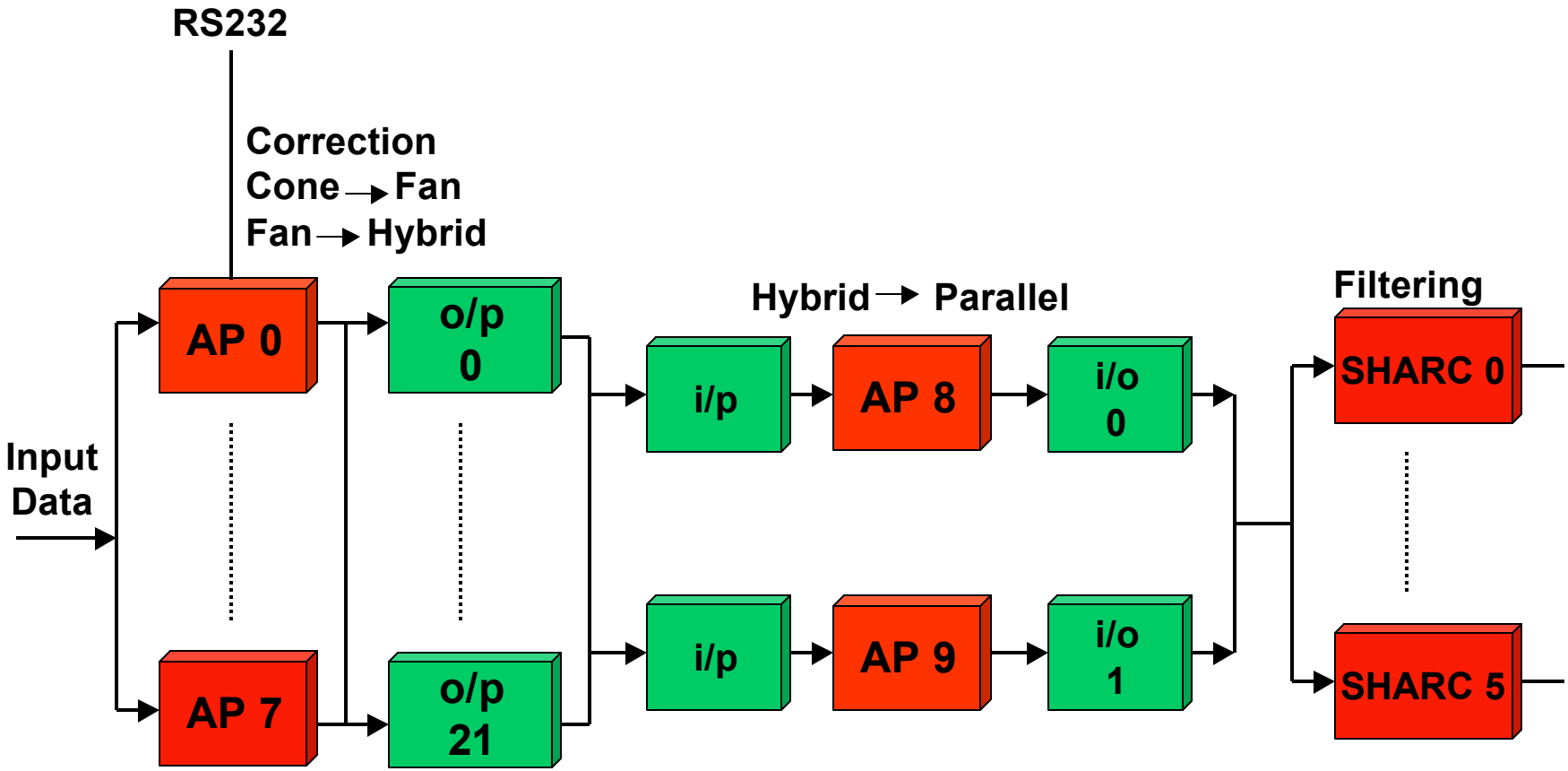

Data Entry Point
SKYburst
Platform 0
AP 0
AP 1
AP 2
AP 3
64 MB
Platform 2
AP 8
AP 9
AP 10
AP 11
64 MB
SCSI
Platform 1
AP 4
AP 5
AP 6
AP 7
64 MB
SKY-CT
SHARCS
4 MB
ASICS
4 MB
SKYchannel
Control Processor
RS232
SKYpack
ANALOGIC

SKYpack Partitioning



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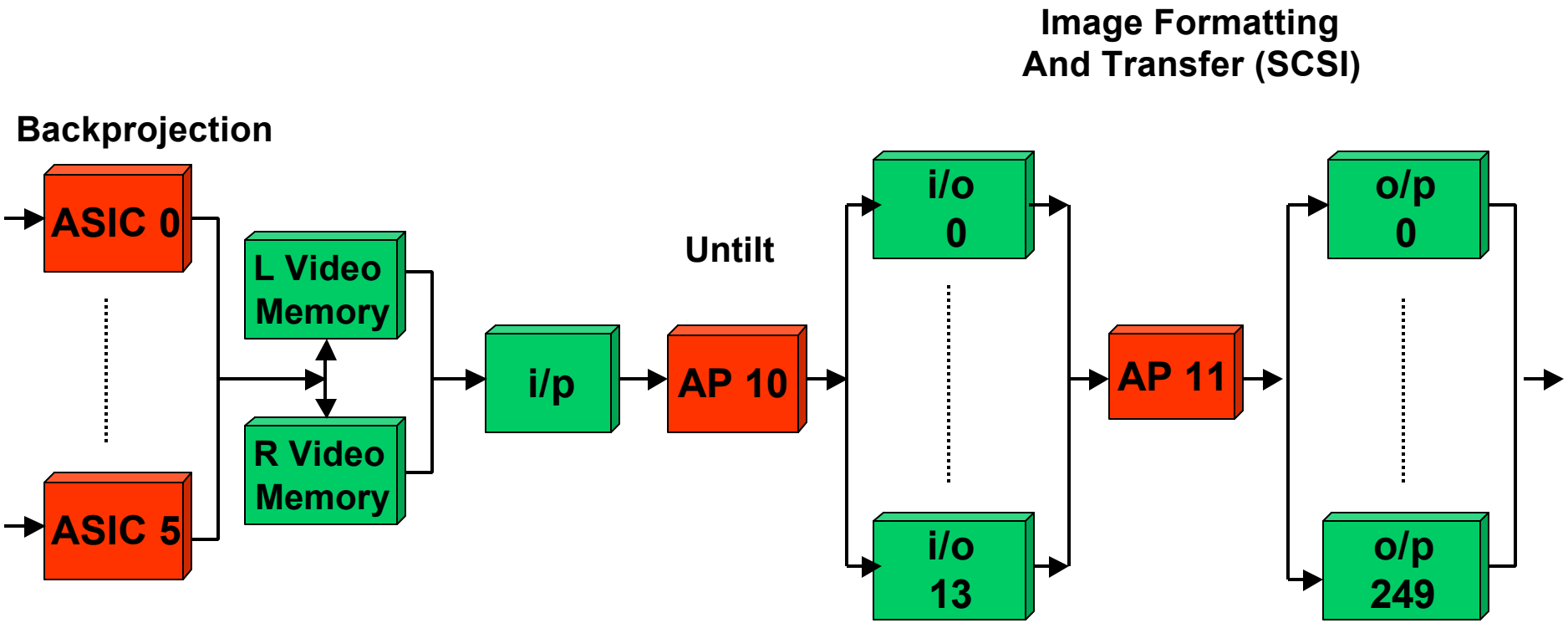
SKYpack Partitioning *cont'd*



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SKYpack Partitioning

- System processor distributes cone beam data to AP 0-7
- AP 0 does RS232 communication and controls other processors
- AP 0-7 correct and convert cone to hybrid data
- Each cone view contributes to 22 slices, every 12th view a new slice is created

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SKYpack Partitioning

- AP 8-9 convert hybrid data to parallel
- SHARCs high pass filter parallel data using FFT
- ASICs backproject filtered data into tilted slices
- AP 10 untilts tilted slices into parallel
- AP 11 formats images and carries out SCSI communication

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Verification and Validation

- Offline, single process software was implemented
- Simulations to verify offline software
- Intermediate results from offline software matched with online software

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Automatic Detection Subsystem

- Consists of four processors
- Does image analysis, archiving and display
- Image data is propagated along two paths that search for two classes of explosives
- Each path uses detection and discrimination algorithms

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References

- **"Nutating Slices CT Image Reconstruction Apparatus and Method"** United States Patent: 5,802,134, September 1998
- **"Parallel Processing Architecture for Computed Tomography Scanning System using Non-Parallel Slices"**
  United States Patent: 5,887,047, March 23, 1999
- **"Computed Tomography Apparatus and Method for Classifying Objects"**
  United States Patent: 6,317,508, November 13, 2001

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