

# Aries PCIe<sup>®</sup> Smart Gearbox

## Portfolio Brief

Asteralabs is a worldwide leader in purpose-built connectivity solutions for AI and cloud infrastructure. It is at the forefront of software-defined architectures that are both scalable and customizable. With PCIe<sup>®</sup>, CXL<sup>®</sup>, and Ethernet-based semiconductor solutions, Asteralabs addresses data, memory, and networking bottlenecks while fostering trusted partnerships with hyperscalers and the broader data center ecosystem.

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## Benefits and Features

- Gearbox rates: 64 GT/s to 32 GT/s, 32 GT/s to 16 GT/s, 16 GT/s to 8 GT/s, 8 GT/s to 5 GT/s, 5 GT/s to 2.5 GT/s
- Optimized for Full Line-Rate Throughput-Matching
- Supports Flit-Mode (FM), Non-Flit-Mode (NFM), and FM-NFM translation.
- Supports reach extension on both ends while supporting different data rates
- Long reach SerDes for maximum-loss channels
- Host and Downstream Port Containment (DPC) and Advanced Error Reporting (AER)
- TLP poisoning and hardware interrupt generation in the event of uncorrectable error
- Extensive diagnostics: PCIe protocol trace capture, LTSSM log, RX margining, Loopback, Generate/Check PRBS
- Advanced in-band and out-of-band diagnostics for fleet management, large-scale server deployments
- Configuration through external SPI flash memory, management via I2C/I3C
- Full-featured SDK for rapid integration of advanced diagnostics features
- Sideband and in-band firmware update, with option to disable in-band update path

## Applications

- Lane conservation between CPU and NICs, and CPU and SSDs
- Rate-matching for double density GPU to CPU connection
- Datacenter reach extension with slim cables

## Description

The Aries Gearbox portfolio facilitates high-bandwidth, low-latency interconnectivity between PCIe components such as CPUs, GPUs, Network Interface Cards (NICs), SSDs, and more. Aries Gearbox is optimized for throughput matching between devices of adjacent PCIe generations (PCIe N to PCIe N-1) providing line-rate connectivity. Each port is independent and may operate at 64 GT/s, 32 GT/s, 16 GT/s, 8 GT/s, 5 GT/s, or 2.5 GT/s with a link width of x16, x8, x4, x2, or x1.

## Product Family Information

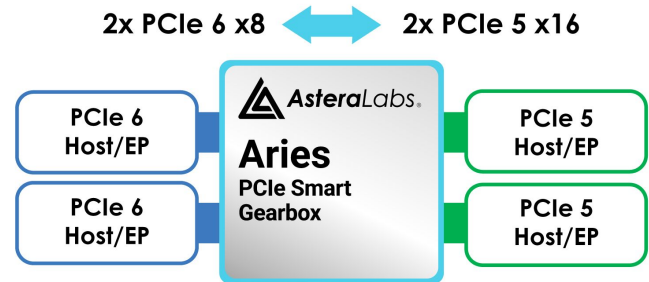
Part #	From (Lanes @PCIe Gen)	To (Lanes @PCIe Gen)	Total Lanes	Status	Compatibility
PG6016 (21 x 21 mm)	8L @ PCIe 6 8L @ PCIe 5 8L @ PCIe 4	16L @ PCIe 5 16L @ PCIe 4 16L @ PCIe 3	24	Sampling	Seamless HW and SW upgradability utilizing industry standard footprints and COSMOS
PG6032 (29 x 29 mm)	8+8L @ PCIe 6 8+8L @ PCIe 5 8+8L @ PCIe 4	16+16L @ PCIe 5 16+16L @ PCIe 4 16+16L @ PCIe 3	48	Sampling	

The integration of long-reach SerDes technology on both ports of Aries Gearbox ensures robust performance even over maximum-loss channels. This enables the use of lower-cost PCB material and multi-connector topologies.

Aries Gearbox is designed to minimize board design complexity with features such as small package body size, low power dissipation, signal-integrity-optimized high-speed signal escape, two power supplies, integrated power supply decoupling, and single PCIe reference clock. In addition, general-purpose I/Os are available with firmware-defined functionality for interrupt signaling, LED control, SPI mux control, or other customizable functionality.

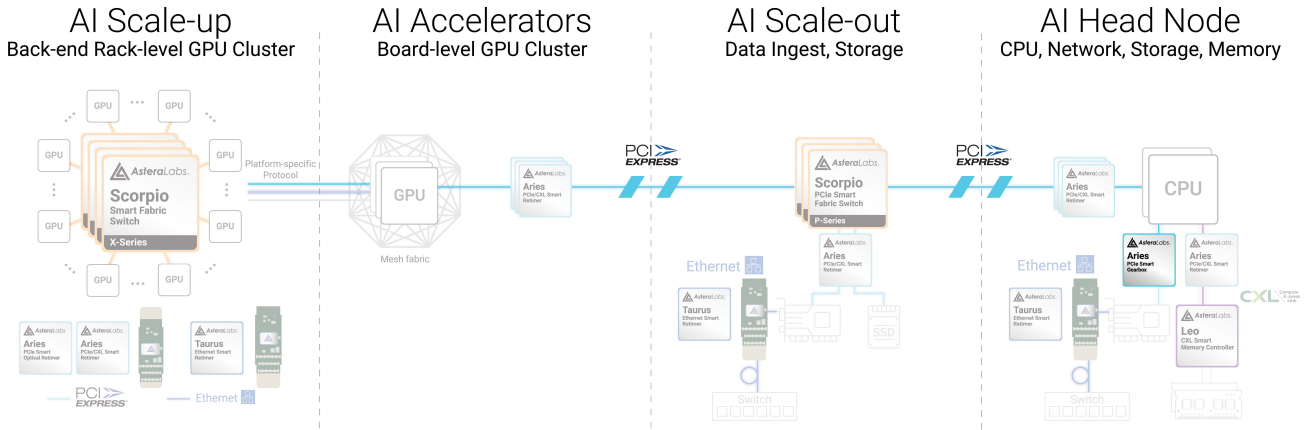
COSMOS advanced fleet management and telemetry features support robust monitoring and debugging for PCIe links directly connected to Aries Gearbox. Each port features a detailed LTSSM state logger and protocol trace capture buffer to simplify protocol-level and electrical-level debug. On-die temperature, process monitoring, and voltage sensors facilitate environmental monitoring and operational management. Full-featured Software Development Kits (SDKs) facilitate rapid deployment of advanced telemetry and monitoring at large scale, abstracting complex tasks such as electrical parameter monitoring into easy-to-use APIs.

*Typical Application Block Diagram*



# AI Server Platform Applications

Aries Smart Gearbox optimizes high-speed CPU-to-NIC connectivity by intelligently bridging PCIe generations and lane widths. This conserves valuable CPU PCIe lanes while ensuring maximum throughput across the system, enabling more efficient and scalable AI/cloud architectures.



# Astera Labs' Intelligent Connectivity Platform

The rapid growth in AI and the accelerated pace of AI platform design cycles is driving the need for exponential compute at cloud-scale, and purpose-built connectivity solutions are required to unlock the full potential of AI and cloud infrastructure.

Driven by the growth of AI workloads at scale, Astera Labs devised the innovative concept of the Intelligent Connectivity Platform, allowing holistic design with monitoring and tracking capabilities for long-term health and performance of connectivity infrastructure. The Scorpio Smart Fabric Switch Portfolio adds to an already long list of ICs, Modules, and Boards that support the unified COSMOS connectivity infrastructure.

## Intelligent Connectivity Platform

Customizable, Interoperable, Reliable, High-Performance, Cloud-Scale

### COSMOS Platform APIs

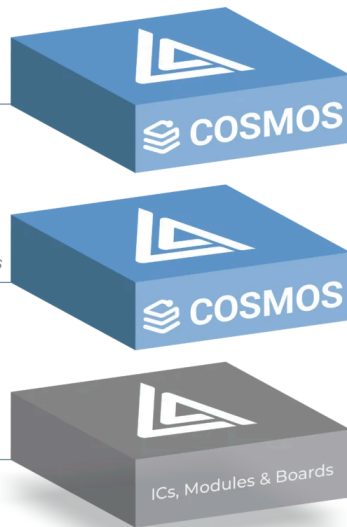
Link, Fleet, RAS Monitoring & Management  
Running on Baseboard/System Management Controllers

### COSMOS Embedded Software

Performance & Protocol Optimization  
Diagnostics, Alerts & Analytics  
Data Integrity & Security  
Running on Microcontrollers Integrated in Astera Labs ICs

### ICs, Modules & Boards

High-Speed Connectivity Solutions  
PCI EXPRESS CXL Compute Express Link Ethernet  
Integrated Matrix of Microcontrollers & Sensors



### Cloud Infrastructure Management Software Stack

