CodeChips are virtual ASICs. Unlike traditional integrated circuits with fixed features, CodeChips are system-on-a-chip solutions that are integrated onto advanced leading-edge programmable gate arrays. CodeChip’s design and feature flexibility allow for lower costs, dramatically faster development cycles, and rapid response to changing requirements. Our CodeChips provide flexible next-generation solutions allowing our customers to meet their growing broadband connection needs.

Cost Savings of an ASIC with Ultimate Flexibility
Key Product Lines

CodeChip™ Product Line
CodeChips are system-on-a-chip solutions that are integrated onto advanced leading-edge FPGAs. Arrive’s flexible CodeChip architecture allows for design changes in real-time, while providing flexibility to accommodate multiple design requirements, adapt to variances in worldwide network standards, and adjust to future technical standard changes—all at a price competitive with fixed-feature ASICs. PCB size, BOM, and power consumption are also reduced by the Arrive CodeChip family.

The CodeChip family begins with a series of core features. From these, each specific design is built to specifications agreed upon by the customer and Arrive.

There are currently three CodeChip families:

- Pseudowire CodeChips
- SONET/SDH CodeChips
- Carrier Ethernet CodeChips

Arrive is currently developing a new family of Next Generation CodeChips™. This new family will add SDN-Ready capabilities to Arrive’s CodeChip products. This new capability will be known as FreeFlo™.

The CodeChip Advantage
CodeChip is more than just IP blocks for FPGAs. An Arrive CodeChip includes the full FPGA Image, a full software development kit including APIs and Drivers, and is backed by the integration and testing experience of Arrive. Many customer applications require combinations of these product lines. Arrive has the experience to combine these solutions effectively.

Multiservice ADM ASIC Product Line
Arrive also specializes in high capacity ASIC devices. The AT4848 is a highly integrated OC-48/STM-16 or OC-12/STM-4 or OC-3/STM-1 Multiservice ADM (Add/Drop Multiplexer) on a chip. Devices in this family can be used in a variety of voice and data over SONET/SDH systems including Multiservice Provisioning Platforms (MSPP), broadband access and enterprise customer premise equipment with an integrated ADM.
Pseudowire CodeChips

Arrive’s Pseudowire CodeChip product line offers a family of complete pseudowire and mobile backhaul CodeChip devices. Arrive provides total solutions in groupings of 1 to 32 E1/DS1/J1 lines; aggregation nodes with up to 84/63 DS1/E1 lines; high-density nodes with 336/252 DS1/E1 lines; or very dense nodes with 1344/1008 DS1/E1/J1 lines. The aggregation and higher density nodes use SONET/SDH interfaces for service side connection. The Pseudowire CodeChip family is described in more detail on the Arrive website.

Pseudowire CodeChip Applications

- Metropolitan Area Network Aggregation
- PON, Cable and Wimax backhaul systems
- Gateway of Pseudowire and voice trunking
- Aggregation of Packet Mobile Backhaul
- Metro Ethernet Equipment
- TDM and LAN aggregation

High Channel Count Pseudowire CodeChip Block Diagram

Note: This is not a specific device, but is a representation that will explain the various functions available.
Pseudowire CodeChips, Key Features:
- IMA/ATM and/or HDLC/PPP/MLPPP optional
- Timing modes for DS1/E1 include: ACR/DCR, external reference, looptime
- ACR/DCR clock recovery algorithm for SAToP and CESoPSN, per ITU G.8261, G.823, G.824 and MEF22
- Very low-cost DDR2/3 for large buffers
- Application-specific high-level API software development kit
  http://www.arrivetechnologies.com/af6/

32E1/DS1 Pseudowire CodeChips
- Supports DS1/E1 pseudowires over packet switched network (SAToP/CESoPSN), ATM pseudowire and packet pseudowire as per RFC4553 and RFC5086
- Up to 128 pseudowire connections
- 1 to 32 serial DS1/E1/J1 interfaces; framer integrated into CodeChip
- 1 or 2 serial GbE interfaces: one active and one standby
  http://www.arrivetechnologies.com/af6-32e1-ds1-table/

STM-1/OC-3, STM-4/OC-12, and STM-16/OC-48 Pseudowire CodeChips
- PDH pseudowire (CES: SAToP and CESoPSN) as per RFC4553, RFC5086, etc.
- SONET/SDH pseudowire (CEP) as per RFC4842
- DS1, E1, J1, DS3, E3, with optional M13/E13
- CEP modes include: VC11, VC12, VC-3 (Basic and Fractional), VC-4 (Basic and Fractional)
- Supports up to 1024 Pseudowire connections
- OC12/STM-4 or OC-3/STM-1 interfaces at service side
- DS1, E1, J1, DS3, E3, with optional M13/E13
- GbE interfaces: One active and one standby
- APM and EPAR Timing modes for CEP
  http://www.arrivetechnologies.com/pseudowire-stm-tables/
SONET/SDH CodeChips

Arrive's SONET/SDH CodeChip product line offers a family of highly integrated SONET/SDH Framer/Mapper products that can be used in Linear or Ring topology SONET/SDH networks. They can support typical transport configurations, including PDH-over-SONET/SDH, Ethernet/FE/GE-over-PDH, Ethernet/FE/GE-over-SONET/SDH, and Ethernet/FE/GE-over-SONET/SDH.

The SONET/SDH CodeChip family begins with a series of core features based on the proven AT4848 ASIC and other devices. From these, each specific design is tailored to a customer’s specifications. Following are several example configurations; the family of devices is described in more detail on the Arrive website.

### SONET/SDH CodeChip Key Features

<table>
<thead>
<tr>
<th>Core</th>
<th>Bandwidth</th>
<th>Key Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>AF4-8E1-EoPDH</td>
<td>2xT3/E3 or 8xT1/E1</td>
<td>• 2xT3/E3 or 8xT1/E1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• OIF-SPI-3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• EoPDH VCAT-LCAS Mapper</td>
</tr>
<tr>
<td>AF4-STM1-ADM</td>
<td>STM-1/OC-3</td>
<td>• 2xOC-3/STM-1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Channelized Ethernet over TDM (EoS, EoPoS) VCAT-LCAS, GFP-F</td>
</tr>
<tr>
<td>AF4-4STM1-PDH</td>
<td>STM-1/OC-3</td>
<td>• 4xOC-3/STM-1</td>
</tr>
<tr>
<td>ADM</td>
<td></td>
<td>• Linear ADM T1/E1 over SONET/SDH</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Full T1/E1 framer without M13/E13</td>
</tr>
<tr>
<td>AF4-STM4-EoS</td>
<td>STM-4/OC-12</td>
<td>• 2xOC-12/STM-4 or 4xOC-3/STM-1, 1+1 MSP</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Channelized Ethernet over TDM (EoS, EoPoS) VCAT-LCAS, GFP-F</td>
</tr>
<tr>
<td>AF4-STM4-ADM</td>
<td>STM-4/OC-12</td>
<td>• 4xOC-12/STM-4/OC-3/STM-1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• ADM 10K DS0 Cross-Connect</td>
</tr>
<tr>
<td>AF4-STM16-EoS</td>
<td>STM-16/OC-48</td>
<td>• 2xOC-48/STM-16/OC-12/STM-4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Channelized Ethernet over TDM VC11/VC12/VC3/VC4 EoS VCAT/LCAS, GFP-F</td>
</tr>
</tbody>
</table>

Carrier Ethernet CodeChips

Arrive’s Carrier Ethernet CodeChip devices offer Packet Processing, Switch, and Flow Processors targeted with different capacities, I/O, features and cost to meet the varied needs of equipment suppliers.

The Carrier Ethernet CodeChips can be used on various packet system line cards and pizza-box systems for optical packet transport and packet radio transport. Broad applications include wireline networks and wireless networks. Many specific applications are possible, such as WDM-PON, FTTH, wholesale Ethernet, LTE, 3G and 4G backhaul, microwave radio backhaul, eNodeB and RT.

Carrier Ethernet CodeChips, Bandwidth Specific Features

<table>
<thead>
<tr>
<th>CodeChip</th>
<th>24G</th>
<th>50G</th>
<th>100G</th>
</tr>
</thead>
<tbody>
<tr>
<td>Switching Capacity</td>
<td>Up to 24Gbps</td>
<td>Up to 12 Gbps</td>
<td>4 Gbps – 5 Gbps</td>
</tr>
<tr>
<td>10 GbE Ports</td>
<td>1 or 2, XAUI or Serial</td>
<td>1 to 4, XAUI or Serial</td>
<td>XAUI or Serial</td>
</tr>
<tr>
<td>GbE Ports</td>
<td>Up to 24, Serial</td>
<td>Up to 48, Serial</td>
<td>Serial</td>
</tr>
<tr>
<td>10/100 Ethernet Ports</td>
<td>Up to 2</td>
<td>Up to 2</td>
<td>Up to 2</td>
</tr>
</tbody>
</table>

Carrier Ethernet CodeChips, Key Features:

- Ethernet bridge with or without VLAN awareness
- Support of frames with lengths up to 14000 bytes
- Class of Service mechanism to prioritize the Ethernet services, 8 output queues for each Ethernet port; MEF 2.0 supported
- OAM Modes:
  - IEEE 802.1ag CFM (Connectivity Fault Management) OAM
  - IEEE 802.3ah EFM (Ethernet in the First Mile) OAM
  - ITU-T Recommendation Y.1731 OAM
- Sub-50 ms protection switching times
- Protection Modes:
  - Ethernet link aggregation (IEEE 802.3ad)
  - Spanning tree (STP) (IEEE 802.1D, IEEE 802.1w, IEEE 802.1s)
  - Rapid spanning tree (RSTP)
  - Ethernet Linear Protection Switching 1+1, 1:1 (G.8031)
  - Ethernet Ring Protection Switching (G.8032)
  - MPLS 1+1, 1:1 protection
- Up to 32 E1/T1/J1 SAToP/CESoP included
- IEEE 1588v2
- G.8262/Y.1362 Synchronous Ethernet (SyncE)
- Optional support via a companion FPGA:
  - CES, CEP
  - ATM/IMA
  - PPP/MLPPP
  - EoS, EoPDH

http://www.arrivetechnologies.com/af5/
CodeChip SDK (Software Development Kit)

All Arrive CodeChips come with a Software Development Kit. Major features are:

- Platform independent via a Hardware Abstraction Layer (HAL) module
- Operating System independent via Operating System Abstraction Layer (OSAL) module
- Modular device driver allowing transparent interface to higher level application layer
- Relieves the system software developer of the task of recreating the CodeChip device driver to speed up the system development and ensure a quick transition to production
- Compliant to standard telecommunications functions including configuration
- Supports interrupt handler
- Includes a command line debugger for controlling and monitoring the device
- Compliant to ANSI-C

EVALUATION PLATFORMS

Arrive has developed evaluation platforms for the CodeChip and Multiservice ADM ASIC products. These platforms are designed to allow prospective customers to comprehensively test and evaluate Arrive's solutions and for existing customers to develop applications software prior to their own hardware becoming available.

EP5/EP6s are standalone boards that allow operation and interoperability testing of the different CodeChip families through various interfaces. User manuals provide an overview of the capabilities and features of the EP5/EP6 boards. Evaluation and testing can be controlled via a 10/100BT Ethernet port which is connected to the onboard CPU by either a PC or a LAN. A standard RS-232 debugging port is also provided.

EP4848
EP4848 is a standalone board that allows operation and interoperability testing through the AT4848 interfaces. It is implemented as a full STS-48/STM-16 or STS-12/STM-4 micro-MSPP. Evaluation and testing can be controlled via a 10/100BT Ethernet port connected to either a PC or a LAN. A standard RS-232 debugging port is also provided.
Multiservice ADM ASIC Product Line

AT4848 | AT1212 | AT4850 | AT1240 | AT1250 | AT1230

Arrive also specializes in high capacity ASIC devices. The AT4848 is a highly integrated OC-48/STM-16 or OC-12/STM-4 Multiservice ADM (Add/Drop Multiplexer) on a chip. Devices in this family can be used in a variety of voice and data over SONET/SDH systems including Multiservice Provisioning Platforms (MSPP), broadband access and enterprise customer premise equipment with an integrated ADM.

The AT4848 has integrated cross-connects supporting DS0, VT/TU and STS/VC level switching. The device includes MACs and framers for a range of drop side interfaces including Fast Ethernet, Gigabit Ethernet, storage and video protocols, SONET/SDH and high density DS1/E1s and DS3/E3s. The AT4848 supports Frame and Transparent GFP mapping, SONET/SDH HI/LO and PDH virtual concatenation (VCAT) and LCAS with 128 groups. The AT4848 provides VLAN/MPLS applications with on-chip L2 Aggregation & Management. An OIF SPI interface is also included.

AT4848 Multiservice ADM ASIC Functional Diagram

These devices will permit almost any service to be carried over any layer one transport seamlessly and transparent to the end user. The family of devices is described in more detail on the Arrive website. [http://www.arrivetechnologies.com/at4848/](http://www.arrivetechnologies.com/at4848/)

These ASICs are in full production and are recommended for new designs.
For more information on Arrive's Codechip and ASIC solutions, please visit our website at

www.arrivetechnologies.com