



IDT's RC32355 Integrated Communications Processor

A Complete Solution for Customer Premise Equipment (CPE)

Abstract

Across both small business and residential premises, a variety of new types of communications boxes are appearing, providing the bridge between the wide area network (WAN) interface and the local area network (LAN) interface(s). This document provides IDT's perspective on what is driving the requirements for these new types of platforms, it addresses the challenges that designers developing such systems face and the impact on silicon providers such as IDT.

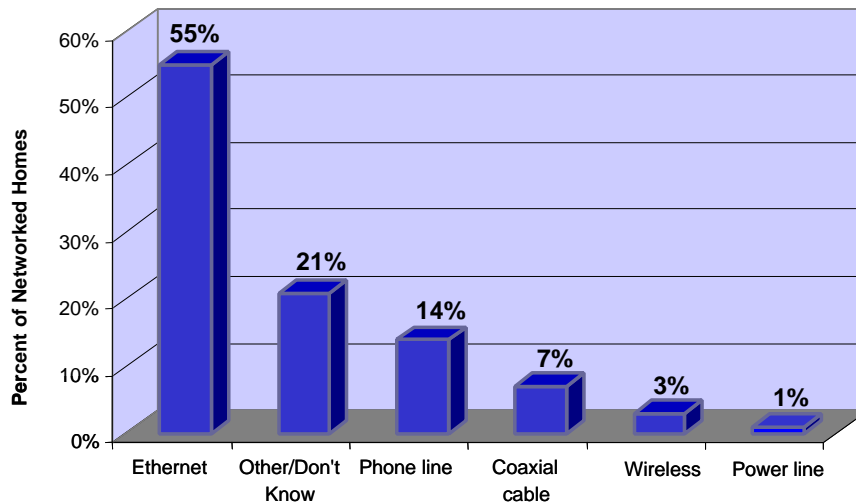
Market Environment

Historically, personal computers located in a small office or home were linked to the Internet using a network card, typically plugged into a PCI slot. This solution worked fine for single PC environments, but as multi-PC environments started to become more commonplace, and as new appliances with Web connectivity started to appear, the users of these systems have recognized the need to share the WAN connection between users, and have started to develop home/small office networks.

With a significant percentage of the world's homes seen as the potential available market to service, the first-generation platforms that have been deployed have used a broad range of connectivity strategies and types of systems to meet the requirements.

The table below, taken from a study completed last year by the Yankee Group, provided a snap shot as to what technologies were being used to connect the appliances inside the American homes to the gateway unit. The key points to note are:

- A broad range of technologies are being deployed today. Indeed, there are several rival standards inside some of the broad connectivity groups outlined below (for example in wireless connectivity)
- As of the time of this study, only 4 percent of U.S. homes featured a home network
- Consumers have shown that simplicity, reliability and pricing of the various technologies will, over time, help certain technologies to predominate





IDT's viewpoint is that with the gateway market currently in its infancy, there is a clear need for the development of highly flexible systems capable of supporting the broad range of existing technologies as well as any new connectivity standards that may appear.

In addition, as consumers are still coming to terms with the potential capabilities of these systems, it appears appropriate to ensure that additional new features can be supported in these systems, being upgraded via software updates over the wide area network. This is driving system designers to select CPUs with higher performance than is required for the initial application, providing as much as 50% spare CPU horsepower, in order to support the bandwidth requirements of future software upgrades.

The third strong dynamic is system cost. The business model being pursued by service providers offering high speed internet access, is one of offering the box at very low cost (and in several cases, free) and then making their money back via the monthly access charges. Therefore, there is pressure on the suppliers of the hardware to minimize the overall system cost, so that they can minimize their NRE expense.

RC32355 Device Overview

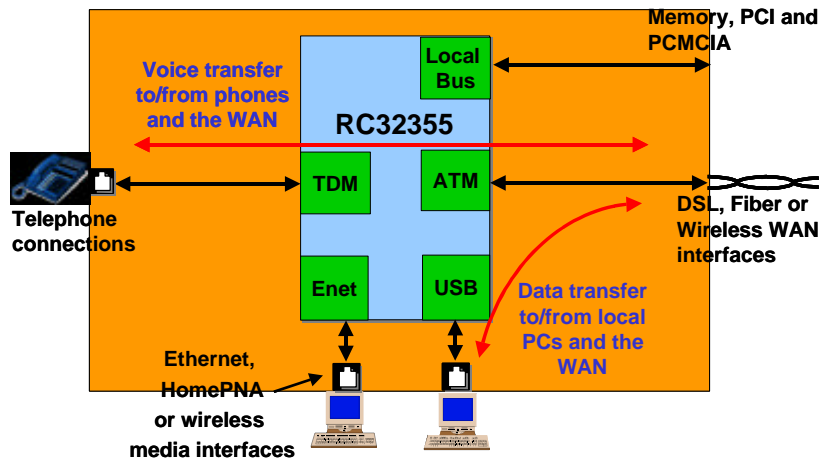
The RC32355 integrated communications processor (ICP) is the third member of an integrated microprocessor family developed to meet the needs of communication applications. This integrated processor couples IDT's award-winning 32-bit RISC^{Core}™ 32300 CPU core [fully compatible with the MIPS instruction set architecture (ISA)], IDT's IPBus system-level integration design methodology, with a series of general-purpose and communications specific peripherals.

The on-chip communications peripherals are

- A 10/100-Mbps Ethernet controller providing an industry standard MII interface off chip
- An ATM segmentation and reassembly (SAR) controller supporting industry standard Utopia 1 and Utopia 2 bus
- A Universal Serial Bus (USB) controller compatible with version 1.1 of the specification
- A time-division multiplex (TDM) bus interface, compatible with a broad range of industry-standard buses.

A high-performance DMA engine on the RC32355 enables customers to move data in any format without restrictions, thus increasing the system flexibility and the software flexibility in manipulating the data and enabling the processor to handle data on all four communications interfaces concurrently.

The RC32355 is ideally suited for a variety of CPE, from the simplest DSL modems to higher-end residential gateways that require voice support. The on-chip communication peripherals allow the customer the flexibility to connect to a variety of LAN and WAN peripherals. For instance, the diagram below indicates how an RC32355-based gateway could be configured.





The ATM interface enables support of both data and voice traffic across the network. In addition to the variety of xDSL chipsets that could be connected via the external Utopia port, this interface is used to link to alternative WAN technologies such as fiber and wireless media.

The TDM bus interface is included to directly access external devices such as telephone CODECs and quality audio A/Ds and D/As. While the TDM interface can support four voice channels, it is also critical for integrated access device (IAD) systems requiring support mix voice and data to support VoIP and Voice-over-x capability.

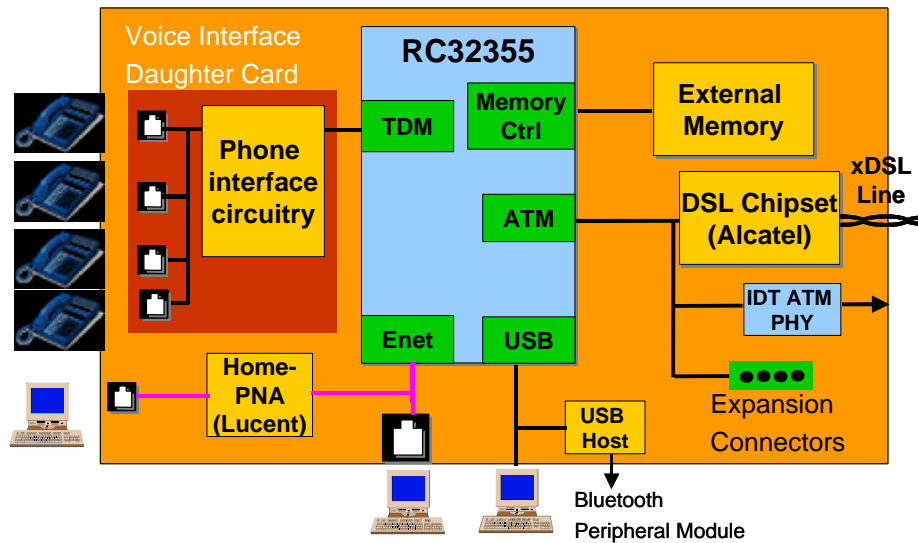
An on-chip Ethernet MAC is capable of 10- and 100-Mbps with an industry standard MII interface. It supports up to 4 MAC addresses. This can be linked to standard Ethernet cable, or used to bridge to alternative technologies such as the home phone networking alliance (HomePNA), which uses existing phone wiring in homes as a data network, and wireless interfaces such as 802.11.

The on-chip USB interface is suitable for platforms requiring connectivity to a single PC. The compatibility to the USB 1.1 standard allows devices to operate up to 12Mbps.

Other communication interfaces supported by the RC32355 include an I²C interface that connects to industry standard peripherals like real-time clocks and serial EPROMs.

IDT Provides Home Gateway Reference Design

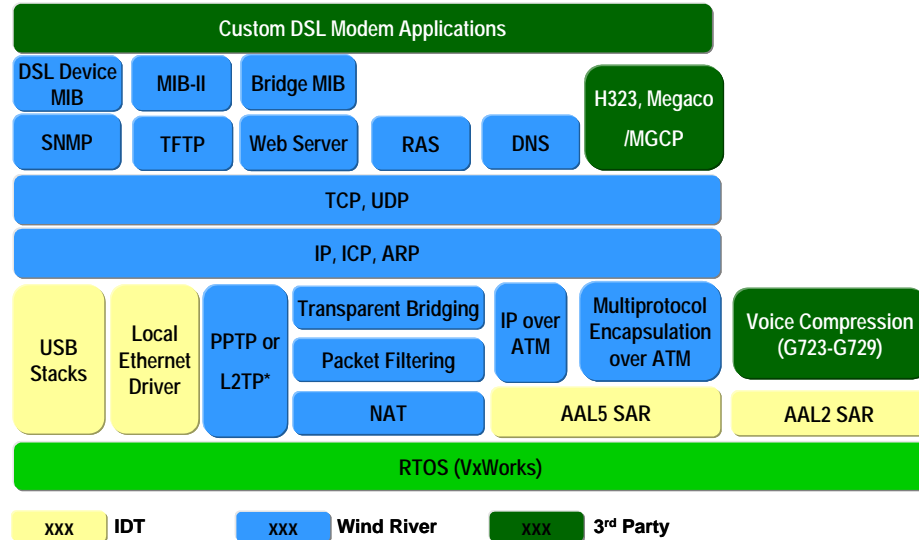
In addition to providing the RC32355 device, IDT has worked with several semiconductor partners to develop a validated hardware reference design to address this marketplace. Based on the RC32355, it includes interfaces out to an ADSL line, via an Alcatel chipset, to a HomePNA interface using the HomeWire chipset from Agere (formerly Lucent Microelectronics) and to standard telephone lines using Lucent's line interface technology. IDT provides the schematics and Gerber files to customers, allowing them to reuse the elements of the solution that is applicable for their system implementation.





Software – The Critical System Element

In addition to having a hardware solution that is optimized for the CPE market, it becomes increasingly important to address the software aspect of the system development. Realizing the need for software solutions as well as hardware solutions to offer the customer, IDT has partnered with Wind River Systems to deliver a complete hardware/software solution for the CPE market by combining the RC32355 integrated processor with Wind River's Tornado for Home Gateways. This newly announced software package, is a comprehensive package of device drivers, protocol stacks and management code that has been optimized for this marketplace. The diagram below outlines some of the core building blocks that have been included



In addition to the Wind River software (shown in blue), the strong 3rd party program developed by Wind River will ensure a broad range of additional software modules can be quickly integrated and validated on a RC32355-based platform.

For more information, access the following website.
<http://www.windriver.com/products/html/homegateway.html>

Summary

The CPE market continues to evolve and mature. With the variety of WAN and LAN standards that currently exist, system designers need to be flexible. The volatile market conditions, emergence of new standards, and the need to get products to market faster and cheaper are all challenges that system designers face today. The need to increase services to support this market is driving system designers to look at highly integrated, high performance processors. The RC32355 integrated processor integrates all of the functions needed for this generation of integrated access devices being deployed. The processor also provides the system expansion capability for next generation industry standard communications interfaces. By partnering with various hardware and software providers such as WindRiver Systems, IDT is enabling the system designers with another level of solutions that will shorten the system development cycle and help get products to market faster.



Detailed RC32355 Product Specifics

Feature	Capability
Maximum CPU Frequency (MHz)	150 MHz
Cache Sizes	8kB instruction cache, 2kB data cache, 2-way set associative, lockable on a per line basis
Maximum System Bus frequency (MHz)	75 MHz
Memory Bandwidth (MB/S)	300Mbps at maximum bus frequency
Performance	200 dhrystones at maximum frequency
Ethernet Interface	10/100Mbps, standard MII interface
ATM Interface	>25Mbps throughput for AAL5 data, across a bus configurable to Utopia 1, Utopia 2 or DPI (compatible with IDT switch fabric) modes
TDM Interface	Supports data rates up to 2Mbps, across broad range of bus standards including Lucent CHI and Mitel ST protocols
USB Interface	12Mbps, fully compatible with version 1.1 of USB specification
Package	208 quad flat pack package (QFP)
Power Consumption (W)	1.8 watts at 150 MHz