

# Reconfigurable Architecture For Car Tuners

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## Outline

- 
- Introduction
  - The ALU Array Architecture
  - The Prototype of Broadcasting Receiver with ALU Array
  - Conclusion

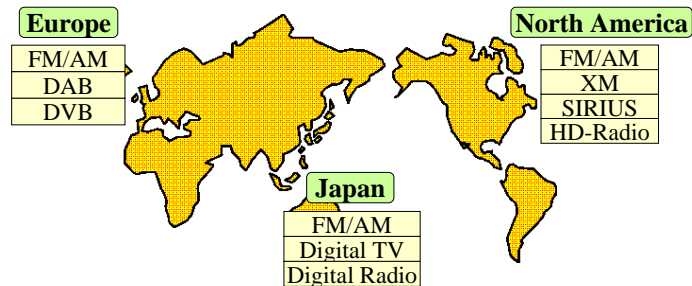
## Introduction

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## Markets of car tuner LSIs in the world

Car navigation systems and DVB-H have become increasingly popular  
(Europe becomes a situation near Japan)

Satellite digital radios have already been so popular  
(Most of luxury cars equip with them)



Analog radio systems are equipped in most of cars  
Car navigation systems with digital terrestrial TV are so popular  
New broadcasts, digital radio etc., will start

## Benefits of reconfigurable tuner LSIs

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### Development of various processing on same LSI by software

We don't have to manufacture new LSIs for new processing

➡ Reduction in the development cost and the development period

#### Support various broadcasts

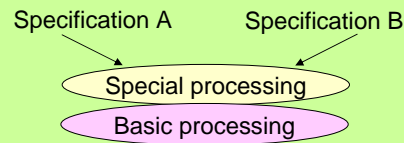
■ one chip supports various broadcasts in the world

Japan North America Europe

FM/AM	FM/AM	FM/AM
Digital TV	XM	DAB
Digital Radio	SIRIUS	DVB
	HD-Radio	

#### Support customer demands

■ one chip is customized to various customer demands



#### Support updating after release

- Update to the latest version which is solved trouble or has higher performance
- Support a new broadcasting processing



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## The ALU Array Architecture

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# ALU Array Architecture



## ALU Array Unit

24 ALUs are arranged in a array

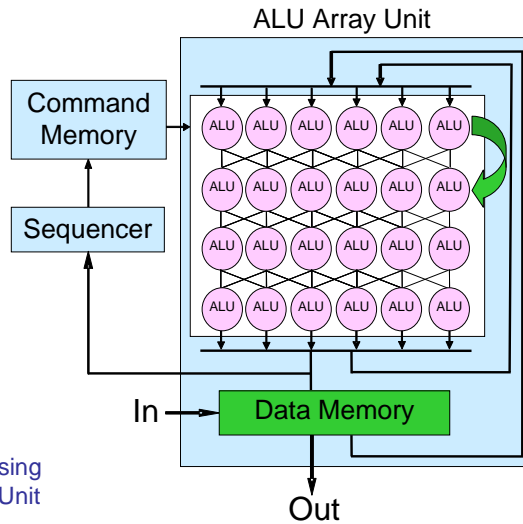
An ALU connects to only 3 adjacent ALUs in the lower row

## Command Memory

It supplies Command Data (control information data) to ALU Array Unit

## Sequencer

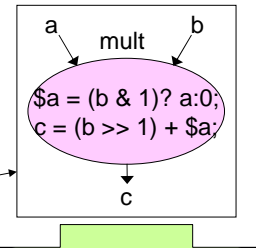
It dynamically controls next processing according to outputs of ALU Array Unit



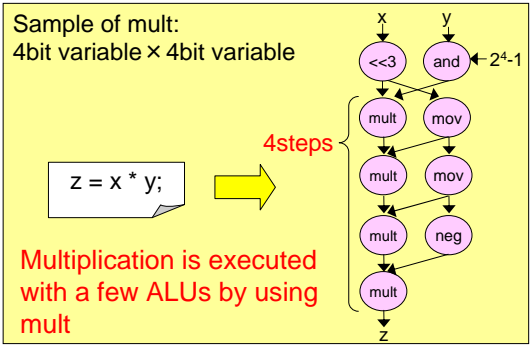
# Operations of an ALU



- Arithmetic operations: +, -
- Logical operations: &, |, <<N, >>N (N=0~15)
- Comparison operations: ==, <, <=
- Selection operations: (c==1)? A : B  
(A < B)? A : B
- Operation for multiplication: mult
- Other operations: sign inversion, through



Bit width of operations: 24bit  
Bit width of Commands: 5bit



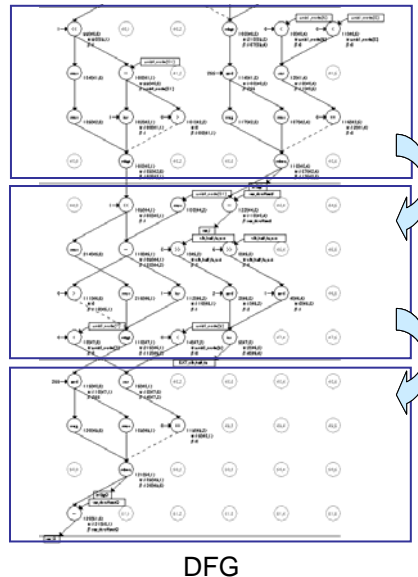
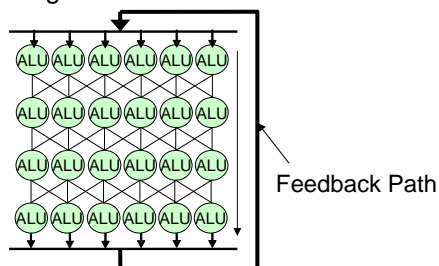
## Motion of ALU Array Unit

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It executes processing according to a DFG (Data Flow Graph) generated by our compiler

It passes outputs of ALUs to inputs of ALUs in the lower row

It passes outputs of ALUs in the bottom row to inputs of ALUs in the top row through Feedback Path



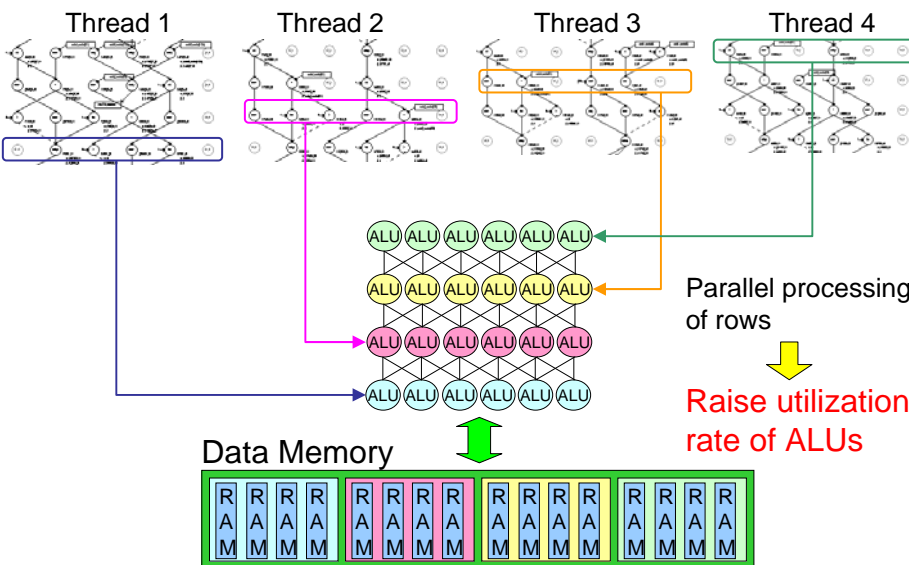
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## Multithread processing in ALU Array Unit

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4 independent processing is executed at the same time



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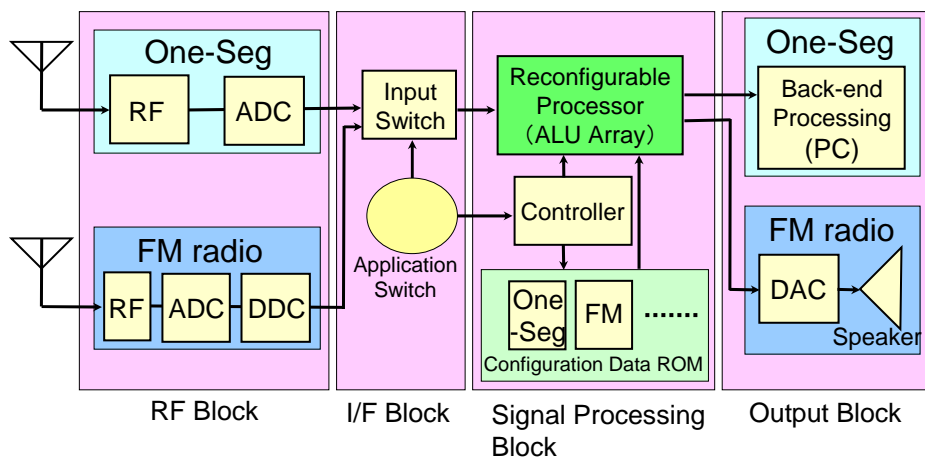
## The Prototype of Broadcasting Receiver with ALU Array

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## The system of prototype of broadcasting receiver **SANYO**

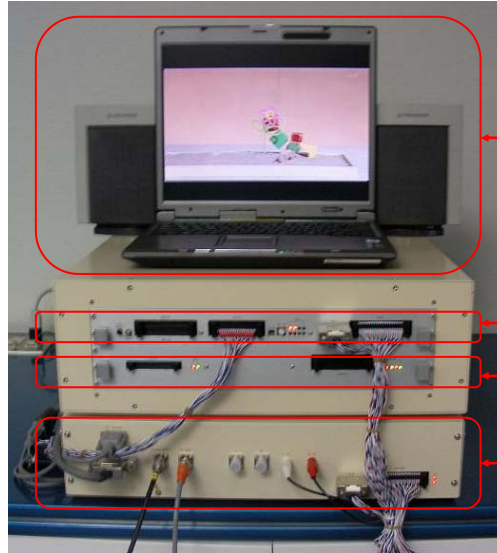
Receivable broadcasts (Applications)

- ✓ Japanese digital terrestrial TV "One-Seg"
- ✓ FM radio



## Photo of the prototype

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Output Block

I/F Block

Signal Processing Block

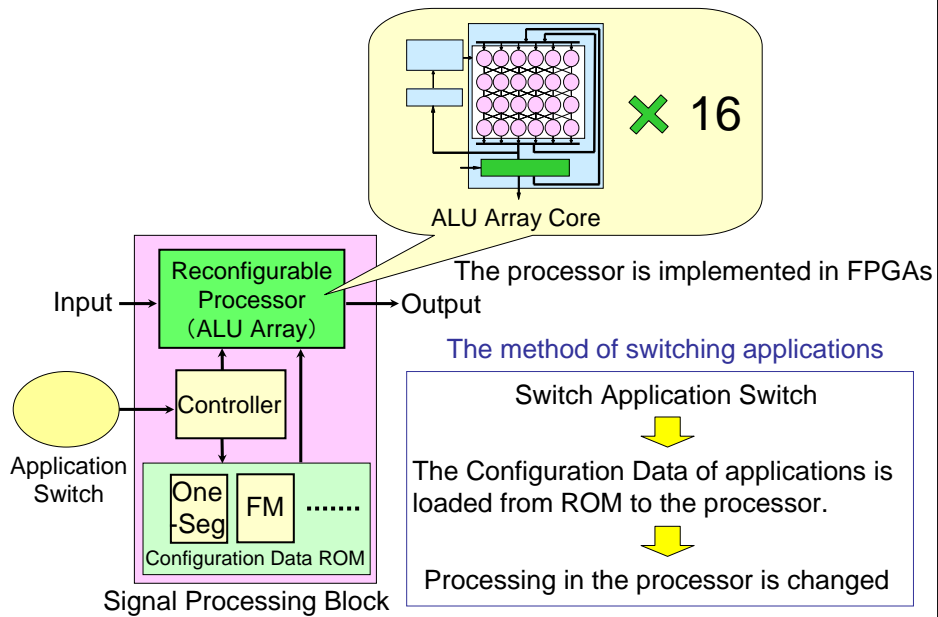
RF Block

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## Signal Processing Block

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## Evaluation of the processor in the prototype



### ■ Allocation of applications

The processor executes One-Seg processing with 15 cores and FM radio processing with 8 cores

### ■ Reception tests with real airwaves

The processor has realized the real-time reception of both One-Seg and FM radio

### ■ Switching tests of Applications

The processor has realized the switching applications in the time,

To One-Seg: 140ms

To FM radio: 40ms



the performance of the processor is suitable for car tuner processing



## Conclusion

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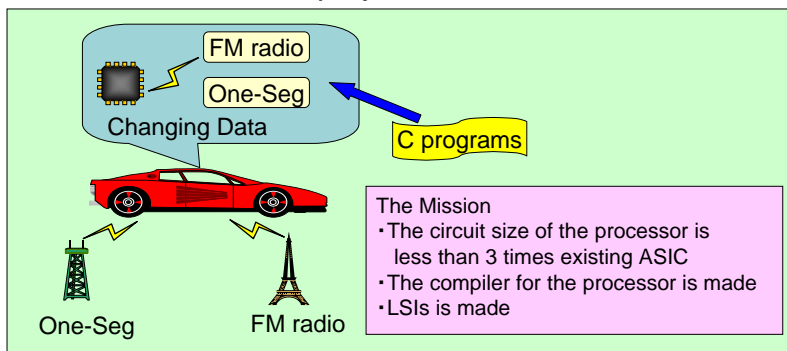


## Schedule of the future

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We have manufactured trial LSIs and evaluated them in fiscal 2007 with supports of NEDO\*

### The project of NEDO



\*NEDO (The New Energy and Industrial Technology Development Organization)

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## Conclusion

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We have developed a reconfigurable processor based on ALU Array for car tuners



We have developed a prototype of broadcasting receiver with the processor

The prototype has realized

- the real-time receptions of both One-Seg and FM radio
- the switching of receptions by changing software in short time



Our processor is an effective device for signal processing of car tuners



We'll commercialize it by optimizations of the performance

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"GAIA" is a term that encompasses the Blue Planet, "Earth," and the infinite varieties of "life" that live and breathe on it. It describes the world as a single living organism, where all life and nature co-exist interdependently. SANYO is committed to listening to GAIA's voice and engaging in activities that are beneficial to life and the Earth.

As a testament to this, SANYO pledges to respond by developing only products that are absolutely essential to life and the Earth. We aim to bequeath a beautiful Earth to future generations. This is SANYO's Brand Vision—Think GAIA.

To realize this vision, SANYO promotes a threefold approach, focusing on the environment, energy and lifestyle. As a leading provider of Environment- and Energy-related products, SANYO seeks to harness its exclusive, unique technology and innovative creativity to deliver global solutions. All for the Earth. All for life. All for GAIA.