An Application Specific Processor for CNN-Based Massive MIMO Positioning

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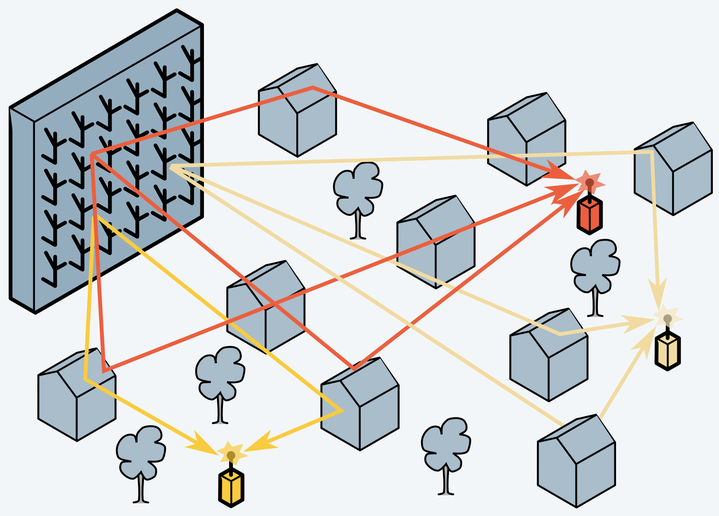
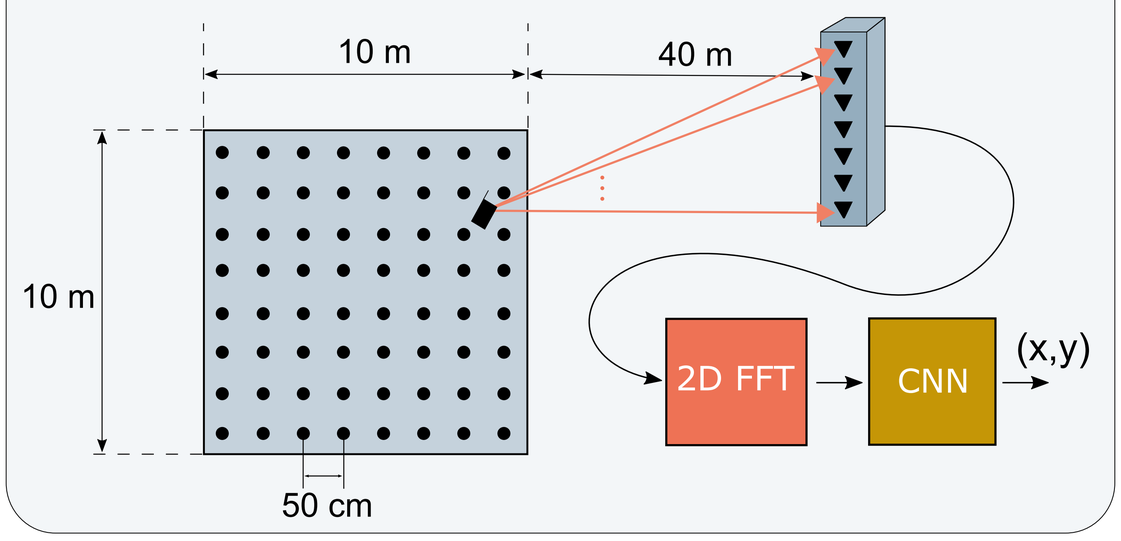
1 Communications Processor

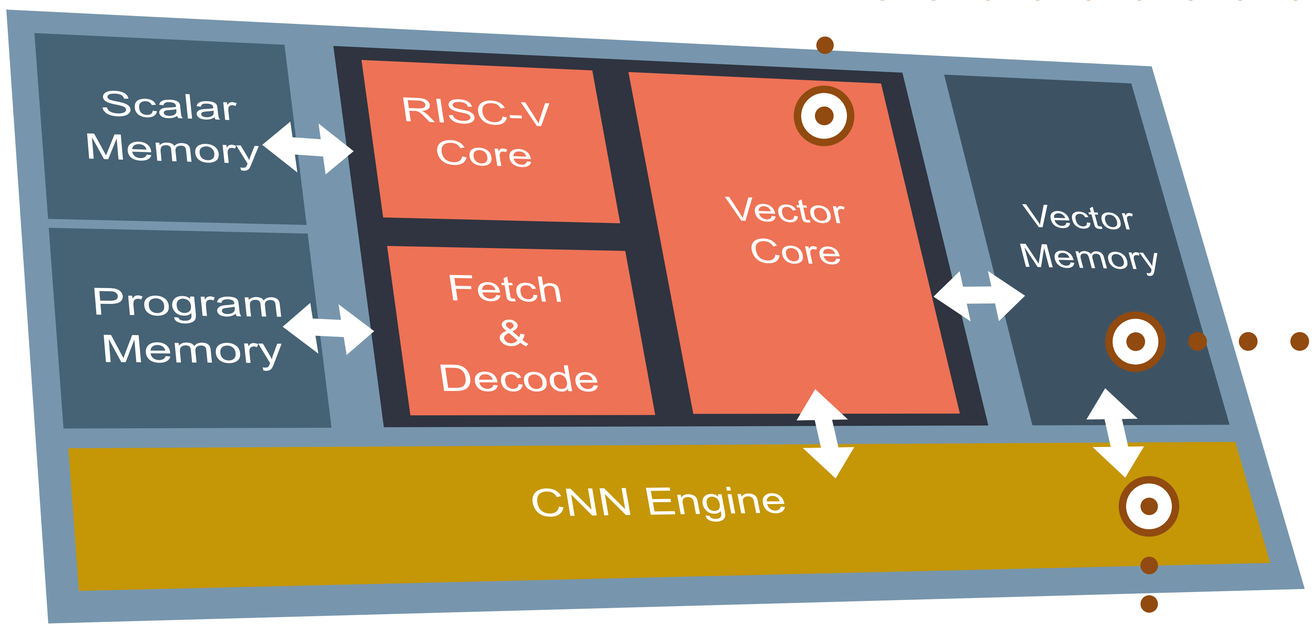
- Next generation wireless systems
- Massive Multiple Input Multiple Output (MIMO)
- High computational demand
- Application Specific Instruction set Processor (ASIP)



2 Fingerprint-based Positioning

- Set of training samples (fingerprints)
- Offline measurements for known positions
- 2D FFT & CNN training
- Online measurements for unknown user locations
- CNN inference





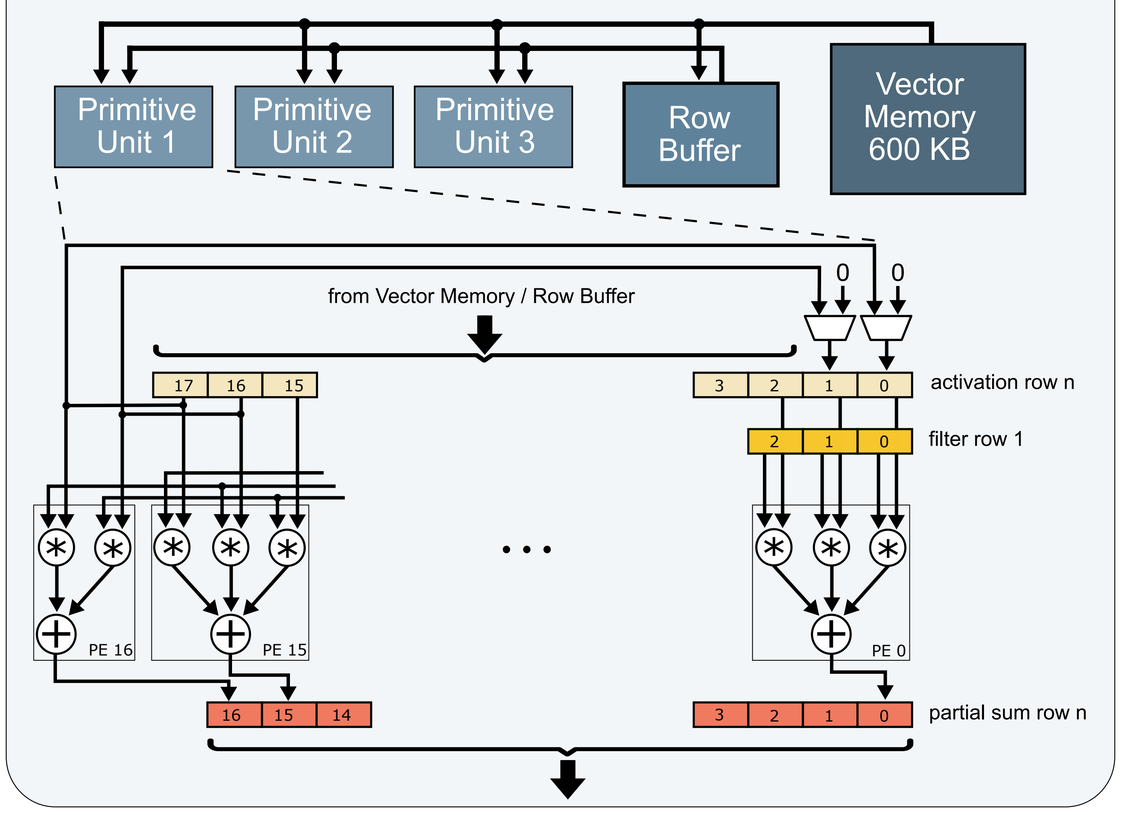
3 Programmable Processor

- Programmable in C
- Programmer-visible intrinsics
- 8-lane Single Instruction Multiple Data (SIMD)
- One-cycle memory access (row, column, diagonal)

```
void dummy_func(vcfrac* A, vcfrac* B)
{
    vcfrac va = load_row(A, 0);
    vcfrac vb = load_column(B, 3);
    vcfrac vc = a * b;
    cfrac c = dot(a, b);
}
```

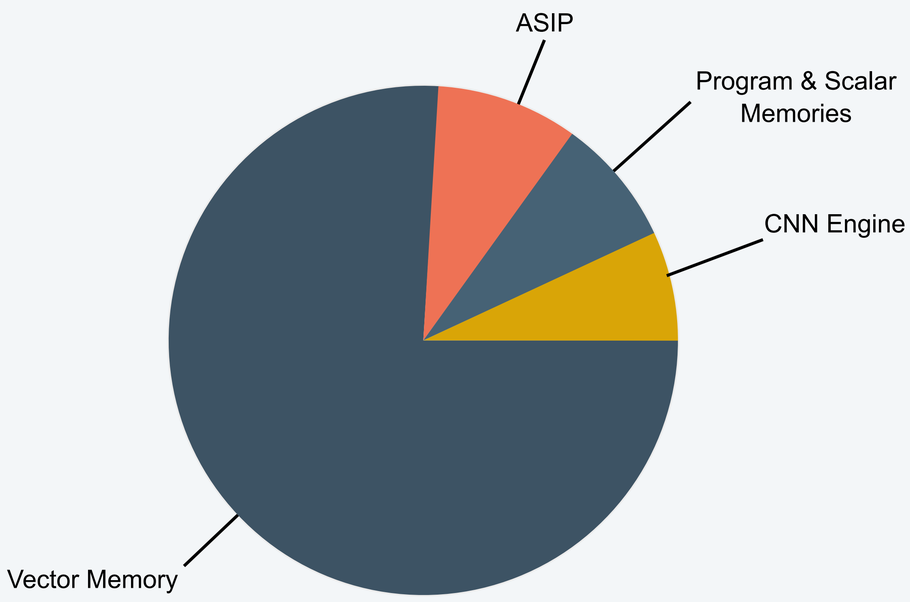
4 CNN Accelerator

- Configurable CNN engine
- 2D convolution based on 1D primitives
- Convolution with 3 Primitve Units (PU)
- Row buffer to reduce repetitive access



5 Results & Conclusion

- Design tool: ASIP Designer from Synopsys
- Technology node: 22 nm
- Clock frequency: 555 MHz
- Average power consumption: 150 mW
- Area: 1 mm^2
- Number of positionings/s: 271



Area % breakdown

Reference & Funding

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