Karlsruhe Institute of Technology

Praktikum:
Entwurf von eingebetteten applikationsspezifischen Prozessoren

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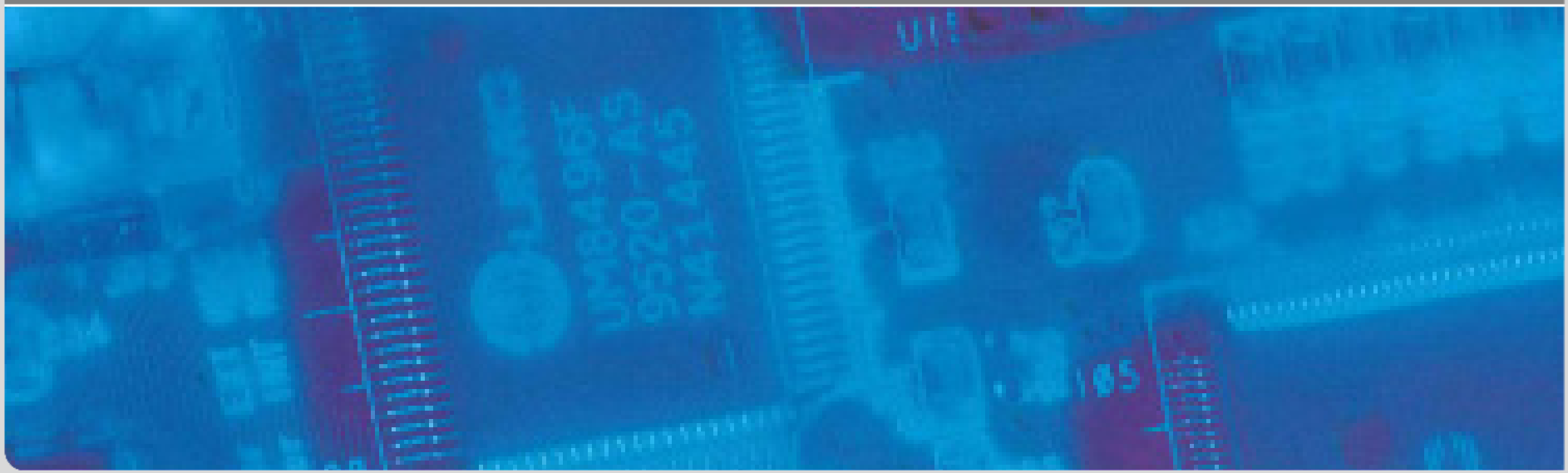
Institute of Computer Engineering (ITEC) – Chair for Embedded Systems (CES)



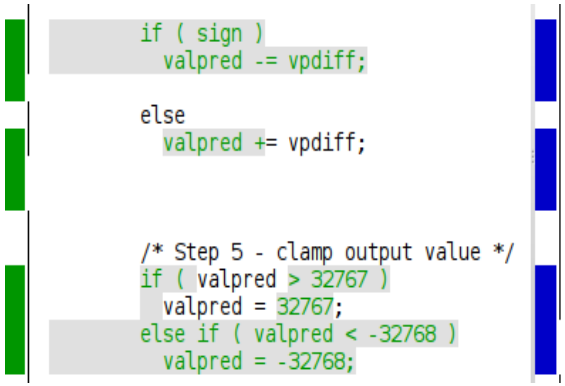
Overview

- ASIP Design Strategies
- Measurements
- Further possibilities

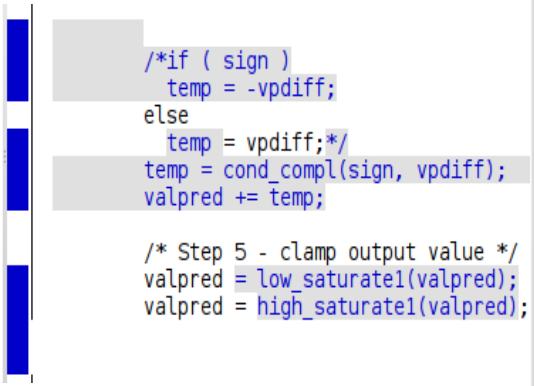
ASIP Design Strategies

- 1st Strategy – optimized for **area** and potentially power:
  - Reduce resources to required
    - Multiplier removed
  - Reduce instructions to required

- 2nd Strategy – optimized for **speed** (potentially energy):
  - Add instructions specific to application C code
  - low_saturate rd, rs0, const
    if (rs0 < const) rd = const;
  - high_saturate rd, rs0, const
    if (rs0 > const) rd = const;
  - cond_compl rd, rs0, rs1
    if (rs0[bit3]) rd = -rs1;
    else rd = rs1;



Normal



Speed

Part of Micro Op Description

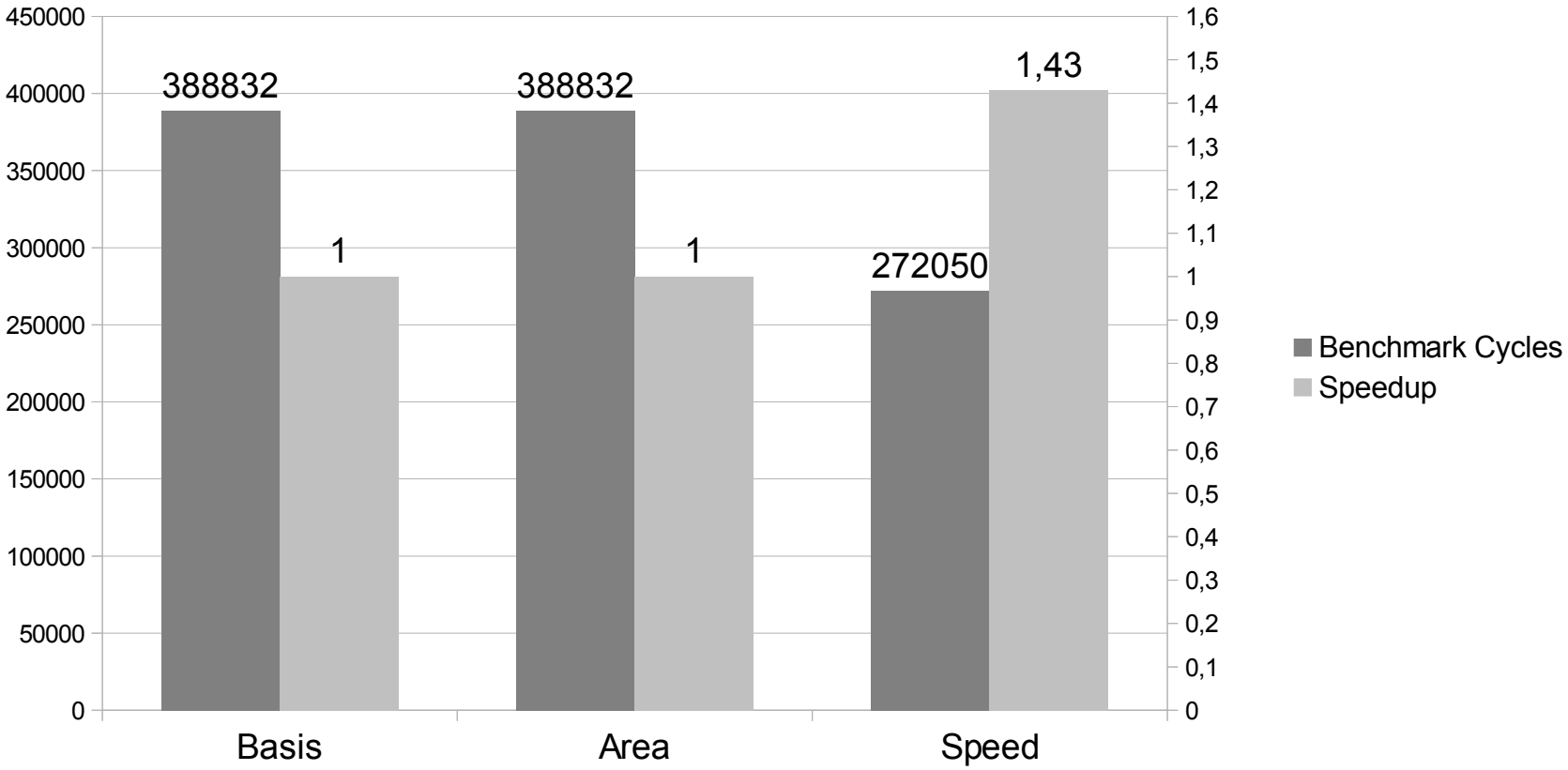
cond_compl rd, rs0, rs1

```
cond = source0[3];

res0 = MUX0.sel(zero32,source1,cond);
res1 = MUX1.sel(source1,zero32,cond);

<result, flag> = ALU0.sub(res1, res0);
```

high_saturate / low_saturate rd, rs0, const

```
result = MUX0.sel(source0,source1,cond);

null  = GPR.write0(rd, result);
```

Cycles



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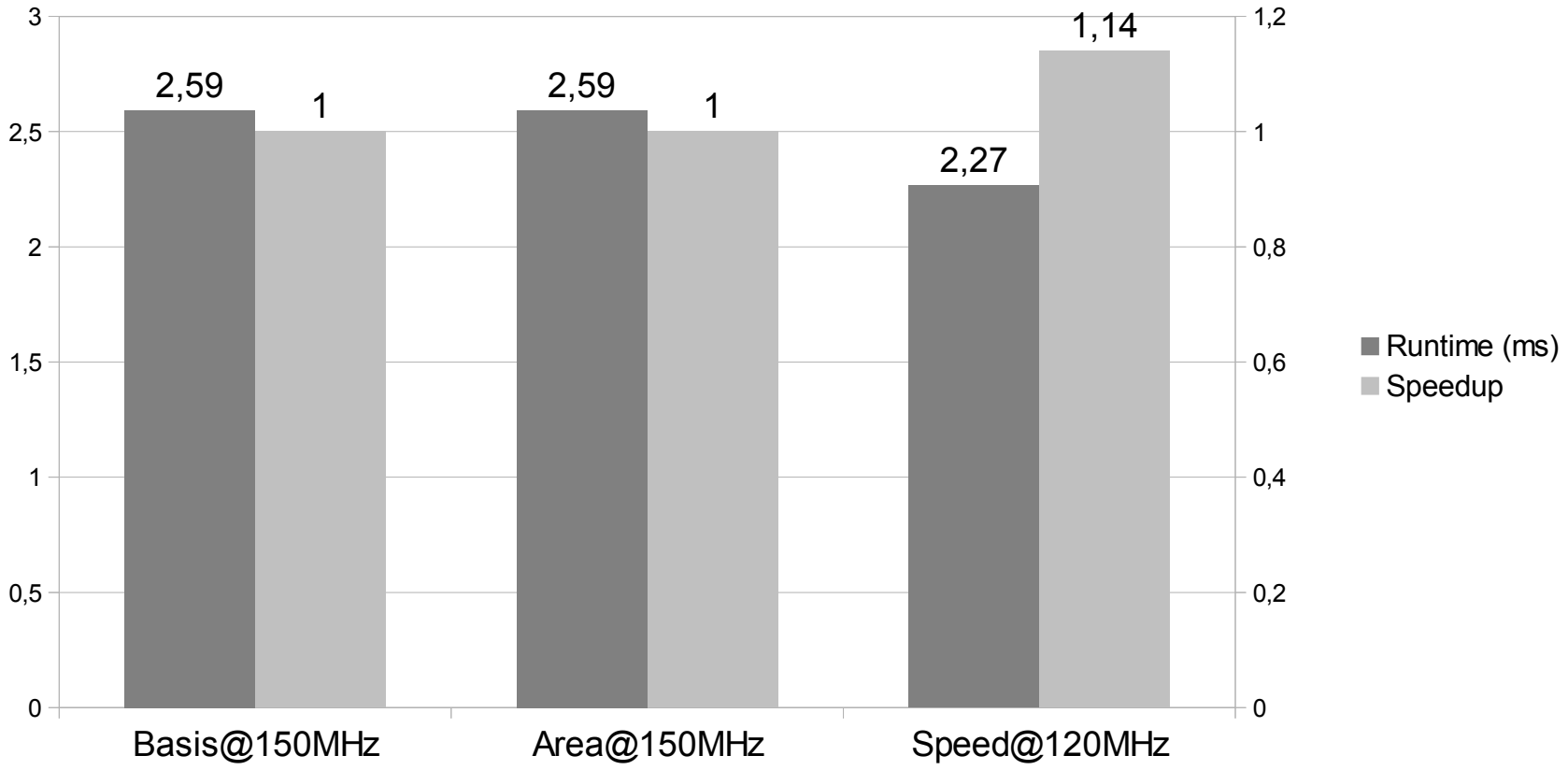
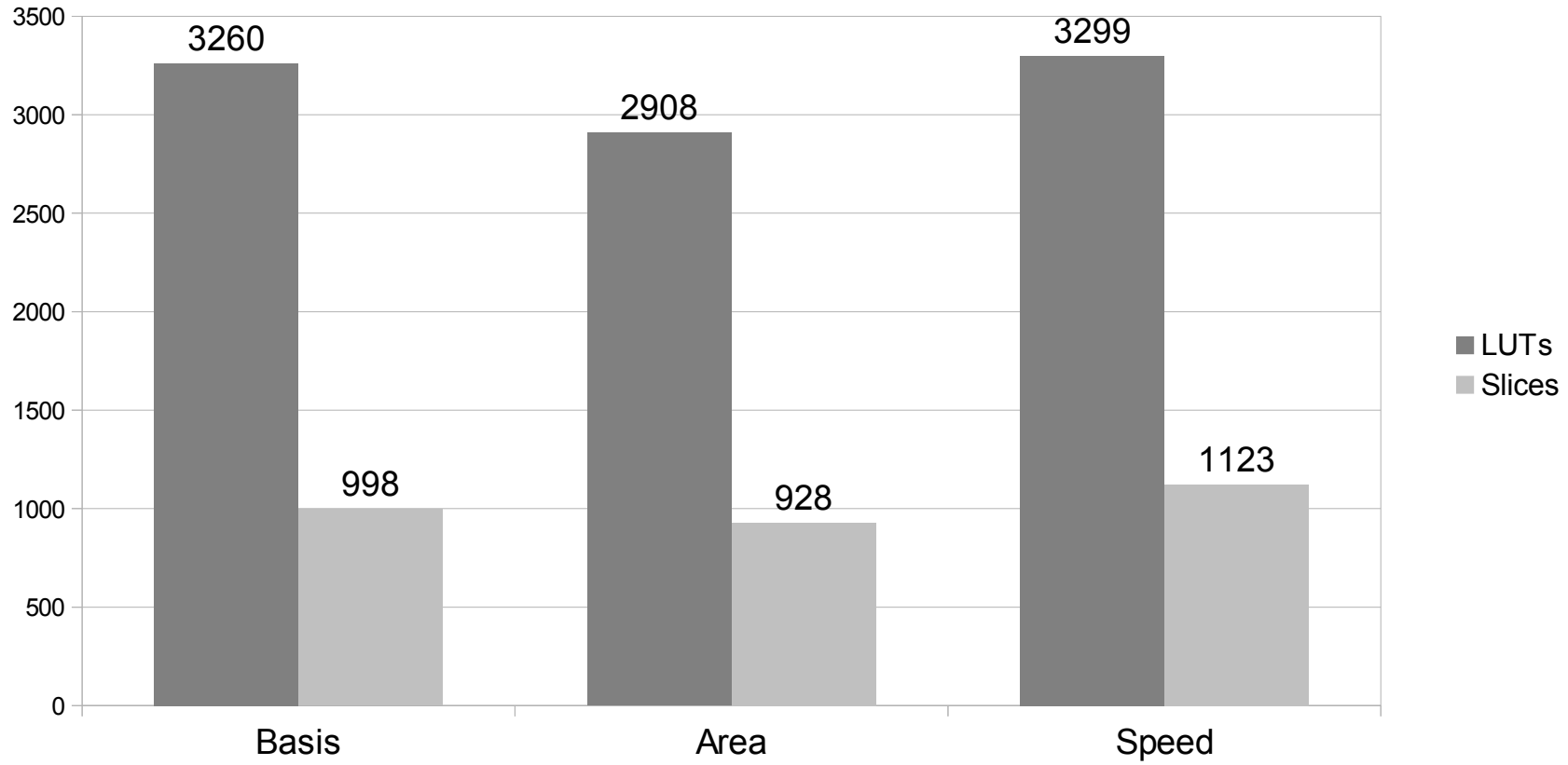
Possible Frequencies

- Min: Benchmark fulfilled, tested from 30-150 Mhz
- Max: Reported maximum frequency from Xilinx ISE
- Basis
  - Max: 158.328MHz (benchmark used: 150Mhz)
  - Min: 60MHz
- Area
  - Max: 167.3MHz (benchmark used: 150MHz)
  - Min: 60MHz
- Speed
  - Max: 120.395MHz
  - Min: 50MHz

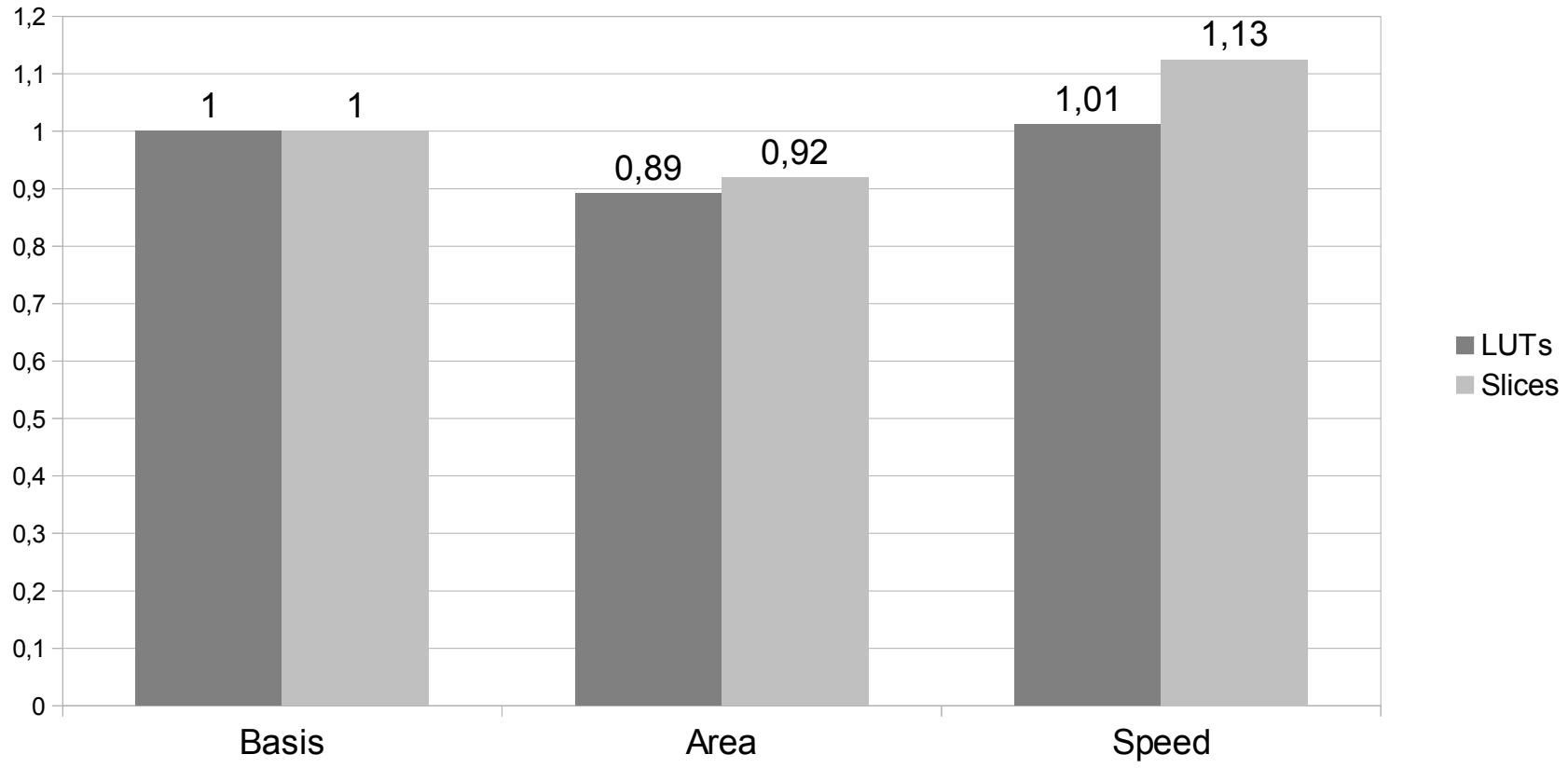
Benchmark runtime at maximum frequency



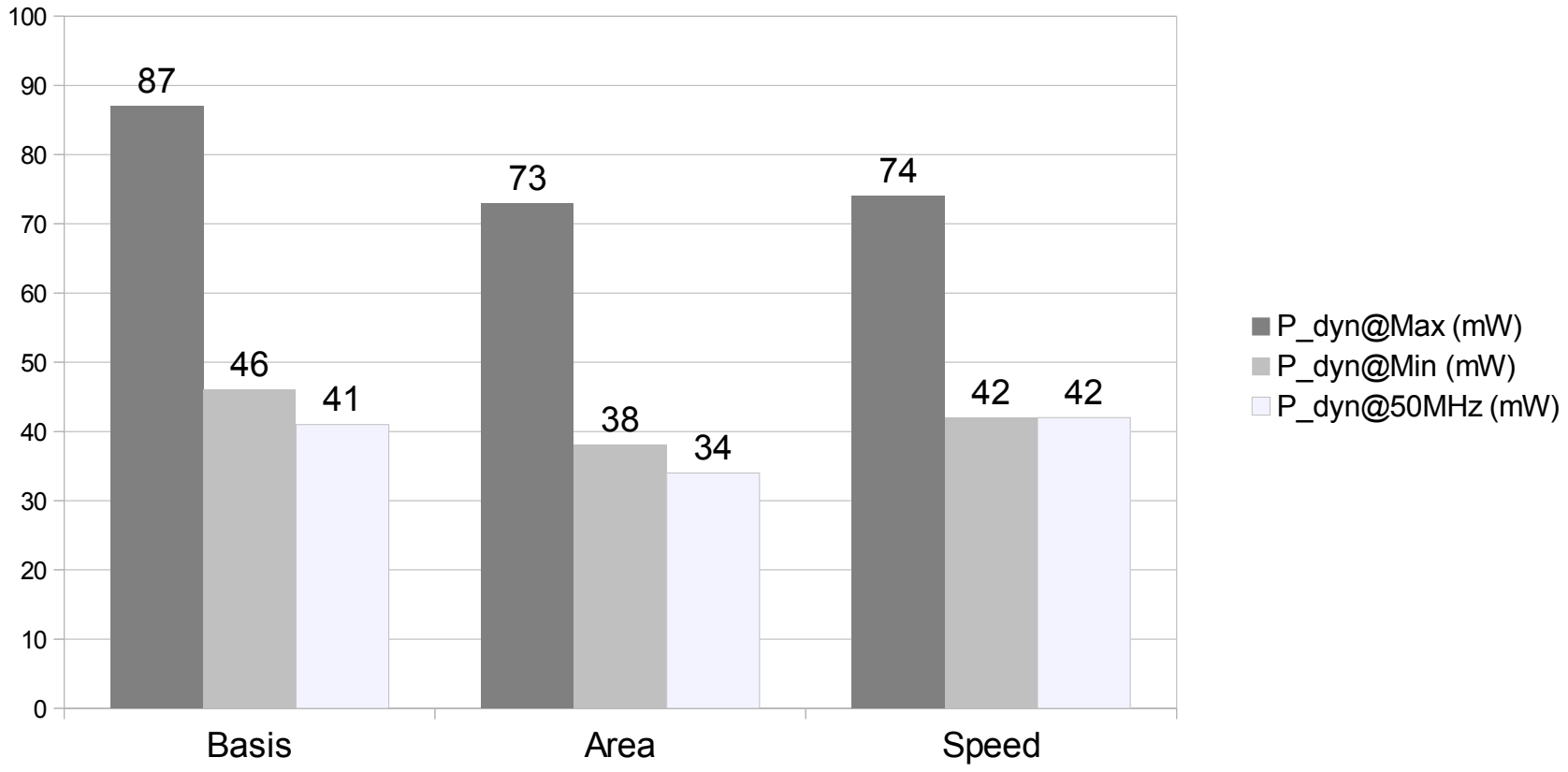
Required Area



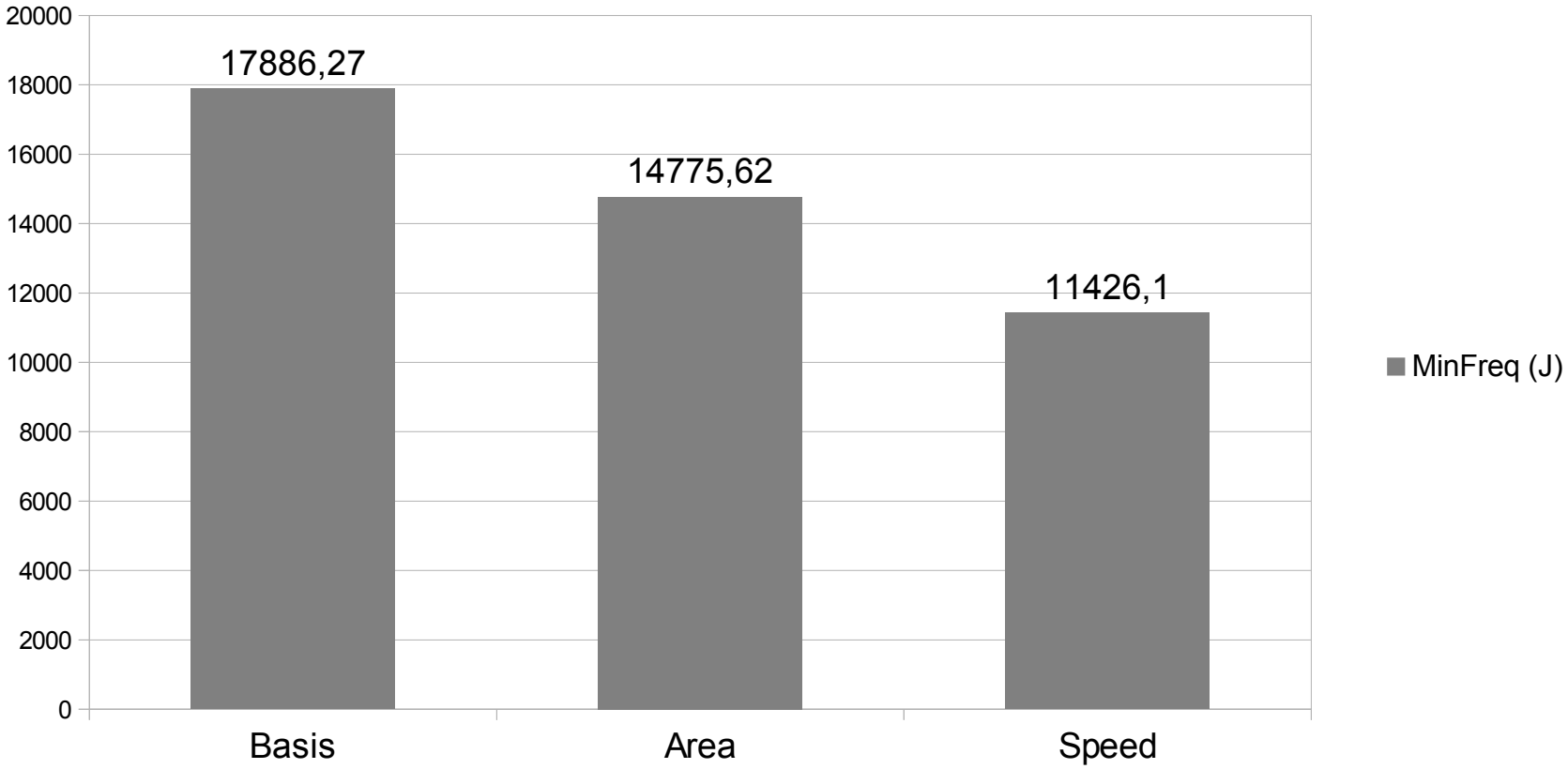
Required Area (normalized)



Power


100
90
80
70
60
50
40
30
20
10
0
87
46
41
73
38
34
74
42
42
Basis
Area
Speed
P_dyn@Max (mW)
P_dyn@Min (mW)
P_dyn@50MHz (mW)

Energy for Application (minimum Frequency)



Further possibilities

- Area:
  - Reduce general purpose registers (GPRs)
- Speed:
  - Special instructions for every step from 1 to 6
- Combine Area+Speed CPUs!

Thanks for your attention!

Are there any questions?