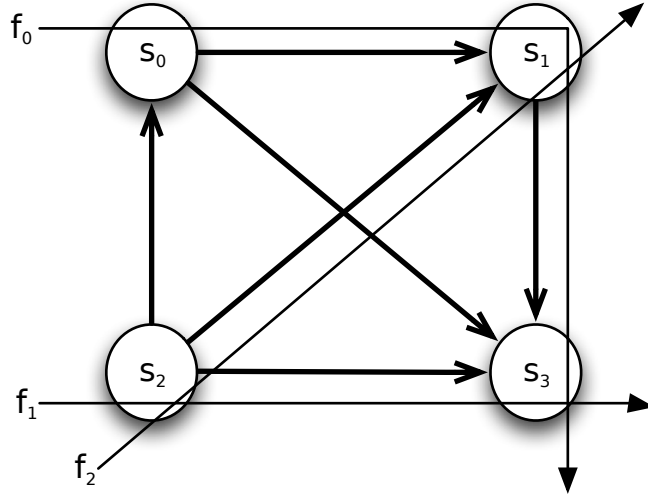
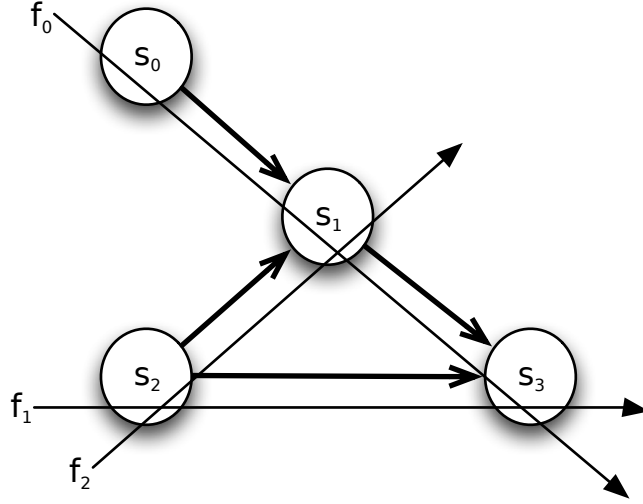


# FeedForward\_1SC\_3Flows\_1AC\_3Paths



- $\beta_{s_0} = \beta_{s_1} = \beta_{s_2} = \beta_{s_3} = \beta_{R_{s_i}, T_{s_i}} = \beta_{20,20}, i \in \{0, 1, 2\}$
- $\mathcal{F} = \{f_0, f_1, f_2\}$
- $\alpha^{f_0} = \alpha^{f_1} = \alpha^{f_2} = \gamma_{r^{f_j}, b^{f_j}} = \gamma_{5,25}, j \in \{0, 1, 2\}$

The above topology can be transformed into an equivalent one by removing the unused edges:



$\text{arrivalBound}(s_3, \{f_1\}, \mathcal{G}), \mathcal{G} \in \mathcal{P}(\mathcal{F} \setminus \{f_2\}) = \alpha_{s_3}^{f_1}$ $= \text{arrivalBound}(s_1, \{f_2\}, \mathcal{G}'), \mathcal{G}' \in \mathcal{P}(\mathcal{F} \setminus \{f_1\}) = \alpha_{s_1}^{f_2}$		FIFO_MUX	ARB_MUX
$\alpha^{f_i} = \alpha^{f_1} = \alpha^{f_2}$		$= \gamma_{5,25}$	
$\alpha_{s_2}^{xf_i} = \alpha_{s_2}^{xf_1} = \alpha_{s_2}^{xf_2} = \alpha^{f_1} = \alpha^{f_2}, i \in \{1, 2\}$		$= \gamma_{5,25}$	
$\beta_{s_2}^{\text{l.o.}f_i} = \beta_{s_2} \ominus \alpha_{s_2}^{xf_i} = \beta_{R_{s_2}^{\text{l.o.}f_i}, T_{s_2}^{\text{l.o.}f_i}}$	$R_{s_2}^{\text{l.o.}f_i}$	$[R_{s_2} - r_{s_2}^{xf_i}]^+ = 15$	
	$T_{s_2}^{\text{l.o.}f_i}$	$\beta_{s_2} = b_{s_2}^{xf_i}$ $20 \cdot [t - 20]^+ = 25$ $t = 21\frac{1}{4}$	$\beta_{s_2} = \alpha_{s_2}^{xf_i}$ $20 \cdot [t - 20]^+ = 5 \cdot t + 25$ $t = 28\frac{1}{3}$
	$=$	$= \beta_{15, 21\frac{1}{4}}$	$= \beta_{15, 28\frac{1}{3}}$
	$=$	$= 5$	$= 5$
$\alpha_{s_1}^{f_2} = \alpha_{s_3}^{f_1} = \alpha^{f_i} \odot \beta_{s_2}^{\text{l.o.}f_i}$ $= \gamma_{r_{s_1}^{f_2}, b_{s_1}^{f_2}} = \gamma_{r_{s_3}^{f_1}, b_{s_3}^{f_1}}$	$r_{s_1}^{f_2} = r_{s_3}^{f_1}$	$= 5$	
	$b_{s_1}^{f_2} = b_{s_3}^{f_1}$	$\alpha^{f_i}(T_{s_2}^{\text{l.o.}f_i}) = 5 \cdot 21\frac{1}{4} + 25 = 131\frac{1}{4}$	$\alpha^{f_i}(T_{s_2}^{\text{l.o.}f_i}) = 5 \cdot 28\frac{1}{3} + 25 = 166\frac{2}{3}$
	$=$	$= \gamma_{5, 131\frac{1}{4}}$	$= \gamma_{5, 166\frac{2}{3}}$

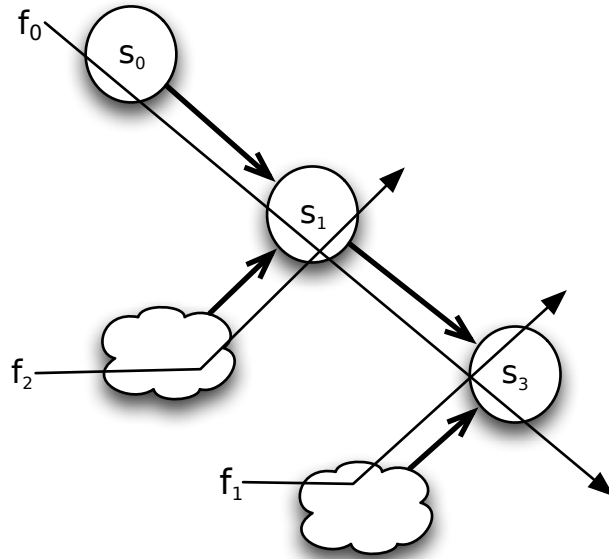
$\text{arrivalBound}(s_1, \{f_0\}, \mathcal{G}), \mathcal{G} \in \mathcal{P}(\mathcal{F} \setminus \{f_2\}) = \alpha_{s_1}^{f_0}$ $= \text{arrivalBound}(s_3, \{f_1\}, \mathcal{G}' \cup \{f_2\}), \mathcal{G}' \in \mathcal{P}(\mathcal{F}) = \alpha_{s_3}^{f_1}$ $= \text{arrivalBound}(s_1, \{f_2\}, \mathcal{G}'' \cup \{f_1\}), \mathcal{G}'' \in \mathcal{P}(\mathcal{F}) = \alpha_{s_1}^{f_2}$	FIFO_MUX	ARB_MUX
$\alpha_{s_0}^{f_0} = \alpha^{f_0} = \alpha_{s_2}^{f_1} = \alpha^{f_1} = \alpha_{s_2}^{f_2} = \alpha^{f_2}$		$= \gamma_{5,25}$
$\alpha_{s_0}^{xf_0} = \alpha_{s_2}^{xf_1} = \alpha_{s_2}^{xf_2}$		$= \gamma_{0,0}$
$\beta_{s_0}^{\text{l.o.}f_0} = \beta_{s_0} = \beta_{s_2}^{\text{l.o.}f_1} = \beta_{s_2} = \beta_{s_2}^{\text{l.o.}f_1} = \beta_{R^{\text{l.o.}}, T^{\text{l.o.}}}$		$= \beta_{20,20}$
$\alpha_{s_1}^{f_0} = \alpha^{f_0} \oslash \beta_{s_0} = \gamma_{r_{s_1}^{f_0}, b_{s_1}^{f_0}}$	$r_{s_1}^{f_0} = r_{s_3}^{f_1} = r_{s_1}^{f_2}$	$= 5$
$= \alpha_{s_3}^{f_1} = \alpha^{f_1} \oslash \beta_{s_2} = \gamma_{r_{s_3}^{f_1}, b_{s_3}^{f_1}}$	$b_{s_1}^{f_0} = b_{s_3}^{f_1} = b_{s_1}^{f_2}$	$\alpha^{f_i}(T^{\text{l.o.}}) = 5 \cdot 20 + 25 = 125, i \in \{0, 1, 2\}$
$= \alpha_{s_1}^{f_2} = \alpha^{f_2} \oslash \beta_{s_2} = \gamma_{r_{s_1}^{f_2}, b_{s_1}^{f_2}}$	$=$	$= \gamma_{5,125}$

$\text{arrivalBound}(s_3, \{f_0\}, \mathcal{G}), \mathcal{G} \in \mathcal{P}(\{f_0\}) = \alpha_{s_3}^{f_0}$		FIFO_MUX	ARB_MUX
$\alpha_{s_1}^{f_0}$		$= \gamma_{5,125}$	
$\alpha_{s_1}^{xf_0} = \alpha_{s_1}^{f_2}$		$= \gamma_{5,131\frac{1}{4}}$	$= \gamma_{5,166\frac{2}{3}}$
$\beta_{s_1}^{\text{l.o.}f_0} = \beta_{s_1} \ominus \alpha_{s_1}^{xf_0} = \beta_{R_{s_1}^{\text{l.o.}f_0}, T_{s_1}^{\text{l.o.}f_0}}$	$R_{s_1}^{\text{l.o.}f_0}$	$[R_{s_1} - r_{s_1}^{xf_0}]^+ = 15$	
	$T_{s_1}^{\text{l.o.}f_0}$	$\beta_{s_1} = b_{s_1}^{xf_0}$ $20 \cdot [t - 20]^+ = 131\frac{1}{4}$ $t = 26\frac{9}{16}$	$\beta_{s_1} = \alpha_{s_1}^{xf_0}$ $20 \cdot [t - 20]^+ = 5 \cdot t + 166\frac{2}{3}$ $t = 37\frac{7}{8}$
	$=$	$= \beta_{15,26\frac{9}{16}}$	$= \beta_{15,37\frac{7}{8}}$
	$r_{s_3}^{f_0}$	$= 5$	
$\alpha_{s_3}^{f_0} = \alpha_{s_1}^{f_0} \oslash \beta_{s_1}^{\text{l.o.}f_0} = \gamma_{r_{s_3}^{f_0}, b_{s_3}^{f_0}}$	$b_{s_3}^{f_0}$	$\alpha_{s_1}^{f_0}(T_{s_1}^{\text{l.o.}f_0}) = 5 \cdot 26\frac{9}{16} + 125 = 257\frac{13}{16}$	$\alpha_{s_1}^{f_0}(T_{s_1}^{\text{l.o.}f_0}) = 5 \cdot 37\frac{7}{8} + 125 = 313\frac{8}{9}$
	$=$	$= \gamma_{5,257\frac{13}{16}}$	$= \gamma_{5,313\frac{8}{9}}$

$\text{arrivalBound}(s_3, \{f_0\}, \{f_1\}) = \alpha_{s_3}^{f_0}$		FIFO_MUX	ARB_MUX
$\alpha_{s_1}^{f_0}$		$= \gamma_{5,125}$	
$\alpha_{s_1}^{xf_0} = \alpha_{s_1}^{f_1}$		$= \gamma_{5,125}$	
$\beta_{s_1}^{\text{l.o.}f_0} = \beta_{s_1} \ominus \alpha_{s_1}^{xf_0} = \beta_{R_{s_1}^{\text{l.o.}f_0}, T_{s_1}^{\text{l.o.}f_0}}$	$R_{s_1}^{\text{l.o.}f_0}$	$[R_{s_1} - r_{s_1}^{xf_0}]^+ = 15$	
	$T_{s_1}^{\text{l.o.}f_0}$	$\beta_{s_1} = b_{s_1}^{xf_0}$ $20 \cdot [t - 20]^+ = 125$ $t = 26\frac{1}{4}$	$\beta_{s_1} = \alpha_{s_1}^{xf_0}$ $20 \cdot [t - 20]^+ = 5 \cdot t + 125$ $t = 35$
	$=$	$= \beta_{15, 26\frac{1}{4}}$	$= \beta_{15, 35}$
	$r_{s_3}^{f_0}$	$= 5$	
$\alpha_{s_3}^{f_0} = \alpha_{s_1}^{f_0} \oslash \beta_{s_1}^{\text{l.o.}f_0} = \gamma_{r_{s_3}^{f_0}, b_{s_3}^{f_0}}$	$b_{s_3}^{f_0}$	$\alpha_{s_1}^{f_0}(T_{s_1}^{\text{l.o.}f_0}) = 5 \cdot 26\frac{1}{4} + 125 = 256\frac{1}{4}$	$\alpha_{s_1}^{f_0}(T_{s_1}^{\text{l.o.}f_0}) = 5 \cdot 35 + 125 = 300$
	$=$	$= \gamma_{5, 256\frac{1}{4}}$	$= \gamma_{5, 300}$

**Flow  $f_0$  (comparable to Tandem\_1SC\_2Flows\_1SC\_2Paths)**

Arrival bound abstraction of  $f_0$ 's cross flows leads to a tree topology comparable to Tandem\_1SC\_2Flows\_1SC\_2Paths:



TFA		FIFO_MUX	ARB_MUX
$s_0$	$\alpha_{s_0} = \alpha_{s_0}^{f_0}$	$= \gamma_{5,25}$	
	$D_{s_0}^{f_0}$	$\beta_{s_0} = b_{s_0}$ $20 \cdot [t - 20]^+ = 25$ $t = 21\frac{1}{4}$	FIFO per micro flow $\beta_{s_0} = b_{s_0}$ $20 \cdot [t - 20]^+ = 25$ $t = 21\frac{1}{4}$
	$B_{s_0}^{f_0}$	$\alpha_{s_0}(T_{s_0}) = 20 \cdot 5 + 25$ $= 125$	
$s_1$	$\alpha_{s_1} = \alpha_{s_1}^{f_0} + \alpha_{s_1}^{f_2}$	$= \gamma_{5,125} + \gamma_{5,131\frac{1}{4}} = \gamma_{10,256\frac{1}{4}}$	$= \gamma_{5,125} + \gamma_{5,166\frac{2}{3}} = \gamma_{10,291\frac{2}{3}}$
	$D_{s_1}^{f_0}$	$\beta_{s_1} = b_{s_1}$ $20 \cdot [t - 20]^+ = 256\frac{1}{4}$ $t = 32\frac{13}{16}$	$\beta_{s_1} = \alpha_{s_1}$ $20 \cdot [t - 20]^+ = 10 \cdot t + 291\frac{2}{3}$ $t = 69\frac{1}{6}$
	$B_{s_1}^{f_0}$	$\alpha_{s_1}(T_{s_1}) = 10 \cdot 20 + 256\frac{1}{4}$ $= 456\frac{1}{4}$	$\alpha_{s_1}(T_{s_1}) = 10 \cdot 20 + 291\frac{2}{3}$ $= 491\frac{2}{3}$
$s_3$	$\alpha_{s_3} = \alpha_{s_3}^{f_0} + \alpha_{s_3}^{f_1}$	$= \gamma_{5,257\frac{13}{16}} + \gamma_{5,131\frac{1}{4}} = \gamma_{10,389\frac{1}{16}}$	$= \gamma_{5,313\frac{8}{9}} + \gamma_{5,166\frac{2}{3}} = \gamma_{10,480\frac{5}{9}}$
	$D_{s_3}^{f_0}$	$\beta_{s_3} = b_{s_3}$ $20 \cdot [t - 20]^+ = 389\frac{1}{16}$ $t = 39\frac{29}{64}$	$\beta_{s_3} = \alpha_{s_3}$ $20 \cdot [t - 20]^+ = 10 \cdot t + 480\frac{5}{9}$ $t = 88\frac{5}{90}$
	$B_{s_3}^{f_0}$	$\alpha_{s_3}(T_{s_3}) = 10 \cdot 20 + 389\frac{1}{16}$ $= 589\frac{1}{16}$	$\alpha_{s_3}(T_{s_3}) = 10 \cdot 20 + 480\frac{5}{9}$ $= 680\frac{5}{9}$
$D^{f_0}$		$\sum_{i=\{0,1,3\}} D_{s_i}^{f_0} = 93\frac{33}{64}$	$\sum_{i=\{0,1,3\}} D_{s_i}^{f_0} = 178\frac{17}{36}$
$B^{f_0}$		$\max_{i=\{0,1,3\}} b_{s_i}^{f_0} = 589\frac{1}{16}$	$\max_{i=\{0,1,3\}} b_{s_i}^{f_0} = 680\frac{5}{9}$

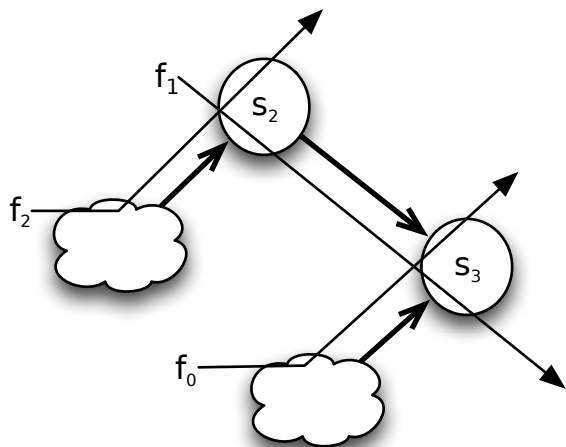
SFA		FIFO_MUX	ARB_MUX
$s_0$	$\alpha_{s_0}^{xf_0}$	$= \gamma_{0,0}$	
	$\beta_{s_0}^{l.o.f_0} = \beta_{s_0} \ominus \alpha_{s_0}^{xf_0}$	$= \beta_{20,20}$	
$s_1$	$\alpha_{s_1}^{xf_0} = \alpha_{s_1}^{f_2}$	$= \gamma_{5,131\frac{1}{4}}$	$= \gamma_{5,166\frac{2}{3}}$
	$\beta_{s_1}^{l.o.f_0} = \beta_{s_1} \ominus \alpha_{s_1}^{xf_0}$	$R_{s_1}^{l.o.f_0}$	$[R_{s_1} - r_{s_1}^{xf_0}]^+ = 15$
		$\beta_{s_1} = b_{s_1}^{xf_0}$	$\beta_{s_1} = \alpha_{s_1}^{xf_0}$
		$20 \cdot [t - 20]^+ = 131\frac{1}{4}$	$20 \cdot [t - 20]^+ = 5 \cdot t + 166\frac{2}{3}$
		$t = 26\frac{9}{16}$	$t = 37\frac{7}{9}$
		$= \beta_{15,26\frac{9}{16}}$	$= \beta_{15,37\frac{7}{9}}$
$s_3$	$\alpha_{s_3}^{xf_0} = \alpha_{s_3}^{f_1}$	$= \gamma_{5,131\frac{1}{4}}$	$= \gamma_{5,166\frac{2}{3}}$
	$\beta_{s_3}^{l.o.f_0} = \beta_{s_3} \ominus \alpha_{s_3}^{xf_0} = \beta_{R_{s_3}^{l.o.f_0}, T_{s_3}^{l.o.f_0}}$	$R_{s_3}^{l.o.f_0}$	$[R_{s_3} - r_{s_3}^{xf_0}]^+ = 15$
		$\beta_{s_3} = b_{s_3}^{xf_0}$	$\beta_{s_3} = \alpha_{s_3}^{xf_0}$
		$20 \cdot [t - 20]^+ = 131\frac{1}{4}$	$20 \cdot [t - 20]^+ = 5 \cdot t + 166\frac{2}{3}$
		$t = 26\frac{9}{16}$	$t = 37\frac{7}{9}$
		$= \beta_{15,26\frac{9}{16}}$	$= \beta_{15,37\frac{7}{9}}$
$\beta_{e2e}^{l.o.f_0} = \beta_{R_{e2e}^{l.o.f_0}, T_{e2e}^{l.o.f_0}}$		$\bigotimes_{i=\{0,1,3\}} \beta_{s_i}^{l.o.f_0} = \beta_{15,73\frac{1}{8}}$	$\bigotimes_{i=\{0,1,3\}} \beta_{s_i}^{l.o.f_0} = \beta_{15,95\frac{5}{9}}$
$D^{f_0}$		$\beta_{e2e}^{l.o.f_0} = b^{f_0}$	$\beta_{e2e}^{l.o.f_0} = b^{f_0}$
		$15 \cdot [t - 73\frac{1}{8}]^+ = 25$	$15 \cdot [t - 95\frac{5}{9}]^+ = 25$
		$t = 74\frac{19}{24}$	$t = 97\frac{2}{9}$
$B^{f_0}$		$\alpha^{f_0}(T_{e2e}^{l.o.f_0}) = 5 \cdot 73\frac{1}{8} + 25$	$\alpha^{f_0}(T_{e2e}^{l.o.f_0}) = 5 \cdot 95\frac{5}{9} + 25$
		$= 390\frac{5}{8}$	$= 502\frac{7}{9}$

PMOO		ARB_MUX
$s_0$	$\alpha_{s_0}^{x'f_0}$	$= \gamma_{0,0}$
	$\alpha_{s_0}^{xf_0}$	$= \gamma_{0,0}$
$s_1$	$\alpha_{s_1}^{x'f_0} = \alpha_{s_1}^{f_2}$	$= \gamma_{5,166\frac{2}{3}}$
	$\alpha_{s_1}^{xf_0} = \alpha_{s_1}^{f_2}$	$= \gamma_{5,166\frac{2}{3}}$
$s_3$	$\alpha_{s_3}^{x'f_0} = \alpha_{s_3}^{f_1}$	$= \gamma_{5,166\frac{2}{3}}$
	$\alpha_{s_3}^{xf_0} = \alpha_{s_3}^{f_1}$	$= \gamma_{5,166\frac{2}{3}}$
$\beta_{e2e}^{l.o.f_0} = \beta_{R_{e2e}^{l.o.f_0}, T_{e2e}^{l.o.f_0}}$	$R_{e2e}^{l.o.f_0} = \bigwedge_{i \in \{0,1,3\}} (R_{s_i} - r_{s_i}^{xf_0})$	$= (20 - 5) \wedge (20 - 5) \wedge (20 - 5)$ $= 15$
	$T_{e2e}^{l.o.f_0} = \sum_{i \in \{0,1,3\}} T_{s_i} + \frac{\sum_{i \in \{0,1,3\}} (b_{s_i}^{x'f_0} + r_{s_i}^{xf_0} \cdot T_{s_i})}{R_{e2e}^{l.o.f_0}}$	$= 20 + 20 + 20 + \frac{0 + 0 \cdot 20 + 166\frac{2}{3} + 5 \cdot 20 + 166\frac{2}{3} + 5 \cdot 20}{15}$ $= 60 + \frac{533\frac{1}{3}}{15}$ $= 95\frac{5}{9}$
	$=$	$= \beta_{15,95\frac{5}{9}}$
$D^{f_0}$		$\beta_{e2e}^{l.o.f_0} = b^{f_0}$ $15 \cdot [t - 95\frac{5}{9}]^+ = 25$ $t = 97\frac{2}{9}$
$B^{f_0}$		$\alpha^{f_0}(T_{e2e}^{l.o.f_0}) = 5 \cdot 95\frac{5}{9} + 25$ $= 502\frac{7}{9}$

(See [1] for details)



Flow  $f_1$

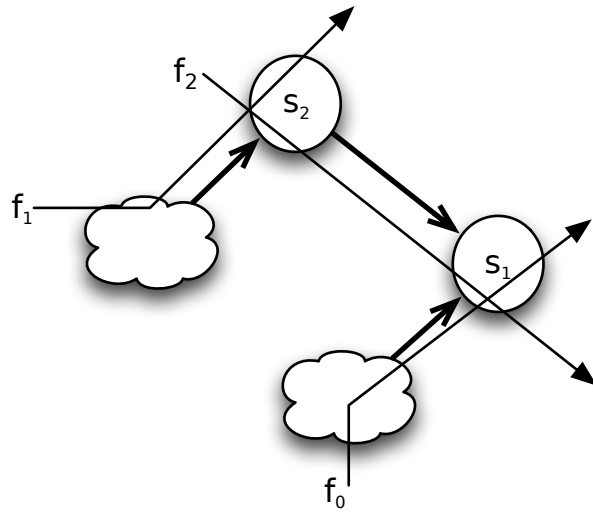


TFA		FIFO_MUX	ARB_MUX
$s_2$	$\alpha_{s_2} = \alpha_{s_2}^{f_1} + \alpha_{s_2}^{f_2}$	$= \gamma_{10,50}$	
	$D_{s_2}^{f_1}$	$\beta_{s_2} = b_{s_2}$ $20 \cdot [t - 20]^+ = 50$ $t = 22\frac{1}{2}$	$\beta_{s_2} = \alpha_{s_2}$ $20 \cdot [t - 20]^+ = 10 \cdot t + 50$ $t = 45$
	$B_{s_2}^{f_1}$	$\alpha_{s_2}(T_{s_2}) = 20 \cdot 10 + 50$ $= 250$	
$s_3$	$\alpha_{s_3} = \alpha_{s_3}^{f_0} + \alpha_{s_3}^{f_1}$	$= \gamma_{5,257\frac{13}{16}} + \gamma_{5,131\frac{1}{4}} = \gamma_{10,389\frac{1}{16}}$	$= \gamma_{5,313\frac{8}{9}} + \gamma_{5,166\frac{2}{3}} = \gamma_{10,480\frac{5}{9}}$
	$D_{s_3}^{f_1}$	$\beta_{s_3} = b_{s_3}$ $20 \cdot [t - 20]^+ = 389\frac{1}{16}$ $t = 39\frac{29}{64}$	$\beta_{s_3} = \alpha_{s_3}$ $20 \cdot [t - 20]^+ = 10 \cdot t + 480\frac{5}{9}$ $t = 88\frac{5}{90}$
	$B_{s_3}^{f_1}$	$\alpha_{s_3}(T_{s_3}) = 10 \cdot 20 + 389\frac{1}{16}$ $= 589\frac{1}{16}$	$\alpha_{s_3}(T_{s_3}) = 10 \cdot 20 + 480\frac{5}{9}$ $= 680\frac{5}{9}$
$D^{f_1}$		$\sum_{i=2}^3 D_{s_i}^{f_1} = 61\frac{61}{64}$	$\sum_{i=2}^3 D_{s_i}^{f_1} = 185\frac{5}{9}$
$B^{f_1}$		$\max_{i=\{2,3\}} b_{s_i}^{f_1} = 589\frac{1}{16}$	$\max_{i=\{2,3\}} b_{s_i}^{f_1} = 680\frac{5}{9}$

SFA		FIFO_MUX	ARB_MUX
$s_2$	$\alpha_{s_2}^{xf_1} = \alpha_{s_2}^{f_2} = \alpha^{f_2}$	$= \gamma_{5,25}$	
	$\beta_{s_2}^{l.o.f_1} = \beta_{s_2} \ominus \alpha_{s_2}^{xf_1}$	$= \beta_{15,21\frac{1}{4}}$	$= \beta_{15,28\frac{1}{3}}$
$s_3$	$\alpha_{s_3}^{xf_1} = \alpha_{s_3}^{f_0}$	$= \gamma_{5,256\frac{1}{4}}$	$= \gamma_{5,300}$
	$\beta_{s_3}^{l.o.f_1} = \beta_{s_3} \ominus \alpha_{s_3}^{xf_1} = \beta_{R_{s_3}^{l.o.f_1}, T_{s_3}^{l.o.f_1}}$	$R_{s_3}^{l.o.f_1}$	$[R_{s_3} - r_{s_3}^{xf_1}]^+ = 15$
		$T_{s_3}^{l.o.f_1}$	$\beta_{s_3} = b_{s_3}^{xf_1}$ $20 \cdot [t - 20]^+ = 256\frac{1}{4}$ $t = 32\frac{13}{16}$
			$\beta_{s_3} = \alpha_{s_3}^{xf_1}$ $20 \cdot [t - 20]^+ = 5 \cdot t + 300$ $t = 46\frac{2}{3}$
		$=$	$= \beta_{15,32\frac{13}{16}}$
$\beta_{e2e}^{l.o.f_1} = \beta_{R_{e2e}^{l.o.f_1}, T_{e2e}^{l.o.f_1}}$		$\bigotimes_{i=2}^3 \beta_{s_i}^{l.o.f_1} = \beta_{15,54\frac{1}{16}}$	$\bigotimes_{i=2}^3 \beta_{s_i}^{l.o.f_1} = \beta_{15,75}$
$D^{f_1}$		$\beta_{e2e}^{l.o.f_1} = b^{f_1}$ $15 \cdot [t - 54\frac{1}{16}]^+ = 25$ $t = 55\frac{35}{48}$	$\beta_{e2e}^{l.o.f_1} = b^{f_1}$ $15 \cdot [t - 75]^+ = 25$ $t = 76\frac{2}{3}$
$B^{f_1}$		$\alpha^{f_1}(T_{e2e}^{l.o.f_1}) = 5 \cdot 54\frac{1}{16} + 25$ $= 295\frac{5}{16}$	$\alpha^{f_1}(T_{e2e}^{l.o.f_1}) = 5 \cdot 75 + 25$ $= 400$

PMOO		ARB_MUX
$s_2$	$\alpha_{s_2}^{x'f_1} = \alpha_{s_2}^{f_2}$	$= \gamma_{5,25}$
	$\alpha_{s_2}^{xf_1} = \alpha_{s_2}^{f_2}$	$= \gamma_{5,25}$
$s_3$	$\alpha_{s_3}^{xf_1} = \alpha_{s_3}^{f_0}$	$= \gamma_{5,300}$
	$\alpha_{s_3}^{xf_1} = \alpha_{s_3}^{f_0}$	$= \gamma_{5,300}$
$\beta_{e2e}^{l.o.f_1} = \beta_{R_{e2e}^{l.o.f_1}, T_{e2e}^{l.o.f_1}}$	$R_{e2e}^{l.o.f_1} = \bigwedge_{i \in \{2,3\}} (R_{s_i} - r_{s_i}^{xf_1})$	$= (20 - 5) \wedge (20 - 5)$
		$= 15$
	$T_{e2e}^{l.o.f_1} = \sum_{i \in \{2,3\}} T_{s_i} + \frac{\sum_{i \in \{2,3\}} (b_{s_i}^{x'f_1} + r_{s_i}^{xf_1} \cdot T_{s_i})}{R_{e2e}^{l.o.f_1}}$	$= 20 + 20 + \frac{25 + 5 \cdot 20 + 300 + 5 \cdot 20}{15}$
		$= 40 + \frac{525}{15}$
	$=$	$= \beta_{15,75}$
$D^{f_1}$		$\beta_{e2e}^{l.o.f_1} = b^{f_1}$ $15 \cdot [t - 75]^+ = 25$ $t = 76\frac{2}{3}$
$B^{f_1}$		$\alpha^{f_1}(T_{e2e}^{l.o.f_1}) = 5 \cdot 75 + 25$ $= 400$

Flow  $f_2$



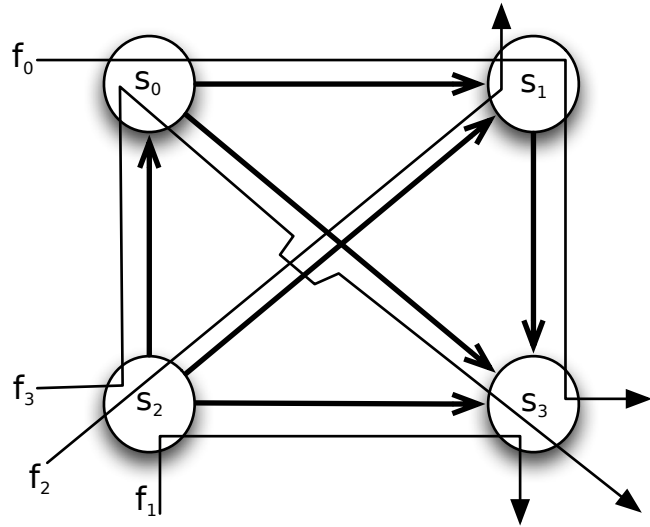
TFA		FIFO_MUX	ARB_MUX
$s_2$	$\alpha_{s_2} = \alpha_{s_2}^{f_1} + \alpha_{s_2}^{f_2}$	$= \gamma_{10,50}$	
	$D_{s_2}^{f_2}$	$\beta_{s_2} = b_{s_2}$ $20 \cdot [t - 20]^+ = 50$ $t = 22\frac{1}{2}$	$\beta_{s_2} = \alpha_{s_2}$ $20 \cdot [t - 20]^+ = 10 \cdot t + 50$ $t = 45$
	$B_{s_2}^{f_2}$	$\alpha_{s_2}(T_{s_2}) = 20 \cdot 10 + 50$ $= 250$	
$s_1$	$\alpha_{s_3} = \alpha_{s_3}^{f_0} + \alpha_{s_3}^{f_1}$	$= \gamma_{5,125} + \gamma_{5,131\frac{1}{4}} = \gamma_{10,256\frac{1}{4}}$	$= \gamma_{5,125} + \gamma_{5,166\frac{2}{3}} = \gamma_{10,291\frac{2}{3}}$
	$D_{s_1}^{f_2}$	$\beta_{s_1} = b_{s_1}$ $20 \cdot [t - 20]^+ = 256\frac{1}{4}$ $t = 32\frac{13}{16}$	$\beta_{s_1} = \alpha_{s_1}$ $20 \cdot [t - 20]^+ = 10 \cdot t + 291\frac{2}{3}$ $t = 69\frac{1}{6}$
	$B_{s_1}^{f_2}$	$\alpha_{s_1}(T_{s_1}) = 10 \cdot 20 + 256\frac{1}{4}$ $= 456\frac{1}{4}$	$\alpha_{s_1}(T_{s_1}) = 10 \cdot 20 + 291\frac{2}{3}$ $= 491\frac{2}{3}$
$D^{f_2}$		$\sum_{i=1}^2 D_{s_i}^{f_2} = 55\frac{5}{16}$	$\sum_{i=1}^2 D_{s_i}^{f_2} = 114\frac{1}{6}$
$B^{f_2}$		$\max_{i=\{1,2\}} b_{s_i}^{f_2} = 456\frac{1}{4}$	$\max_{i=\{1,2\}} b_{s_i}^{f_2} = 491\frac{2}{3}$

SFA			FIFO_MUX	ARB_MUX
s2	$\alpha_{s_2}^{xf_2} = \alpha_{s_2}^{f_1}$		$= \gamma_{5,25}$	
	$\beta_{s_2}^{l.o.f_2} = \beta_{s_2} \ominus \alpha_{s_2}^{xf_1}$		$= \beta_{15,21\frac{1}{4}}$	$= \beta_{15,28\frac{1}{3}}$
s1	$\alpha_{s_1}^{xf_2} = \alpha_{s_1}^{f_0}$		$= \gamma_{5,125}$	
	$\beta_{s_1}^{l.o.f_2} = \beta_{s_1} \ominus \alpha_{s_1}^{xf_2} = \beta_{R_{s_1}^{l.o.f_2}, T_{s_1}^{l.o.f_2}}$	$R_{s_1}^{l.o.f_2}$	$[R_{s_1} - r_{s_1}^{xf_2}]^+ = 15$	
		$T_{s_1}^{l.o.f_2}$	$\beta_{s_1} = b_{s_1}$ $20 \cdot [t - 20]^+ = 125$ $t = 26\frac{1}{4}$	$\beta_{s_1} = \alpha_{s_1}^{xf_2}$ $20 \cdot [t - 20]^+ = 5 \cdot t + 125$ $t = 35$
		$=$	$= \beta_{15,26\frac{1}{4}}$	$= \beta_{15,35}$
$\beta_{e2e}^{l.o.f_2} = \beta_{R_{e2e}^{l.o.f_2}, T_{e2e}^{l.o.f_2}}$		$\bigotimes_{i=1}^2 \beta_{s_i}^{l.o.f_2} = \beta_{15,47\frac{1}{2}}$	$\bigotimes_{i=1}^2 \beta_{s_i}^{l.o.f_2} = \beta_{15,63\frac{1}{3}}$	
$D^{f_2}$		$\beta_{e2e}^{l.o.f_2} = b^{f_2}$ $15 \cdot [t - 47\frac{1}{2}]^+ = 25$ $t = 49\frac{1}{6}$	$\beta_{e2e}^{l.o.f_2} = b^{f_2}$ $15 \cdot [t - 63\frac{1}{3}]^+ = 25$ $t = 65$	
$B^{f_2}$		$\alpha^{f_2}(T_{e2e}^{l.o.f_2}) = 5 \cdot 47\frac{1}{2} + 25$ $= 262\frac{1}{2}$	$\alpha^{f_2}(T_{e2e}^{l.o.f_2}) = 5 \cdot 63\frac{1}{3} + 25$ $= 341\frac{2}{3}$	

PMOO		ARB_MUX
$s_2$	$\alpha_{s_2}^{x'f_2} = \alpha_{s_2}^{f_1}$	$= \gamma_{5,25}$
	$\alpha_{s_2}^{xf_2} = \alpha_{s_2}^{f_1}$	$= \gamma_{5,25}$
$s_1$	$\alpha_{s_1}^{x'f_2} = \alpha_{s_1}^{f_0}$	$= \gamma_{5,125}$
	$\alpha_{s_1}^{xf_2} = \alpha_{s_1}^{f_0}$	$= \gamma_{5,125}$
$\beta_{e2e}^{l.o.f_2} = \beta_{R_{e2e}^{l.o.f_2}, T_{e2e}^{l.o.f_2}}$	$R_{e2e}^{l.o.f_2} = \bigwedge_{i \in \{2,1\}} (R_{s_i} - r_{s_i}^{xf_2})$	$= (20 - 5) \wedge (20 - 5)$
		$= 15$
	$T_{e2e}^{l.o.f_2} = \sum_{i \in \{2,1\}} T_{s_i} + \frac{\sum_{i \in \{2,1\}} (b_{s_i}^{x'f_2} + r_{s_i}^{xf_2} \cdot T_{s_i})}{R_{e2e}^{l.o.f_2}}$	$= 20 + 20 + \frac{25 + 5 \cdot 20 + 125 + 5 \cdot 20}{15}$
		$= 40 + \frac{350}{15}$
		$= 63\frac{1}{3}$
	$=$	$= \beta_{15, 63\frac{1}{3}}$
$D^{f_2}$		$\beta_{e2e}^{l.o.f_2} = b^{f_2}$ $15 \cdot [t - 63\frac{1}{3}]^+ = 25$ $t = 65$
$B^{f_2}$		$\alpha^{f_2}(T_{e2e}^{l.o.f_2}) = 5 \cdot 63\frac{1}{3} + 25$ $= 341\frac{2}{3}$



# FeedForward\_1SC\_4Flows\_1AC\_4Paths



- $\beta_{s_0} = \beta_{s_1} = \beta_{s_2} = \beta_{s_3} = \beta_{R_{s_i}, T_{s_i}} = \beta_{20,20}, i \in \{0, 1, 2, 3\}$
- $\mathcal{F} = \{f_0, f_1, f_2, f_3\}$
- $\alpha^{f_i} = \gamma_{r^{f_j}, b^{f_j}} = \gamma_{5,25}, j \in \{0, 1, 2, 3\}$

$\text{arrivalBound}(s_3, \{f_1\}, \mathcal{G}), \mathcal{G} \in \mathcal{P}(\mathcal{F} \setminus \{f_2, f_3\}) = \alpha_{s_3}^{f_1}$ $= \text{arrivalBound}(s_1, \{f_2\}, \mathcal{G}'), \mathcal{G}' \in \mathcal{P}(\mathcal{F} \setminus \{f_1, f_3\}) = \alpha_{s_1}^{f_2}$ $= \text{arrivalBound}(s_0, \{f_3\}, \mathcal{G}''), \mathcal{G}'' \in \mathcal{P}(\mathcal{F} \setminus \{f_1, f_2\}) = \alpha_{s_0}^{f_3}$		FIFO_MUX	ARB_MUX
$\alpha_{s_2}^{f_1} = \alpha^{f_1} = \alpha_{s_2}^{f_2} = \alpha^{f_2} = \alpha_{s_2}^{f_3} = \alpha^{f_3} = \alpha^{f_i}, i \in \{1, 2, 3\}$		$= \gamma_{5,25}$	
$\alpha_{s_2}^{xf_i} = \alpha_{s_2}^{xf_1} = \alpha_{s_2}^{xf_2} = \alpha_{s_2}^{xf_3}$		$= \gamma_{10,50}$	
$\beta_{s_2}^{l.o.f_i} = \beta_{s_2} \ominus \alpha^{xf_i} = \beta_{R_{s_2}^{l.o.f_i}, T_{s_2}^{l.o.f_i}}$	$R_{s_2}^{l.o.f_i}$	$[R_{s_2} - r_{s_2}^{xf_i}]^+ = 15$	
	$T_{s_2}^{l.o.f_i}$	$\beta_{s_2} = b_{s_2}^{xf_i}$ $20 \cdot [t - 20]^+ = 50$ $t = 22\frac{1}{2}$	$\beta_{s_2} = \alpha_{s_2}^{xf_i}$ $20 \cdot [t - 20]^+ = 10 \cdot t + 50$ $t = 45$
	$=$	$= \beta_{10,22\frac{1}{2}}$	$= \beta_{10,45}$
	$r_{s_3}^{f_1} = r_{s_1}^{f_2} = r_{s_0}^{f_3}$	$= 5$	
$\alpha_{s_3}^{f_1} = \alpha^{f_1} \oslash \beta_{s_2}^{l.o.f_i} = \gamma_{r_{s_3}^{f_1}, b_{s_3}^{f_1}}$ $= \alpha_{s_1}^{f_2} = \alpha^{f_2} \oslash \beta_{s_2}^{l.o.f_i} = \gamma_{r_{s_1}^{f_2}, b_{s_1}^{f_2}}$ $= \alpha_{s_0}^{f_3} = \alpha^{f_3} \oslash \beta_{s_2}^{l.o.f_i} = \gamma_{r_{s_0}^{f_3}, b_{s_0}^{f_3}}$	$b_{s_3}^{f_1} = b_{s_1}^{f_2} = b_{s_0}^{f_3}$	$\alpha^{f_i}(T_{s_2}^{l.o.f_i}) = 5 \cdot 22\frac{1}{2} + 25 = 137\frac{1}{2}$	$\alpha^{f_i}(T_{s_2}^{l.o.f_i}) = 5 \cdot 45 + 25 = 250$
	$=$	$= \gamma_{5,137\frac{1}{2}}$	$= \gamma_{5,250}$

$\text{arrivalBound}(s_1, \{f_0\}, \mathcal{G}), \mathcal{G} \in \mathcal{P}(\{f_0\}) = \alpha_{s_1}^{f_0}$		FIFO_MUX	ARB_MUX
$\alpha_{s_0}^{f_0} = \alpha^{f_0}$		$= \gamma_{5,25}$	
$\alpha_{s_0}^{xf_0} = \alpha_{s_0}^{f_3}$		$= \gamma_{5,137\frac{1}{2}}$	$= \gamma_{5,250}$
$\beta_{s_0}^{l.o.f_0} = \beta_{s_0} \ominus \alpha_{s_0}^{xf_0} = \beta_{R_{s_0}^{l.o.f_0}, T_{s_0}^{l.o.f_0}}$	$R_{s_0}^{l.o.f_0}$	$[R_{s_0} - r_{s_0}^{xf_0}]^+ = 15$	
	$T_{s_0}^{l.o.f_0}$	$\beta_{s_0} = b_{s_0}^{xf_0}$ $20 \cdot [t - 20]^+ = 137\frac{1}{2}$ $t = 26\frac{7}{8}$	$\beta_{s_0} = \alpha_{s_0}^{xf_0}$ $20 \cdot [t - 20]^+ = 5 \cdot t + 250$ $t = 43\frac{1}{3}$
	$=$	$= \beta_{15,26\frac{7}{8}}$	$= \beta_{15,43\frac{1}{3}}$
	$r_{s_1}^{f_0}$	$= 5$	
$\alpha_{s_1}^{f_0} = \alpha^{f_0} \oslash \beta_{s_0}^{l.o.f_0} = \gamma_{r_{s_1}^{f_0}, b_{s_1}^{f_0}}$	$b_{s_1}^{f_0}$	$\alpha^{f_0}(T_{s_0}^{l.o.f_0}) = 5 \cdot 26\frac{7}{8} + 25 = 159\frac{3}{8}$	$\alpha^{f_0}(T_{s_0}^{l.o.f_0}) = 5 \cdot 43\frac{1}{3} + 25 = 241\frac{2}{3}$
	$=$	$= \gamma_{5,159\frac{3}{8}}$	$= \gamma_{5,241\frac{2}{3}}$

arrivalBound( $s_3, \{f_3\}, \mathcal{G}$ ), $\mathcal{G} \in \mathcal{P}(\{f_3\}) = \alpha_{s_3}^{f_3}$		FIFO_MUX	ARB_MUX
$\alpha_{s_0}^{f_3}$		$= \gamma_{5,137\frac{1}{2}}$	$= \gamma_{5,250}$
$\alpha_{s_0}^{xf_3} = \alpha_{s_0}^{f_0}$		$= \gamma_{5,25}$	
$\beta_{s_0}^{l.o.f_3} = \beta_{s_0} \ominus \alpha_{s_0}^{xf_3} = \beta_{R_{s_0}^{l.o.f_3}, T_{s_0}^{l.o.f_3}}$	$R_{s_0}^{l.o.f_3}$	$[R_{s_0} - r_{s_0}^{xf_3}]^+ = 15$	
	$T_{s_0}^{l.o.f_3}$	$\beta_{s_0} = b_{s_0}^{f_0}$ $20 \cdot [t - 20]^+ = 25$ $t = 21\frac{1}{4}$	$\beta_{s_0} = \alpha_{s_0}^{f_0}$ $20 \cdot [t - 20]^+ = 5 \cdot t + 25$ $t = 28\frac{1}{3}$
	$=$	$= \beta_{15,21\frac{1}{4}}$	$= \beta_{15,28\frac{1}{3}}$
	$r_{s_3}^{f_3}$	$= 5$	
$\alpha_{s_3}^{f_3} = \alpha_{s_0}^{f_3} \oslash \beta_{s_0}^{l.o.f_3} = \gamma_{r_{s_3}^{f_3}, b_{s_3}^{f_3}}$	$b_{s_3}^{f_3}$	$\alpha_{s_0}^{f_3}(T_{s_0}^{l.o.f_3}) = 5 \cdot 21\frac{1}{4} + 137\frac{1}{2} = 243\frac{3}{4}$	$\alpha_{s_0}^{f_3}(T_{s_0}^{l.o.f_3}) = 5 \cdot 28\frac{1}{3} + 250 = 391\frac{2}{3}$
	$=$	$= \gamma_{5,243\frac{3}{4}}$	$= \gamma_{5,391\frac{2}{3}}$

arrivalBound( $s_3, \{f_0\}, \mathcal{G}$ ), $\mathcal{G} \in \mathcal{P}(\{f_0\}) = \alpha_{s_3}^{f_0}$		FIFO_MUX	ARB_MUX
$\alpha_{s_1}^{f_0}$		$= \gamma_{5,159\frac{3}{8}}$	$= \gamma_{5,241\frac{2}{3}}$
$\alpha_{s_1}^{xf_0} = \alpha_{s_2s_1}^{f_2} = (\alpha_{s_2}^{f_2})^*$		$= \gamma_{5,137\frac{1}{2}}$	$= \gamma_{5,250}$
$\beta_{s_1}^{l.o.f_0} = \beta_{s_1} \otimes \alpha_{s_1}^{xf_0} = \beta_{R_{s_1}^{l.o.f_0}, T_{s_1}^{l.o.f_0}}$	$R_{s_1}^{l.o.f_0}$	$[R_{s_1} - r_{s_1}^{xf_0}]^+ = 15$	
	$T_{s_1}^{l.o.f_0}$	$\beta_{s_1} = b_{s_1}^{xf_0}$ $20 \cdot [t - 20]^+ = 137\frac{1}{2}$ $t = 26\frac{7}{8}$	$\beta_{s_1} = \alpha_{s_1}^{xf_0}$ $20 \cdot [t - 20]^+ = 5 \cdot t + 250$ $t = 43\frac{1}{3}$
	$=$	$= \beta_{15,26\frac{7}{8}}$	$= \beta_{15,43\frac{1}{3}}$
	$r_{s_3}^{f_0}$	$= 5$	
$\alpha_{s_3}^{f_0} = \alpha_{s_1}^{f_0} \oslash \beta_{s_1}^{l.o.f_0} = \gamma_{r_{s_3}^{f_0}, b_{s_3}^{f_0}}$	$b_{s_3}^{f_0}$	$\alpha_{s_1}^{f_0}(T_{s_1}^{l.o.f_0}) = 5 \cdot 26\frac{7}{8} + 159\frac{3}{8} = 293\frac{3}{4}$	$\alpha_{s_1}^{f_0}(T_{s_1}^{l.o.f_0}) = 5 \cdot 43\frac{1}{3} + 241\frac{2}{3} = 458\frac{1}{3}$
	$=$	$= \gamma_{5,293\frac{3}{4}}$	$= \gamma_{5,458\frac{1}{3}}$

$\begin{aligned} & \text{arrivalBound}(s_0, \{f_3\}, \{f_1\}) \\ &= \text{arrivalBound}(s_0, \{f_3\}, \{f_2\}) = \alpha_{s_0}^{f_3}; \\ & \text{arrivalBound}(s_1, \{f_2\}, \{f_1\}) \\ &= \text{arrivalBound}(s_1, \{f_2\}, \{f_3\}) = \alpha_{s_1}^{f_2}; \\ & \text{arrivalBound}(s_3, \{f_1\}, \{f_3\}) = \alpha_{s_3}^{f_1} \end{aligned}$		FIFO_MUX	ARB_MUX
$\alpha_{s_2}^{f_i} = \alpha^{f_i}, i \in \{1, 2, 3\}$		$= \gamma_{5,25}$	
$\alpha_{s_2}^{xf_i}$		$= \gamma_{5,25}$	
$\beta_{s_2}^{\text{l.o.}f_i} = \beta_{s_2} \ominus \alpha_{s_2}^{xf_i} = \beta_{R_{s_2}^{\text{l.o.}f_i}, T_{s_2}^{\text{l.o.}f_i}}$	$R_{s_2}^{\text{l.o.}f_i}$	$[R_{s_2} - r_{s_2}^{xf_i}]^+ = 15$	
	$T_{s_2}^{\text{l.o.}f_i}$	$\begin{aligned} \beta_{s_2} &= b_{s_2}^{xf_i} \\ 20 \cdot [t - 20]^+ &= 25 \\ t &= 21\frac{1}{4} \end{aligned}$	$\begin{aligned} \beta_{s_2} &= \alpha_{s_2}^{xf_i} \\ 20 \cdot [t - 20]^+ &= 5 \cdot t + 25 \\ t &= 28\frac{1}{3} \end{aligned}$
	$=$	$= \beta_{10, 21\frac{1}{4}}$	$= \beta_{10, 28\frac{1}{3}}$
	$r_{s_0}^{f_i}$	$= 5$	
$\alpha_{s_0}^{f_i} = \alpha_{s_2}^{f_i} \oslash \beta_{s_2}^{\text{l.o.}f_i} = \gamma_{r_{s_0}^{f_i}, b_{s_0}^{f_i}}$	$b_{s_0}^{f_i}$	$\alpha^{f_i}(T_{s_2}^{\text{l.o.}f_i}) = 5 \cdot 21\frac{1}{4} + 25 = 126\frac{1}{4}$	$\alpha^{f_i}(T_{s_2}^{\text{l.o.}f_i}) = 5 \cdot 28\frac{1}{3} + 25 = 166\frac{2}{3}$
	$=$	$= \gamma_{5, 131\frac{1}{4}}$	$= \gamma_{5, 166\frac{2}{3}}$
	$r_{s_0}^{f_i}$	$= 5$	

$\begin{aligned} & \text{arrivalBound}(s_1, \{f_0\}, \{f_1\}) \\ &= \text{arrivalBound}(s_1, \{f_0\}, \{f_2\}) = \alpha_{s_1}^{f_0} \end{aligned}$		FIFO_MUX	ARB_MUX
$\alpha_{s_0}^{f_0} = \alpha^{f_0}$		$= \gamma_{5,25}$	
$\alpha_{s_0}^{xf_0} = \alpha_{s_0}^{f_3}$		$= \gamma_{5, 131\frac{1}{4}}$	$= \gamma_{5, 166\frac{2}{3}}$
$\beta_{s_0}^{\text{l.o.}f_0} = \beta_{s_0} \ominus \alpha_{s_0}^{xf_0} = \beta_{R_{s_0}^{\text{l.o.}f_0}, T_{s_0}^{\text{l.o.}f_0}}$	$R_{s_0}^{\text{l.o.}f_0}$	$[R_{s_0} - r_{s_0}^{xf_0}]^+ = 15$	
	$T_{s_0}^{\text{l.o.}f_0}$	$\begin{aligned} \beta_{s_0} &= b_{s_0}^{xf_0} \\ 20 \cdot [t - 20]^+ &= 131\frac{1}{4} \\ t &= 26\frac{9}{16} \end{aligned}$	$\begin{aligned} \beta_{s_0} &= \alpha_{s_0}^{xf_0} \\ 20 \cdot [t - 20]^+ &= 5 \cdot t + 166\frac{2}{3} \\ t &= 37\frac{7}{9} \end{aligned}$
	$=$	$= \beta_{15, 26\frac{9}{16}}$	$= \beta_{15, 37\frac{7}{9}}$
	$r_{s_1}^{f_0}$	$= 5$	
$\alpha_{s_1}^{f_0} = \alpha_{s_0}^{f_0} \oslash \beta_{s_0}^{\text{l.o.}f_0} = \gamma_{r_{s_1}^{f_0}, b_{s_1}^{f_0}}$	$b_{s_1}^{f_0}$	$\alpha^{f_0}(T_{s_0}^{\text{l.o.}f_0}) = 5 \cdot 26\frac{9}{16} + 25 = 157\frac{13}{16}$	$\alpha^{f_0}(T_{s_0}^{\text{l.o.}f_0}) = 5 \cdot 37\frac{7}{9} + 25 = 213\frac{8}{9}$
	$=$	$= \gamma_{5, 157\frac{13}{16}}$	$= \gamma_{5, 213\frac{8}{9}}$
	$r_{s_1}^{f_0}$	$= 5$	

arrivalBound( $s_3, \{f_3\}, \{f_1\}$ ) = arrivalBound( $s_3, \{f_3\}, \{f_2\}$ ) = $\alpha_{s_3}^{f_3}$		FIFO_MUX	ARB_MUX
$\alpha_{s_0}^{f_3}$		$= \gamma_{5,131\frac{1}{4}}$	$= \gamma_{5,166\frac{2}{3}}$
$\alpha_{s_0}^{xf_3} = \alpha^{f_0}$		$= \gamma_{5,25}$	
$\beta_{s_0}^{l.o.f_3} = \beta_{s_0} \ominus \alpha_{s_0}^{xf_3} = \beta_{R_{s_0}^{l.o.f_3}, T_{s_0}^{l.o.f_3}}$	$R_{s_0}^{l.o.f_3}$	$[R_{s_0} - r_{s_0}^{xf_3}]^+ = 15$	
	$T_{s_0}^{l.o.f_3}$	$\beta_{s_0} = b_{s_0}^{f_0}$ $20 \cdot [t - 20]^+ = 25$ $t = 21\frac{1}{4}$	$\beta_{s_0} = \alpha^{f_0}$ $20 \cdot [t - 20]^+ = 5 \cdot t + 25$ $t = 28\frac{1}{3}$
	=	$= \beta_{15,21\frac{1}{4}}$	$= \beta_{15,28\frac{1}{3}}$
	$r_{s_3}^{f_3}$	$= 5$	
$\alpha_{s_3}^{f_3} = \alpha_{s_0}^{f_3} \oslash \beta_{s_0}^{l.o.f_3} = \gamma_{r_{s_3}^{f_3}, b_{s_3}^{f_3}}$	$b_{s_3}^{f_3}$	$\alpha_{s_0}^{f_3}(T_{s_0}^{l.o.f_3}) = 5 \cdot 21\frac{1}{4} + 131\frac{1}{4} = 232\frac{1}{2}$	$\alpha_{s_0}^{f_3}(T_{s_0}^{l.o.f_3}) = 5 \cdot 28\frac{1}{3} + 166\frac{2}{3} = 308\frac{1}{3}$
	=	$= \gamma_{5,237\frac{1}{2}}$	$= \gamma_{5,308\frac{1}{3}}$

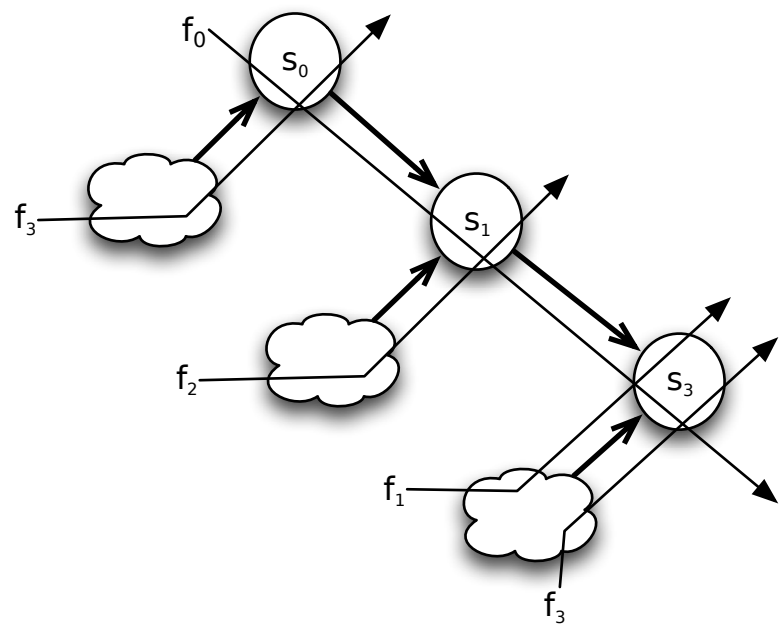
arrivalBound( $s_3, \{f_0\}, \{f_1\}$ ) = $\alpha_{s_3}^{f_0}$		FIFO_MUX	ARB_MUX
$\alpha_{s_1}^{f_0}$		$= \gamma_{5,157\frac{13}{16}}$	$= \gamma_{5,213\frac{8}{9}}$
$\alpha_{s_1}^{xf_0} = \alpha_{s_1}^{f_2}$		$= \gamma_{5,131\frac{1}{4}}$	$= \gamma_{5,166\frac{2}{3}}$
$\beta_{s_1}^{l.o.f_0} = \beta_{s_1} \ominus \alpha_{s_1}^{xf_0} = \beta_{R_{s_1}^{l.o.f_0}, T_{s_1}^{l.o.f_0}}$	$R_{s_1}^{l.o.f_0}$	$[R_{s_1} - r_{s_1}^{xf_0}]^+ = 15$	
	$T_{s_1}^{l.o.f_0}$	$\beta_{s_0} = b_{s_0}^{xf_0}$ $20 \cdot [t - 20]^+ = 131\frac{1}{4}$ $t = 26\frac{9}{16}$	$\beta_{s_0} = \alpha_{s_0}^{xf_0}$ $20 \cdot [t - 20]^+ = 5 \cdot t + 166\frac{2}{3}$ $t = 37\frac{7}{9}$
	=	$= \beta_{15,26\frac{9}{16}}$	$= \beta_{15,37\frac{7}{9}}$
	$r_{s_3}^{f_0}$	$= 5$	
$\alpha_{s_3}^{f_0} = \alpha_{s_1}^{f_0} \oslash \beta_{s_1}^{l.o.f_0} = \gamma_{r_{s_3}^{f_0}, b_{s_3}^{f_0}}$	$b_{s_3}^{f_0}$	$\alpha_{s_1}^{f_0}(T_{s_0}^{l.o.f_0}) = 5 \cdot 26\frac{9}{16} + 157\frac{13}{16} = 290\frac{5}{8}$	$\alpha_{s_1}^{f_0}(T_{s_0}^{l.o.f_0}) = 5 \cdot 37\frac{7}{9} + 213\frac{8}{9} = 402\frac{7}{9}$
	=	$= \gamma_{5,290\frac{5}{8}}$	$= \gamma_{5,402\frac{7}{9}}$

arrivalBound( $s_3, \{f_3\}, \{f_0\}$ ) = $\alpha_{s_3}^{f_3}$		FIFO_MUX	ARB_MUX
$\alpha_{s_0}^{f_3}$		$= \gamma_{5,137\frac{1}{2}}$	$= \gamma_{5,250}$
$\alpha_{s_0}^{xf_3}$		$= \gamma_{0,0}$	
$\beta_{s_0}^{l.o.f_3} = \beta_{s_0} = \beta_{R_{s_0}^{l.o.f_3}, T_{s_0}^{l.o.f_3}}$		$= \beta_{20,20}$	
$\alpha_{s_3}^{f_3} = \alpha_{s_0}^{f_3} \odot \beta_{s_0}^{l.o.f_3} = \gamma_{r_{s_3}^{f_3}, b_{s_3}^{f_3}}$	$r_{s_3}^{f_3}$	$= 5$	
	$b_{s_3}^{f_3}$	$\alpha_{s_0}^{f_3}(T_{s_0}^{l.o.f_3}) = 5 \cdot 20 + 137\frac{1}{2} = 237\frac{1}{2}$	$\alpha_{s_0}^{f_3}(T_{s_0}^{l.o.f_3}) = 5 \cdot 20 + 250 = 350$
	$=$	$= \gamma_{5,237\frac{1}{2}}$	$= \gamma_{5,350}$

arrivalBound( $s_1, \{f_0\}, \{f_3\}$ ) = $\alpha_{s_1}^{f_0}$		FIFO_MUX	ARB_MUX
$\alpha_{s_0}^{f_0} = \alpha^{f_0}$		$= \gamma_{5,25}$	
$\alpha_{s_0}^{xf_0}$		$= \gamma_{0,0}$	
$\beta_{s_0}^{l.o.f_0} = \beta_{s_0} \ominus \alpha_{s_0}^{xf_0}$		$= \beta_{20,20}$	
$\alpha_{s_1}^{f_0} = \alpha_{s_0}^{f_0} \odot \beta_{s_0}^{l.o.f_0} = \gamma_{r_{s_0 s_1}^{f_0}, b_{s_0 s_1}^{f_0}}$	$r_{s_0 s_1}^{f_0}$	$= 5$	
	$b_{s_0 s_1}^{f_0}$	$\alpha^{f_0}(T_{s_0}^{l.o.f_0}) = 5 \cdot 20 + 25 = 125$	
	$=$	$= \gamma_{5,125}$	

arrivalBound( $s_3, \{f_0\}, \{f_3\}$ ) = $\alpha_{s_3}^{f_0}$		FIFO_MUX	ARB_MUX
$\alpha_{s_1}^{f_0} = \alpha^{f_0}$		$= \gamma_{5,125}$	
$\alpha_{s_1}^{xf_0} = \alpha_{s_1}^{f_2}$		$= \gamma_{5,131\frac{1}{4}}$	$= \gamma_{5,166\frac{2}{3}}$
$\beta_{s_1}^{l.o.f_0} = \beta_{s_1} \ominus \alpha_{s_1}^{xf_0} = \beta_{R_{s_1}^{l.o.f_0}, T_{s_1}^{l.o.f_0}}$	$R_{s_1}^{l.o.f_0}$	$[R_{s_1} - r_{s_1}^{xf_0}]^+ = 15$	
	$T_{s_1}^{l.o.f_0}$	$\beta_{s_0} = b_{s_0}^{xf_0}$ $20 \cdot [t - 20]^+ = 131\frac{1}{4}$ $t = 26\frac{9}{16}$	$\beta_{s_0} = \alpha_{s_0}^{xf_0}$ $20 \cdot [t - 20]^+ = 5 \cdot t + 166\frac{2}{3}$ $t = 37\frac{7}{9}$
	$=$	$= \beta_{15,26\frac{9}{16}}$	$= \beta_{15,37\frac{7}{9}}$
	$=$	$= 5$	$= 5$
$\alpha_{s_3}^{f_0} = \alpha_{s_1}^{f_0} \odot \beta_{s_1}^{l.o.f_0} = \gamma_{r_{s_1 s_3}^{f_0}, b_{s_1 s_3}^{f_0}}$	$r_{s_1 s_3}^{f_0}$	$\alpha^{f_0}(T_{s_0}^{l.o.f_0}) = 5 \cdot 26\frac{9}{16} + 125 = 257\frac{13}{16}$	
	$b_{s_1 s_3}^{f_0}$	$\alpha^{f_0}(T_{s_0}^{l.o.f_0}) = 5 \cdot 37\frac{7}{9} + 125 = 313\frac{8}{9}$	$\alpha^{f_0}(T_{s_0}^{l.o.f_0}) = 5 \cdot 37\frac{7}{9} + 125 = 313\frac{8}{9}$
	$=$	$= \gamma_{5,257\frac{13}{16}}$	$= \gamma_{5,313\frac{8}{9}}$

Flow  $f_0$



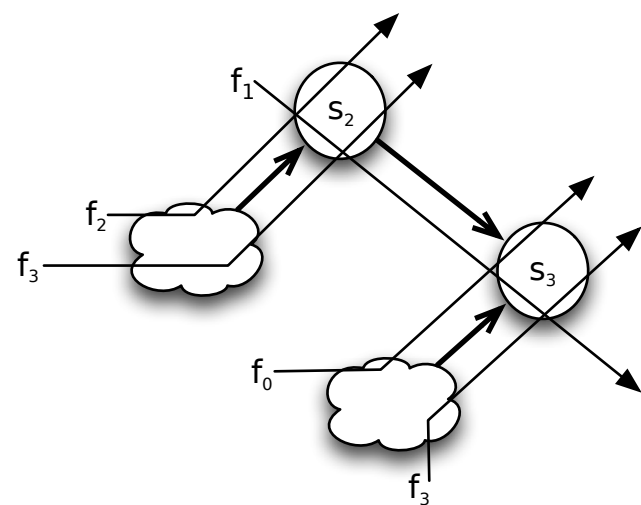
TFA		FIFO_MUX	ARB_MUX
$s_0$	$\alpha_{s_0} = \alpha_{s_0}^{f_0} + \alpha_{s_0}^{f_3}$	$= \gamma_{5,25} + \gamma_{5,137\frac{1}{2}} = \gamma_{10,162\frac{1}{2}}$	$= \gamma_{5,25} + \gamma_{5,250} = \gamma_{10,275}$
	$D_{s_0}^{f_0}$	$\beta_{s_0} = b_{s_0}$ $20 \cdot [t - 20]^+ = 162\frac{1}{2}$ $t = 28\frac{1}{8}$	$\beta_{s_0} = \alpha_{s_0}$ $20 \cdot [t - 20]^+ = 10 \cdot t + 275$ $t = 67\frac{1}{2}$
	$B_{s_0}^{f_0}$	$\alpha_{s_0}(T_{s_0}) = 10 \cdot 20 + 162\frac{1}{2}$ $= 262\frac{1}{2}$	$\alpha_{s_0}(T_{s_0}) = 10 \cdot 20 + 275$ $= 475$
$s_1$	$\alpha_{s_1} = \alpha_{s_1}^{f_0} + \alpha_{s_1}^{f_2}$	$= \gamma_{5,159\frac{3}{8}} + \gamma_{5,137\frac{1}{2}} = \gamma_{10,296\frac{7}{8}}$	$= \gamma_{5,241\frac{2}{3}} + \gamma_{5,250} = \gamma_{10,491\frac{2}{3}}$
	$D_{s_1}^{f_0}$	$\beta_{s_1} = b_{s_1}$ $20 \cdot [t - 20]^+ = 296\frac{7}{8}$ $t = 34\frac{27}{32}$	$\beta_{s_1} = \alpha_{s_1}$ $20 \cdot [t - 20]^+ = 10 \cdot t + 491\frac{2}{3}$ $t = 89\frac{1}{6}$
	$B_{s_1}^{f_0}$	$\alpha_{s_1}(T_{s_1}) = 10 \cdot 20 + 296\frac{7}{8}$ $= 496\frac{7}{8}$	$\alpha_{s_1}(T_{s_1}) = 10 \cdot 20 + 491\frac{2}{3}$ $= 691\frac{2}{3}$
$s_3$	$\alpha_{s_3} = \alpha_{s_3}^{f_0} + \alpha_{s_3}^{f_1} + \alpha_{s_3}^{f_3}$	$= \gamma_{5,293\frac{3}{4}} + \gamma_{5,137\frac{1}{2}} + \gamma_{5,243\frac{3}{4}} = \gamma_{15,675}$	$= \gamma_{5,458\frac{1}{3}} + \gamma_{5,250} + \gamma_{5,391\frac{2}{3}} = \gamma_{15,1100}$
	$D_{s_3}^{f_0}$	$\beta_{s_3} = b_{s_3}$ $20 \cdot [t - 20]^+ = 675$ $t = 53\frac{3}{4}$	$\beta_{s_3} = \alpha_{s_3}$ $20 \cdot [t - 20]^+ = 15 \cdot t + 1100$ $t = 300$
	$B_{s_3}^{f_0}$	$\alpha_{s_3}(T_{s_3}) = 15 \cdot 20 + 675$ $= 975$	$\alpha_{s_3}(T_{s_3}) = 15 \cdot 20 + 1100$ $= 1400$
$D_{s_0}^{f_0}$		$D_{s_0}^{f_0} + D_{s_1}^{f_0} + D_{s_3}^{f_0} = 116\frac{23}{32}$	$D_{s_0}^{f_0} + D_{s_1}^{f_0} + D_{s_3}^{f_0} = 456\frac{2}{3}$
$B_{s_0}^{f_0}$		$\max\{B_{s_0}^{f_0}, B_{s_1}^{f_0}, B_{s_3}^{f_0}\} = 975$	$\max\{B_{s_0}^{f_0}, B_{s_1}^{f_0}, B_{s_3}^{f_0}\} = 1400$



SFA		FIFO_MUX	ARB_MUX
$s_0$	$\alpha_{s_0}^{xf_0} = \alpha_{s_0}^{f_3}$	$= \gamma_{5,137\frac{1}{2}}$	$= \gamma_{5,250}$
	$\beta_{s_0}^{l.o.f_0} = \beta_{s_0} \ominus \alpha_{s_0}^{xf_3}$	$= \beta_{15,26\frac{7}{8}}$	$= \beta_{15,43\frac{1}{3}}$
$s_1$	$\alpha_{s_1}^{xf_0} = \alpha_{s_1}^{f_1}$	$= \gamma_{5,137\frac{1}{2}}$	$= \gamma_{5,250}$
	$\beta_{s_1}^{l.o.f_0} = \beta_{s_1} \ominus \alpha_{s_1}^{xf_0}$	$= \beta_{15,26\frac{7}{8}}$	$= \beta_{15,43\frac{1}{3}}$
$s_3$	$\alpha_{s_3}^{xf_0} = \alpha_{s_3}^{f_2} + \alpha_{s_3}^{f_3}$		$= \gamma_{5,137\frac{1}{2}} + \gamma_{5,237\frac{1}{2}} = \gamma_{10,375}$
	$\beta_{s_3}^{l.o.f_0} = \beta_{s_3} \ominus \alpha_{s_3}^{xf_0} = \beta_{R_{s_3}^{l.o.f_0}, T_{s_3}^{l.o.f_0}}$	$R_{s_3}^{l.o.f_0}$	$[R_{s_3} - r_{s_3}^{xf_0}]^+ = 10$
		$\beta_{s_3} = b_{s_3}^{xf_0}$	$\beta_{s_3} = \alpha_{s_3}^{xf_0}$
		$20 \cdot [t - 20]^+ = 375$	$20 \cdot [t - 20]^+ = 10 \cdot t + 600$
		$t = 38\frac{3}{4}$	$t = 100$
		$=$	$= \beta_{10,38\frac{3}{4}}$
	$\beta_{e2e}^{l.o.f_0} = \beta_{R_{e2e}^{l.o.f_0}, T_{e2e}^{l.o.f_0}}$	$\bigotimes_{i=\{0,1,3\}} \beta_{s_i}^{l.o.f_0} = \beta_{10,92\frac{1}{2}}$	$\bigotimes_{i=\{0,1,3\}} \beta_{s_i}^{l.o.f_0} = \beta_{10,186\frac{2}{3}}$
	$D^{f_0}$	$\beta_{e2e}^{l.o.f_0} = b^{f_0}$	$\beta_{e2e}^{l.o.f_0} = b^{f_0}$
		$10 \cdot [t - 92\frac{1}{2}]^+ = 25$	$10 \cdot [t - 186\frac{2}{3}]^+ = 25$
		$t = 95$	$t = 189\frac{1}{6}$
	$B^{f_0}$	$\alpha^{f_0}(T_{e2e}^{l.o.f_0}) = 5 \cdot 92\frac{1}{2} + 25$	$\alpha^{f_0}(T_{e2e}^{l.o.f_0}) = 5 \cdot 186\frac{2}{3} + 25$
		$= 487\frac{1}{2}$	$= 958\frac{1}{3}$

PMOO		ARB_MUX
$s_0$	$\alpha_{s_0}^{x'f_0} = \alpha_{s_0}^{f_3}$	$= \gamma_{5,250}$
	$\alpha_{s_0}^{xf_0} = \alpha_{s_0}^{f_3}$	$= \gamma_{5,250}$
$s_1$	$\alpha_{s_1}^{x'f_0} = \alpha_{s_1}^{f_2}$	$= \gamma_{5,250}$
	$\alpha_{s_1}^{xf_0} = \alpha_{s_1}^{f_2}$	$= \gamma_{5,250}$
$s_3$	$\alpha_{s_3}^{x'f_0} = \alpha_{s_3}^{f_2} + \alpha_{s_3}^{f_3}$	$= \gamma_{5,250} + \gamma_{5,350} = \gamma_{10,600}$
	$\alpha_{s_3}^{xf_0} = \alpha_{s_3}^{f_2} + \alpha_{s_3}^{f_3}$	$= \gamma_{5,250} + \gamma_{5,350} = \gamma_{10,600}$
$\beta_{e2e}^{l.o.f_0} = \beta_{R_{e2e}^{l.o.f_0}, T_{e2e}^{l.o.f_0}}$	$R_{e2e}^{l.o.f_0} = \bigwedge_{i \in \{0,1,3\}} (R_{s_i} - r_{s_i}^{xf_0})$	$= (20 - 5) \wedge (20 - 5) \wedge (20 - 10)$
		$= \frac{10}{20 + 20 + 20 + \frac{250 + 5 \cdot 20 + 250 + 5 \cdot 20 + 600 + 10 \cdot 20}{10}}$
	$T_{e2e}^{l.o.f_0} = \sum_{i \in \{0,1,3\}} T_{s_i} + \frac{\sum_{i \in \{0,1,3\}} (b_{s_i}^{x'f_0} + r_{s_i}^{xf_0} \cdot T_{s_i})}{R_{e2e}^{l.o.f_0}}$	$= 60 + \frac{1500}{10}$
	$=$	$= \frac{210}{210}$
$D^{f_0}$		$\beta_{e2e}^{l.o.f_0} = b^{f_0}$
		$10 \cdot [t - 210]^+ = 25$
		$t = 212\frac{1}{2}$
$B^{f_0}$		$\alpha^{f_0}(T_{e2e}^{l.o.f_0}) = 5 \cdot 210 + 25$
		$= 1075$

Flow  $f_1$

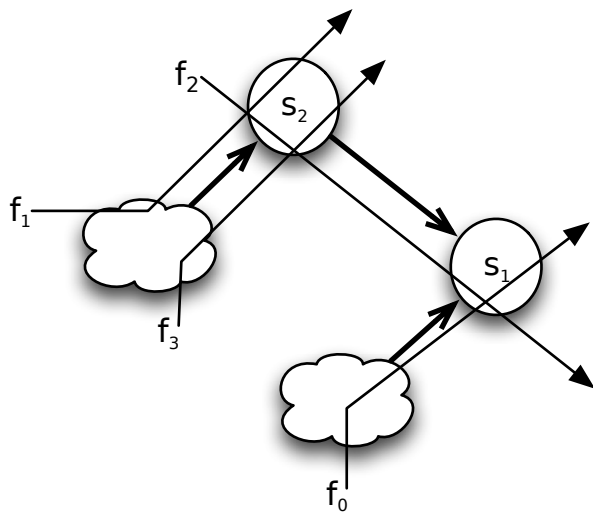


TFA		FIFO_MUX	ARB_MUX
$s_2$	$\alpha_{s_2} = \alpha_{s_2}^{f_1} + \alpha_{s_2}^{f_2} + \alpha_{s_2}^{f_3}$	$= 3 \cdot \gamma_{5,25} = \gamma_{15,75}$	
	$D_{s_2}^{f_1}$	$\beta_{s_2} = b_{s_2}$ $20 \cdot [t - 20]^+ = 75$ $t = 23\frac{3}{4}$	$\beta_{s_2} = \alpha_{s_2}$ $20 \cdot [t - 20]^+ = 15 \cdot t + 75$ $t = 95$
	$B_{s_2}^{f_1}$	$\alpha_{s_2}(T_{s_2}) = 15 \cdot 20 + 75$ $= 375$	
$s_3$	$\alpha_{s_3} = \alpha_{s_3}^{f_0} + \alpha_{s_3}^{f_1} + \alpha_{s_3}^{f_3}$	$= \gamma_{5,137\frac{1}{2}} + \gamma_{5,293\frac{3}{4}} + \gamma_{5,243\frac{3}{4}} = \gamma_{15,675}$	$= \gamma_{5,250} + \gamma_{5,458\frac{1}{3}} + \gamma_{5,391\frac{2}{3}} = \gamma_{15,1100}$
	$D_{s_3}^{f_1}$	$\beta_{s_3} = b_{s_3}$ $20 \cdot [t - 20]^+ = 675$ $t = 53\frac{3}{4}$	$\beta_{s_3} = \alpha_{s_3}$ $20 \cdot [t - 20]^+ = 15 \cdot t + 1100$ $t = 300$
	$B_{s_3}^{f_1}$	$\alpha_{s_3}(T_{s_3}) = 15 \cdot 20 + 675$ $= 975$	$\alpha_{s_3}(T_{s_3}) = 15 \cdot 20 + 1100$ $= 1400$
$D_{s_2}^{f_1}$		$D_{s_2}^{f_1} + D_{s_3}^{f_1} = 77\frac{1}{2}$	$D_{s_2}^{f_1} + D_{s_3}^{f_1} = 395$
$B_{s_2}^{f_1}$		$\max\{B_{s_2}^{f_1}, B_{s_3}^{f_1}\} = 975$	$\max\{B_{s_2}^{f_1}, B_{s_3}^{f_1}\} = 1400$

SFA		FIFO_MUX	ARB_MUX
$s_2$	$\alpha_{s_2}^{xf_1} = \alpha_{s_2}^{f_2} + \alpha_{s_2}^{f_3}$	$= 2 \cdot \gamma_{5,25} = \gamma_{10,50}$	
	$\beta_{s_2}^{l.o.f_1} = \beta_{s_2} \ominus \alpha_{s_2}^{xf_1}$	$= \beta_{10,22\frac{1}{2}}$	$= \beta_{10,45}$
$s_3$	$\alpha_{s_3}^{xf_1} = \alpha_{s_3}^{f_0} + \alpha_{s_3}^{f_3}$	$= \gamma_{5,290\frac{5}{8}} + \gamma_{5,237\frac{1}{2}} = \gamma_{10,528\frac{1}{8}}$	$= \gamma_{5,402\frac{7}{9}} + \gamma_{5,308\frac{1}{3}} = \gamma_{10,711\frac{1}{9}}$
	$\beta_{s_3}^{l.o.f_1} = \beta_{s_3} \ominus \alpha_{s_3}^{xf_1} = \beta_{R_{s_3}^{l.o.f_1}, T_{s_3}^{l.o.f_1}}$	$R_{s_3}^{l.o.f_1}$	$[R_{s_3} - r_{s_3}^{xf_1}]^+ = 10$
		$\beta_{s_3} = b_{s_3}^{xf_1}$	$\beta_{s_3} = \alpha_{s_3}^{xf_1}$
		$20 \cdot [t - 20]^+ = 528\frac{1}{8}$	$20 \cdot [t - 20]^+ = 10 \cdot t + 711\frac{1}{9}$
		$t = 46\frac{13}{32}$	$t = 111\frac{1}{9}$
	$=$	$= \beta_{10,46\frac{13}{32}}$	$= \beta_{10,111\frac{1}{9}}$
$\beta_{e2e}^{l.o.f_1} = \beta_{R_{e2e}^{l.o.f_1}, T_{e2e}^{l.o.f_1}}$		$\bigotimes_{i=2}^3 \beta_{s_i}^{l.o.f_1} = \beta_{10,68\frac{29}{32}}$	$\bigotimes_{i=2}^3 \beta_{s_i}^{l.o.f_1} = \beta_{10,156\frac{1}{9}}$
$D^{f_1}$		$\beta_{e2e}^{l.o.f_1} = b^{f_1}$	$\beta_{e2e}^{l.o.f_1} = b^{f_1}$
		$10 \cdot [t - 68\frac{29}{32}]^+ = 25$	$10 \cdot [t - 156\frac{1}{9}]^+ = 25$
		$t = 71\frac{13}{32}$	$t = 158\frac{11}{18}$
$B^{f_1}$		$\alpha^{f_1}(T_{e2e}^{l.o.f_1}) = 5 \cdot 68\frac{29}{32} + 25$	$\alpha^{f_1}(T_{e2e}^{l.o.f_1}) = 5 \cdot 156\frac{1}{9} + 25$
		$= 369\frac{17}{32}$	$= 805\frac{5}{9}$

PMOO		ARB_MUX
$s_2$	$\alpha_{s_2}^{x'f_1} = \alpha_{s_2}^{f_2} + \alpha_{s_2}^{f_3}$	$= 2 \cdot \gamma_{5,25} = \gamma_{10,50}$
	$\alpha_{s_2}^{xf_1} = \alpha_{s_2}^{f_2} + \alpha_{s_2}^{f_3}$	$= 2 \cdot \gamma_{5,25} = \gamma_{10,50}$
$s_3$	$\alpha_{s_3}^{x'f_1} = \alpha_{s_3}^{f_0} + \alpha_{s_3}^{f_3}$	$= \gamma_{5,402\frac{7}{9}} + \gamma_{5,308\frac{1}{3}} = \gamma_{10,711\frac{1}{9}}$
	$\alpha_{s_3}^{xf_1} = \alpha_{s_3}^{f_0} + \alpha_{s_3}^{f_3}$	$= \gamma_{5,402\frac{7}{9}} + \gamma_{5,308\frac{1}{3}} = \gamma_{10,711\frac{1}{9}}$
$\beta_{e2e}^{l.o.f_1} = \beta_{R_{e2e}^{l.o.f_1}, T_{e2e}^{l.o.f_1}}$	$R_{e2e}^{l.o.f_1} = \bigwedge_{i \in \{2,3\}} (R_{s_i} - r_{s_i}^{xf_1})$	$= (20 - 10) \wedge (20 - 10)$
		$= 10$
	$T_{e2e}^{l.o.f_1} = \sum_{i \in \{2,3\}} T_{s_i} + \frac{\sum_{i \in \{2,3\}} (b_{s_i}^{x'f_1} + r_{s_i}^{xf_1} \cdot T_{s_i})}{R_{e2e}^{l.o.f_1}}$	$= 20 + 20 + \frac{50 + 10 \cdot 20 + 711\frac{1}{9} + 10 \cdot 20}{10}$
		$= 40 + \frac{1161\frac{1}{9}}{10}$
	$=$	$= 156\frac{1}{9}$
$D^{f_1}$		$\beta_{e2e}^{l.o.f_1} = b^{f_1}$
		$10 \cdot [t - 156\frac{1}{9}]^+ = 25$
		$t = 158\frac{11}{18}$
$B^{f_1}$		$\alpha^{f_1}(T_{e2e}^{l.o.f_1}) = 5 \cdot 156\frac{1}{9} + 25$
		$= 805\frac{5}{9}$

Flow  $f_2$



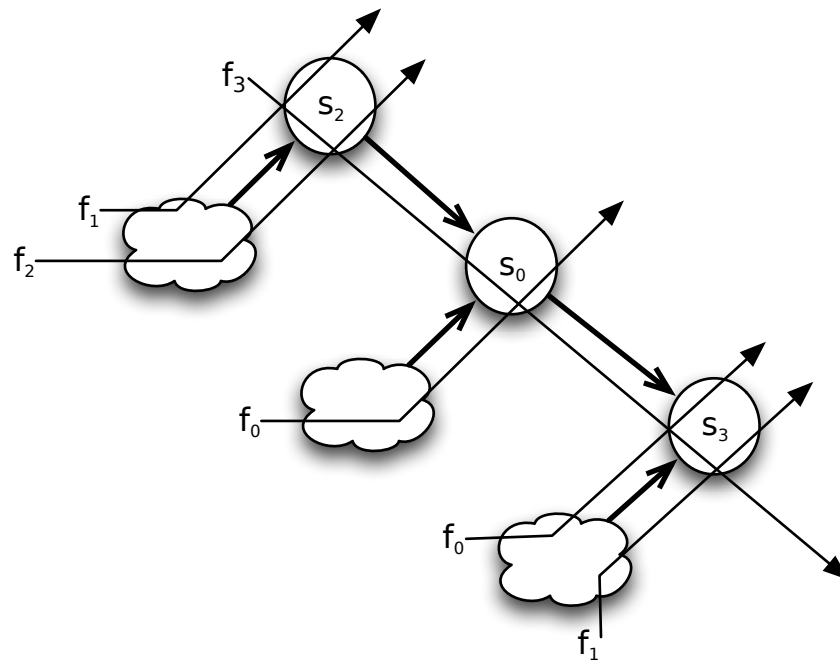
TFA		FIFO_MUX	ARB_MUX
$s_2$	$\alpha_{s_2} = \alpha_{s_2}^{f_2} + \alpha_{s_2}^{f_1} + \alpha_{s_2}^{f_3}$	$= 3 \cdot \gamma_{5,25} = \gamma_{15,75}$	
	$D_{s_2}^{f_2}$	$\beta_{s_2} = b_{s_2}$ $20 \cdot [t - 20]^+ = 75$ $t = 23\frac{3}{4}$	$\beta_{s_2} = \alpha_{s_2}$ $20 \cdot [t - 20]^+ = 15 \cdot t + 75$ $t = 95$
	$B_{s_2}^{f_2}$	$\alpha_{s_2}(T_{s_2}) = 15 \cdot 20 + 75$ $= 375$	
$s_1$	$\alpha_{s_1} = \alpha_{s_1}^{f_2} + \alpha_{s_1}^{f_0}$	$= \gamma_{5,137\frac{1}{2}} + \gamma_{5,159\frac{3}{8}} = \gamma_{10,296\frac{7}{8}}$	
	$D_{s_1}^{f_2}$	$\beta_{s_1} = b_{s_1}$ $20 \cdot [t - 20]^+ = 296\frac{7}{8}$ $t = 34\frac{27}{32}$	$\beta_{s_1} = \alpha_{s_1}$ $20 \cdot [t - 20]^+ = 10 \cdot t + 491\frac{2}{3}$ $t = 89\frac{1}{6}$
	$B_{s_1}^{f_2}$	$\alpha_{s_1}(T_{s_1}) = 10 \cdot 20 + 296\frac{7}{8}$ $= 496\frac{7}{8}$	$\alpha_{s_1}(T_{s_1}) = 10 \cdot 20 + 491\frac{2}{3}$ $= 691\frac{2}{3}$
$D^{f_2}$		$D_{s_2}^{f_2} + D_{s_1}^{f_2} = 58\frac{19}{32}$	$D_{s_2}^{f_2} + D_{s_1}^{f_2} = 184\frac{1}{6}$
$B^{f_2}$		$\max\{B_{s_2}^{f_2}, B_{s_1}^{f_2}\} = 496\frac{7}{8}$	$\max\{B_{s_2}^{f_2}, B_{s_1}^{f_2}\} = 691\frac{2}{3}$



SFA		FIFO_MUX	ARB_MUX
$s_2$	$\alpha_{s_2}^{xf_2} = \alpha_{s_2}^{f_1} + \alpha_{s_2}^{f_3}$	$= 2 \cdot \gamma_{5,25} = \gamma_{10,50}$	
	$\beta_{s_2}^{l.o.f_2} = \beta_{s_2} \ominus \alpha_{s_2}^{xf_2}$	$= \beta_{10,22\frac{1}{2}}$	$= \beta_{10,45}$
$s_1$	$\alpha_{s_1}^{xf_2} = \alpha_{s_1}^{f_0}$	$= \gamma_{5,157\frac{13}{16}}$	$= \gamma_{5,213\frac{8}{9}}$
	$\beta_{s_1}^{l.o.f_2} = \beta_{s_1} \ominus \alpha_{s_1}^{xf_2} = \beta_{R_{s_1}^{l.o.f_2}, T_{s_1}^{l.o.f_2}}$	$R_{s_1}^{l.o.f_2}$	$[R_{s_2} - r_{s_2}^{xf_2}]^+ = 15$
		$\beta_{s_1} = b_{s_1}^{xf_2}$	$\beta_{s_1} = \alpha_{s_1}^{xf_2}$
		$20 \cdot [t - 20]^+ = 157\frac{13}{16}$	$20 \cdot [t - 20]^+ = 5 \cdot t + 213\frac{8}{9}$
		$t = 27\frac{57}{64}$	$t = 40\frac{25}{27}$
	$=$	$= \beta_{10,27\frac{57}{64}}$	$= \beta_{10,40\frac{25}{27}}$
$\beta_{e2e}^{l.o.f_2} = \beta_{R_{e2e}^{l.o.f_2}, T_{e2e}^{l.o.f_2}}$		$\bigotimes_{i=1}^2 \beta_{s_i}^{l.o.f_2} = \beta_{10,50\frac{25}{64}}$	$\bigotimes_{i=1}^2 \beta_{s_i}^{l.o.f_2} = \beta_{10,85\frac{25}{27}}$
$D^{f_2}$		$\beta_{e2e}^{l.o.f_2} = b^{f_2}$	$\beta_{e2e}^{l.o.f_2} = b^{f_2}$
		$10 \cdot [t - 50\frac{25}{64}]^+ = 25$	$10 \cdot [t - 85\frac{25}{27}]^+ = 25$
		$t = 52\frac{57}{64}$	$t = 88\frac{23}{54}$
$B^{f_2}$		$\alpha^{f_2}(T_{e2e}^{l.o.f_2}) = 5 \cdot 50\frac{25}{64} + 25$	$\alpha^{f_2}(T_{e2e}^{l.o.f_2}) = 5 \cdot 85\frac{25}{27} + 25$
		$= 276\frac{61}{64}$	$= 454\frac{17}{27}$

PMOO		ARB_MUX
$s_2$	$\alpha_{s_2}^{x'f_2} = \alpha_{s_2}^{f_1} + \alpha_{s_2}^{f_3}$	$= 2 \cdot \gamma_{5,25} = \gamma_{10,50}$
	$\alpha_{s_2}^{xf_2} = \alpha_{s_2}^{f_1} + \alpha_{s_2}^{f_3}$	$= 2 \cdot \gamma_{5,25} = \gamma_{10,50}$
$s_1$	$\alpha_{s_1}^{x'f_2} = \alpha_{s_1}^{f_0}$	$= \gamma_{5,213\frac{8}{9}}$
	$\alpha_{s_1}^{xf_2} = \alpha_{s_1}^{f_0}$	$= \gamma_{5,213\frac{8}{9}}$
$\beta_{e2e}^{1.o.f_2} = \beta_{R_{e2e}^{1.o.f_2}, T_{e2e}^{1.o.f_2}}$	$R_{e2e}^{1.o.f_2} = \bigwedge_{i \in \{2,1\}} (R_{s_i} - r_{s_i}^{xf_2})$	$= (20 - 10) \wedge (20 - 5)$
		$= 10$
	$T_{e2e}^{1.o.f_2} = \sum_{i \in \{2,1\}} T_{s_i} + \frac{\sum_{i \in \{2,1\}} (b_{s_i}^{x'f_2} + r_{s_i}^{xf_2} \cdot T_{s_i})}{R_{e2e}^{1.o.f_2}}$	$= 20 + 20 + \frac{50 + 10 \cdot 20 + 213\frac{8}{9} + 5 \cdot 20}{10}$
		$= 40 + \frac{539\frac{8}{9}}{10}$
		$= 96\frac{7}{18}$
	$=$	$= \beta_{10,96\frac{7}{18}}$
$D^{f_2}$		$\beta_{e2e}^{1.o.f_2} = b^{f_2}$
		$10 \cdot [t - 96\frac{7}{18}]^+ = 25$
		$t = 98\frac{8}{9}$
$B^{f_2}$		$\alpha^{f_2}(T_{e2e}^{1.o.f_2}) = 5 \cdot 96\frac{7}{18} + 25$
		$= 506\frac{17}{18}$

Flow  $f_3$

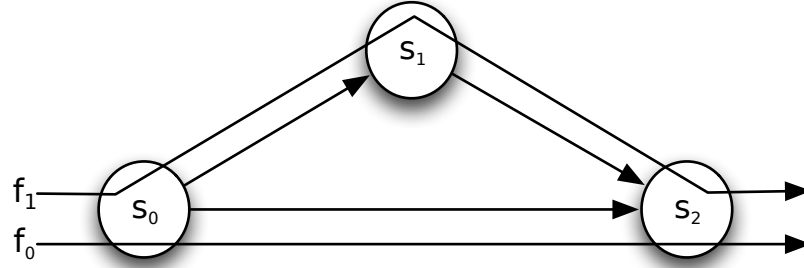


TFA		FIFO_MUX	ARB_MUX
$s_2$	$\alpha_{s_2} = \alpha_{s_2}^{f_3} + \alpha_{s_2}^{f_1} + \alpha_{s_2}^{f_2}$	$= 3 \cdot \gamma_{5,25} = \gamma_{15,75}$	
	$D_{s_2}^{f_3}$	$\beta_{s_2} = b_{s_2}$ $20 \cdot [t - 20]^+ = 75$ $t = 23\frac{3}{4}$	$\beta_{s_2} = \alpha_{s_2}$ $20 \cdot [t - 20]^+ = 15 \cdot t + 75$ $t = 95$
	$B_{s_2}^{f_3}$	$\alpha_{s_2}(T_{s_2}) = 15 \cdot 20 + 75$ $= 375$	
$s_0$	$\alpha_{s_0} = \alpha_{s_0}^{f_0} + \alpha_{s_0}^{f_3}$	$= \gamma_{5,25} + \gamma_{5,137\frac{1}{2}} = \gamma_{10,162\frac{1}{2}}$	
	$D_{s_0}^{f_3}$	$\beta_{s_0} = b_{s_0}$ $20 \cdot [t - 20]^+ = 162\frac{1}{2}$ $t = 28\frac{1}{8}$	$\beta_{s_0} = \alpha_{s_0}$ $20 \cdot [t - 20]^+ = 10 \cdot t + 275$ $t = 67\frac{1}{2}$
	$B_{s_0}^{f_3}$	$\alpha_{s_0}(T_{s_0}) = 10 \cdot 20 + 162\frac{1}{2}$ $= 262\frac{1}{2}$	
$s_3$	$\alpha_{s_3} = \alpha_{s_3}^{f_0} + \alpha_{s_3}^{f_1} + \alpha_{s_3}^{f_3}$	$= \gamma_{5,293\frac{3}{4}} + \gamma_{5,137\frac{1}{2}} + \gamma_{5,243\frac{3}{4}} = \gamma_{15,675}$	
	$D_{s_3}^{f_3}$	$\beta_{s_3} = b_{s_3}$ $20 \cdot [t - 20]^+ = 675$ $t = 53\frac{3}{4}$	$\beta_{s_3} = \alpha_{s_3}$ $20 \cdot [t - 20]^+ = 15 \cdot t + 1100$ $t = 300$
	$B_{s_3}^{f_3}$	$\alpha_{s_3}(T_{s_3}) = 15 \cdot 20 + 675$ $= 975$	
$D_{s_2}^{f_3}$		$D_{s_2}^{f_3} + D_{s_0}^{f_3} + D_{s_3}^{f_3} = 105\frac{5}{8}$	
$B_{s_2}^{f_3}$		$\max\{B_{s_2}^{f_3}, B_{s_0}^{f_3}, B_{s_3}^{f_3}\} = 975$	
$D_{s_3}^{f_3}$		$D_{s_2}^{f_3} + D_{s_0}^{f_3} + D_{s_3}^{f_3} = 462\frac{1}{2}$	
$B_{s_3}^{f_3}$		$\max\{B_{s_2}^{f_3}, B_{s_0}^{f_3}, B_{s_3}^{f_3}\} = 1400$	

SFA			FIFO_MUX	ARB_MUX
s2	$\alpha_{s_2}^{xf_3} = \alpha_{s_2}^{f_1} + \alpha_{s_2}^{f_2}$		$= 2 \cdot \gamma_{5,25} = \gamma_{10,50}$	
	$\beta_{s_2}^{l.o.f_3} = \beta_{s_2} \ominus \alpha_{s_2}^{xf_3}$		$= \beta_{10,22\frac{1}{2}}$	$= \beta_{10,45}$
s0	$\alpha_{s_0}^{xf_3} = \alpha_{s_0}^{f_0}$		$= \gamma_{5,25}$	
	$\beta_{s_0}^{l.o.f_3} = \beta_{s_0} \ominus \alpha_{s_0}^{xf_3}$		$= \beta_{15,21\frac{1}{4}}$	$= \beta_{15,28\frac{1}{3}}$
s3	$\alpha_{s_3}^{xf_3} = \alpha_{s_3}^{f_0} + \alpha_{s_3}^{f_1}$		$= \gamma_{5,257\frac{13}{16}} + \gamma_{5,131\frac{1}{4}} = \gamma_{10,389\frac{1}{16}}$	$= \gamma_{5,313\frac{8}{9}} + \gamma_{5,166\frac{2}{3}} = \gamma_{10,480\frac{5}{9}}$
	$\beta_{s_3}^{l.o.f_3} = \beta_{s_3} \ominus \alpha_{s_3}^{xf_3} = \beta_{R_{s_3}^{l.o.f_3}, T_{s_3}^{l.o.f_3}}$	$R_{s_3}^{l.o.f_3}$	$[R_{s_3} - r_{s_3}^{xf_3}]^+ = 10$	
		$T_{s_3}^{l.o.f_3}$	$\beta_{s_3} = b_{s_3}^{xf_3}$	$\beta_{s_3} = \alpha_{s_3}^{xf_3}$
			$20 \cdot [t - 20]^+ = 389\frac{1}{16}$	$20 \cdot [t - 20]^+ = 10 \cdot t + 480\frac{5}{9}$
			$t = 39\frac{29}{64}$	$t = 88\frac{1}{18}$
	$=$	$= \beta_{10,39\frac{29}{64}}$	$= \beta_{10,88\frac{1}{18}}$	
$\beta_{e2e}^{l.o.f_3} = \beta_{R_{e2e}^{l.o.f_3}, T_{e2e}^{l.o.f_3}}$			$\bigotimes_{i=\{2,0,3\}} \beta_{s_i}^{l.o.f_3} = \beta_{10,83\frac{13}{64}}$	$\bigotimes_{i=\{2,0,3\}} \beta_{s_i}^{l.o.f_3} = \beta_{10,161\frac{7}{18}}$
$D^{f_3}$			$\beta_{e2e}^{l.o.f_3} = b^{f_3}$	$\beta_{e2e}^{l.o.f_3} = b^{f_3}$
			$10 \cdot [t - 83\frac{13}{64}]^+ = 25$	$10 \cdot [t - 161\frac{7}{18}]^+ = 25$
			$t = 85\frac{45}{64}$	$t = 163\frac{8}{9}$
$B^{f_3}$			$\alpha^{f_3}(T_{e2e}^{l.o.f_3}) = 5 \cdot 83\frac{13}{64} + 25$	$\alpha^{f_3}(T_{e2e}^{l.o.f_3}) = 5 \cdot 161\frac{7}{18} + 25$
			$= 441\frac{1}{64}$	$= 831\frac{17}{18}$

PMOO		ARB_MUX
$s_2$	$\alpha_{s_2}^{x'f_3} = \alpha_{s_2}^{f_1} + \alpha_{s_2}^{f_2}$	$= 2 \cdot \gamma_{5,25} = \gamma_{10,50}$
	$\alpha_{s_2}^{xf_3} = \alpha_{s_2}^{f_1} + \alpha_{s_2}^{f_2}$	$= 2 \cdot \gamma_{5,25} = \gamma_{10,50}$
$s_0$	$\alpha_{s_0}^{x'f_3} = \alpha_{s_0}^{f_0}$	$= \gamma_{5,25}$
	$\alpha_{s_0}^{xf_3} = \alpha_{s_0}^{f_0}$	$= \gamma_{5,25}$
$s_3$	$\alpha_{s_3}^{x'f_3} = \alpha_{s_3}^{f_0} + \alpha_{s_3}^{f_1}$	$= \gamma_{5,313\frac{8}{9}} + \gamma_{5,166\frac{2}{3}} = \gamma_{10,480\frac{5}{9}}$
	$\alpha_{s_3}^{xf_3} = \alpha_{s_3}^{f_0} + \alpha_{s_3}^{f_1}$	$= \gamma_{5,313\frac{8}{9}} + \gamma_{5,166\frac{2}{3}} = \gamma_{10,480\frac{5}{9}}$
$\beta_{e2e}^{l.o.f_3} = \beta_{R_{e2e}^{l.o.f_3}, T_{e2e}^{l.o.f_3}}$	$R_{e2e}^{l.o.f_3} = \bigwedge_{i \in \{2,0,3\}} (R_{s_i} - r_{s_i}^{xf_3})$	$= (20 - 10) \wedge (20 - 5) \wedge (20 - 10)$
		$= 10$
	$T_{e2e}^{l.o.f_3} = \sum_{i \in \{2,0,3\}} T_{s_i} + \frac{\sum_{i \in \{2,0,3\}} (b_{s_i}^{x'f_3} + r_{s_i}^{xf_3} \cdot T_{s_i})}{R_{e2e}^{l.o.f_3}}$	$= 20 + 20 + 20 + \frac{50 + 10 \cdot 20 + 25 + 5 \cdot 20 + 480\frac{5}{9} + 10 \cdot 20}{10}$
		$= 60 + \frac{1055\frac{5}{9}}{10}$
	$=$	$= 165\frac{5}{9}$
$D^{f_3}$		$\beta_{e2e}^{l.o.f_3} = b^{f_3}$
		$10 \cdot [t - 165\frac{5}{9}]^+ = 25$
		$t = 168\frac{1}{18}$
$B^{f_3}$		$\alpha^{f_3}(T_{e2e}^{l.o.f_3}) = 5 \cdot 165\frac{5}{9} + 25$
		$= 852\frac{7}{9}$

# FeedForward\_1SC\_2Flows\_1AC\_2Paths



- $\beta_{s_0} = \beta_{s_1} = \beta_{s_2} = \beta_{R_{s_i}, T_{s_i}} = \beta_{20,20}, i \in \{0, 1, 2\}$
- $\mathcal{F} = \{f_0, f_1\}$
- $\alpha^{f_0} = \alpha^{f_1} = \gamma_{r^{f_j}, b^{f_j}} = \gamma_{5,25}, j \in \{0, 1\}$

arrivalBound( $s_2, \{f_0\}, \mathcal{G}$ ), $\mathcal{G} = \mathcal{P}(\{f_0\}) = \alpha_{s_2}^{f_0}$ = arrivalBound( $s_0, \{f_1\}, \mathcal{G}$ ), $\mathcal{G} = \mathcal{P}(\{f_1\}) = \alpha_{s_1}^{f_1}$		FIFO_MUX	ARB_MUX
$\alpha_{s_0}^{f_0}$		$= \gamma_{5,25}$	
$\alpha_{s_0}^{x f_0}$		$= \gamma_{5,25}$	
$\beta_{s_0}^{l.o.f_0} = \beta_{s_0} \ominus \alpha_{s_0}^{x f_0}$	$R_{s_0}^{l.o.f_0}$	$= 15$	
	$T_{s_0}^{l.o.f_0}$	$\beta_{s_0} = b_{s_0}^{x f_0}$ $20 \cdot [t - 20]^+ = 25$ $t = 21\frac{1}{4}$	$\beta_{s_0} = \alpha_{s_0}^{x f_0}$ $20 \cdot [t - 20]^+ = 5 \cdot t + 25$ $t = 28\frac{1}{3}$
	$=$	$= \beta_{15, 21\frac{1}{4}}$	$= \beta_{15, 28\frac{1}{3}}$
	$=$	$= 5$	$= 5$
$\alpha_{s_2}^{f_0} = \alpha^{f_0} \oslash \beta_{s_0}^{l.o.f_0}$	$r_{s_2}^{f_0}$	$= 5$	
	$b_{s_2}^{f_0}$	$\alpha^{f_0}(T_{s_0}^{l.o.f_0}) = 131\frac{1}{4}$	$\alpha^{f_0}(T_{s_0}^{l.o.f_0}) = 166\frac{2}{3}$
	$=$	$= \gamma_{5, 131\frac{1}{4}}$	$= \gamma_{5, 166\frac{2}{3}}$

$\text{arrivalBound}(s_2, \{f_1\}, \mathcal{G}), \mathcal{G} = \mathcal{P}(\{f_1\}) = \alpha_{s_2}^{f_1}$		FIFO_MUX	ARB_MUX
$\alpha_{s_1} = \alpha_{s_1}^{f_1}$		$= \gamma_{5,131\frac{1}{4}}$	$= \gamma_{5,166\frac{2}{3}}$
$\alpha_{s_1}^{xf_1}$		$= \gamma_{0,0}$	
$\beta_{s_1}^{\text{l.o.}f_1} = \beta_{s_1} \ominus \alpha_{s_1}^{xf_1}$		$= \beta_{20,20}$	
$\alpha_{s_2}^{f_1} = \alpha_{s_1}^{f_1} \oslash \beta_{s_1}^{\text{l.o.}f_1} = \alpha^{f_1} \oslash \beta_{s_1}^{\text{l.o.}f_1}$	$r_{s_2}^{f_1}$	$= 5$	
	$b_{s_2}^{f_1}$	$\alpha^{f_0}(T_{s_0}^{\text{l.o.}f_0}) = 231\frac{1}{4}$	$\alpha^{f_0}(T_{s_0}^{\text{l.o.}f_0}) = 266\frac{2}{3}$
	$=$	$= \gamma_{5,231\frac{1}{4}}$	$= \gamma_{5,266\frac{2}{3}}$

$\text{arrivalBound}(s_2, \{f_0\}, \{f_1\}) = \alpha_{s_2}^{f_0}$		FIFO_MUX	ARB_MUX
$\alpha_{s_0}^{f_0}$		$= \gamma_{5,25}$	
$\alpha_{s_0}^{xf_0}$		$= \gamma_{0,0}$	
$\beta_{s_0}^{\text{SFA l.o.}f_0} = \beta_{s_0} \ominus \alpha_{s_0}^{xf_0}$		$= \beta_{20,20}$	
$\alpha_{s_2}^{f_0} = \alpha^{f_0} \oslash \beta_{s_0}^{\text{l.o.}f_0}$	$r_{s_2}^{f_0}$	$= 5$	
	$b_{s_2}^{f_0}$	$\alpha^{f_0}(T_{s_0}^{\text{l.o.}f_0}) = 125$	
	$=$	$= \gamma_{5,125}$	



**Flow  $f_0$**

TFA		FIFO_MUX	ARB_MUX
$s_0$	$\alpha_{s_0} = \alpha_{s_0}^{f_0} + \alpha_{s_0}^{f_1}$	$= \gamma_{10,50}$	
	$D_{s_0}^{f_0}$	$\beta_{s_0} = b_{s_0}$ $20 \cdot [t - 20]^+ = 50$ $t = 22\frac{1}{2}$	$\beta_{s_0} = \alpha_{s_0}$ $20 \cdot [t - 20]^+ = 10 \cdot t + 50$ $t = 45$
	$B_{s_0}^{f_0}$	$\alpha_{s_0}(T_{s_0}) = 10 \cdot 20 + 50$ $= 250$	
$s_2$	$\alpha_{s_2} = \alpha_{s_2}^{f_0} + \alpha_{s_2}^{f_1}$	$= \gamma_{10,362\frac{1}{2}}$	
	$D_{s_2}^{f_0}$	$\beta_{s_2} = b_{s_2}$ $20 \cdot [t - 20]^+ = 362\frac{1}{2}$ $t = 38\frac{1}{8}$	$\beta_{s_2} = \alpha_{s_2}$ $20 \cdot [t - 20]^+ = 10 \cdot t + 433\frac{1}{3}$ $t = 83\frac{1}{3}$
	$B_{s_2}^{f_0}$	$\alpha_{s_2}(T_{s_2}) = 10 \cdot 20 + 362\frac{1}{2}$ $= 562\frac{1}{2}$	
$D^{f_0}$		$= 60\frac{5}{8}$	
$B^{f_0}$		$\max_{i=\{0,2\}} b_{s_i}^{f_0} = 562\frac{1}{2}$	
		$\max_{i=\{0,2\}} b_{s_i}^{f_0} = 633\frac{1}{3}$	

SFA FIFO\_MUX:

$$\begin{aligned}
\beta_{e2e}^{l.o.f_0} &= (\beta_{s_0}^{l.o.xf_0} \ominus \alpha_{s_0}^{xf_0}) \otimes (\beta_{s_2}^{l.o.xf_0} \ominus \alpha_{s_2}^{xf_0}) \\
&= (\beta_{s_0} \ominus \alpha^{f_1}) \otimes (\beta_{s_2} \ominus \alpha_{s_2}^{f_1}) \\
&= (\beta_{s_0} \ominus \alpha^{f_1}) \otimes (\beta_{s_2} \ominus (\alpha_{s_1}^{f_1} \oslash \beta_{s_1}^{l.o.xf_1})) \\
&= (\beta_{s_0} \ominus \alpha^{f_1}) \otimes (\beta_{s_2} \ominus ((\alpha^{f_1} \oslash \beta_{s_0}^{l.o.xf_1}) \oslash \beta_{s_1})) \\
&= (\beta_{s_0} \ominus \alpha^{f_1}) \otimes (\beta_{s_2} \ominus ((\alpha^{f_1} \oslash \beta_{s_0}) \oslash \beta_{s_1})) \\
&= (\beta_{20,20} \ominus \gamma_{5,25}) \otimes (\beta_{20,20} \ominus ((\gamma_{5,25} \oslash \beta_{20,20}) \oslash \beta_{20,20})) \\
&= (\beta_{20,20} \ominus \gamma_{5,25}) \otimes (\beta_{20,20} \ominus (\gamma_{5,125} \oslash \beta_{20,20})) \\
&= \beta_{15,21\frac{1}{4}} \otimes (\beta_{20,20} \ominus \gamma_{5,225}) \\
&= \beta_{15,21\frac{1}{4}} \otimes \beta_{15,31\frac{1}{4}} \\
&= \beta_{15,52\frac{1}{2}}
\end{aligned}$$

$$\begin{aligned}
D^{f_0} &= \frac{R_{e2e}^{l.o.f_0} \cdot T_{e2e}^{l.o.f_0} + b^{f_0}}{R_{e2e}^{l.o.f_0}} \\
&= \frac{15 \cdot 52\frac{1}{2} + 25}{15} \\
&= 54\frac{1}{6}
\end{aligned}$$

$$\begin{aligned}
B^{f_0} &= \alpha^{f_0}(T_{e2e}^{l.o.f_0}) \\
&= 5 \cdot 52\frac{1}{2} + 25 \\
&= 287\frac{1}{2}
\end{aligned}$$

SFA ARB\_MUX:

$$\begin{aligned}
\beta_{e2e}^{l.o.,f_0} &= (\beta_{s_0}^{l.o.,xf_0} \ominus \alpha_{s_0}^{xf_0}) \otimes (\beta_{s_2}^{l.o.,xf_0} \ominus \alpha_{s_2}^{xf_0}) \\
&= (\beta_{s_0} \ominus \alpha^{f_1}) \otimes (\beta_{s_2} \ominus \alpha_{s_2}^{f_1}) \\
&= (\beta_{s_0} \ominus \alpha^{f_1}) \otimes (\beta_{s_2} \ominus (\alpha_{s_1}^{f_1} \oslash \beta_{s_1}^{l.o.,xf_1})) \\
&= (\beta_{s_0} \ominus \alpha^{f_1}) \otimes (\beta_{s_2} \ominus ((\alpha^{f_1} \oslash \beta_{s_0}^{l.o.,xf_1}) \oslash \beta_{s_1})) \\
&= (\beta_{s_0} \ominus \alpha^{f_1}) \otimes [(\beta_{s_2} \ominus ((\alpha^{f_1} \oslash \beta_{s_0})) \oslash \beta_{s_1})) \\
&= (\beta_{20,20} \ominus \gamma_{5,25}) \otimes (\beta_{20,20} \ominus ((\gamma_{5,25} \oslash \beta_{20,20})) \oslash \beta_{20,20})) \\
&= (\beta_{20,20} \ominus \gamma_{5,25}) \otimes (\beta_{20,20} \ominus (\gamma_{5,125} \oslash \beta_{20,20})) \\
&= \beta_{15,28\frac{1}{3}} \otimes (\beta_{20,20} \ominus \gamma_{5,225}) \\
&= \beta_{15,28\frac{1}{3}} \otimes \beta_{15,41\frac{2}{3}} \\
&= \beta_{15,70}
\end{aligned}$$

$$\begin{aligned}
D^{f_0} &= \frac{R_{e2e}^{l.o.,f_0} \cdot T_{e2e}^{l.o.,f_0} + b^{f_0}}{R_{e2e}^{l.o.,f_0}} \\
&= \frac{15 \cdot 70 + 25}{15} \\
&= 71\frac{2}{3}
\end{aligned}$$

$$\begin{aligned}
B^{f_0} &= \alpha^{f_0}(T_{e2e}^{l.o.,f_0}) \\
&= 5 \cdot 70 + 25 \\
&= 375
\end{aligned}$$

PMOO		ARB_MUX
$s_0$	$\alpha_{s_0}^{x'f_0}$	$= \gamma_{5,25}$
	$\alpha_{s_0}^{xf_0}$	$= \gamma_{5,25}$
$s_2$	$\alpha_{s_2}^{x'f_0}$	$= \gamma_{5,266\frac{2}{3}}$
	$\alpha_{s_2}^{xf_0}$	$= \gamma_{5,266\frac{2}{3}}$
$\beta_{e2e}^{1.o.f_0} = \beta_{R_{e2e}^{1.o.f_0}, T_{e2e}^{1.o.f_0}}$	$R_{e2e}^{1.o.f_0} = \bigwedge_{i \in \{0,2\}} (R_{s_i} - r_{s_i}^{xf_0})$	$= (20 - 5) \wedge (20 - 5)$ $= 15$
	$T_{e2e}^{1.o.f_0} = \sum_{i \in \{0,2\}} T_{s_i} + \frac{\sum_{i \in \{0,2\}} (b_{s_i}^{x'f_0} + r_{s_i}^{xf_0} \cdot T_{s_i})}{R_{e2e}^{1.o.f_0}}$	$= 20 + 20 + \frac{25 + 5 \cdot 20 + 266\frac{2}{3} + 5 \cdot 20}{15}$ $= 40 + \frac{491\frac{2}{3}}{15}$ $= 72\frac{7}{9}$
	$=$	$= \beta_{15,72\frac{7}{9}}$
$D^{f_0}$		$\beta_{e2e}^{1.o.f_0} = b^{f_0}$ $15 \cdot [t - 72\frac{7}{9}]^+ = 25$ $t = 74\frac{4}{9}$
$B^{f_0}$		$\alpha^{f_0}(T_{e2e}^{1.o.f_0}) = 5 \cdot 72\frac{7}{9} + 25$ $= 388\frac{8}{9}$

**Flow  $f_1$**

TFA		FIFO_MUX	ARB_MUX
$s_0$	$\alpha_{s_0} = \alpha_{s_0}^{f_0} + \alpha_{s_0}^{f_1}$	$= \gamma_{10,50}$	
	$D_{s_0}^{f_0}$	$\beta_{s_0} = b_{s_0}$ $20 \cdot [t - 20]^+ = 50$ $t = 22\frac{1}{2}$	$\beta_{s_0} = \alpha_{s_0}$ $20 \cdot [t - 20]^+ = 10 \cdot t + 50$ $t = 45$
	$B_{s_0}^{f_0}$	$\alpha_{s_0}(T_{s_0}) = 10 \cdot 20 + 50$ $= 250$	
$s_1$	$\alpha_{s_1} = \alpha_{s_1}^{f_1}$	$= \gamma_{5,131\frac{1}{4}}$	$= \gamma_{5,166\frac{2}{3}}$
	$D_{s_1}^{f_1}$	$\beta_{s_1} = b_{s_1}$ $20 \cdot [t - 20]^+ = 131\frac{1}{4}$ $t = 26\frac{9}{16}$	FIFO per micro flow $\beta_{s_1} = b_{s_1}$ $20 \cdot [t - 20]^+ = 166\frac{2}{3}$ $t = 28\frac{1}{3}$
	$B_{s_1}^{f_1}$	$\alpha_{s_1}(T_{s_1}) = 5 \cdot 20 + 131\frac{1}{4}$ $= 231\frac{1}{4}$	$\alpha_{s_1}(T_{s_1}) = 5 \cdot 20 + 166\frac{2}{3}$ $= 266\frac{2}{3}$
$s_2$	$\alpha_{s_2} = \alpha_{s_2}^{f_0} + \alpha_{s_2}^{f_1}$	$= \gamma_{10,362\frac{1}{2}}$	$= \gamma_{10,433\frac{1}{3}}$
	$D_{s_2}^{f_1}$	$\beta_{s_2} = b_{s_2}$ $20 \cdot [t - 20]^+ = 362\frac{1}{2}$ $t = 38\frac{1}{8}$	$\beta_{s_2} = \alpha_{s_2}$ $20 \cdot [t - 20]^+ = 10 \cdot t + 433\frac{1}{3}$ $t = 83\frac{1}{3}$
	$B_{s_2}^{f_1}$	$\alpha_{s_2}(T_{s_2}) = 10 \cdot 20 + 362\frac{1}{2}$ $= 562\frac{1}{2}$	$\alpha_{s_2}(T_{s_2}) = 10 \cdot 20 + 433\frac{1}{3}$ $= 633\frac{1}{3}$
$D^{f_1}$		$\sum_{i=0}^2 \beta_{s_i}^{f_1} = 87\frac{3}{16}$	$\sum_{i=0}^2 \beta_{s_i}^{f_1} = 156\frac{2}{3}$
$B^{f_1}$		$\max_{i=0}^2 b_{s_i}^{f_1} = 562\frac{1}{2}$	$\max_{i=0}^2 b_{s_i}^{f_1} = 633\frac{1}{3}$

SFA FIFO\_MUX:

$$\begin{aligned}
\beta_{e2e}^{l.o.f_1} &= (\beta_{s_0}^{l.o.xf_1} \ominus \alpha_{s_0}^{xf_1}) \otimes (\beta_{s_1}^{l.o.xf_1} \ominus \alpha_{s_1}^{xf_1}) \otimes (\beta_{s_2}^{l.o.xf_1} \ominus \alpha_{s_2}^{xf_1}) \\
&= (\beta_{s_0} \ominus \alpha^{f_0}) \otimes \beta_{s_1} \otimes (\beta_{s_2} \ominus \alpha_{s_2}^{f_0}) \\
&= (\beta_{s_0} \ominus \alpha^{f_0}) \otimes \beta_{s_1} \otimes (\beta_{s_2} \ominus ((\alpha_{s_0}^{f_0} \oslash \beta_{s_0}^{l.o.xf_1}))) \\
&= (\beta_{s_0} \ominus \alpha^{f_0}) \otimes \beta_{s_1} \otimes (\beta_{s_2} \ominus (\alpha^{f_0} \oslash \beta_{s_0})) \\
&= (\beta_{20,20} \ominus \gamma_{5,25}) \otimes \beta_{20,20} \otimes (\beta_{20,20} \ominus (\gamma_{5,25} \oslash \beta_{20,20})) \\
&= \beta_{15,21\frac{1}{4}} \otimes \beta_{20,20} \otimes (\beta_{20,20} \ominus \gamma_{5,125}) \\
&= \beta_{15,21\frac{1}{4}} \otimes \beta_{20,20} \otimes \beta_{15,26\frac{1}{4}} \\
&= \beta_{15,67\frac{1}{2}}
\end{aligned}$$

$$\begin{aligned}
D^{f_1} &= \frac{R_{e2e}^{l.o.f_1} \cdot T_{e2e}^{l.o.f_1} + b^{f_1}}{R_{e2e}^{l.o.f_1}} \\
&= \frac{15 \cdot 67\frac{1}{2} + 25}{15} \\
&= 69\frac{1}{6}
\end{aligned}$$

$$\begin{aligned}
B^{f_1} &= \alpha^{f_1}(T_{e2e}^{l.o.f_1}) \\
&= 5 \cdot 67\frac{1}{2} + 25 \\
&= 362\frac{1}{2}
\end{aligned}$$

SFA ARB\_MUX:

$$\begin{aligned}
\beta_{\text{e2e}}^{\text{l.o.},f_1} &= (\beta_{s_0}^{\text{l.o.},xf_1} \ominus \alpha_{s_0}^{xf_1}) \otimes (\beta_{s_1}^{\text{l.o.},xf_1} \ominus \alpha_{s_1}^{xf_1}) \otimes (\beta_{s_2}^{\text{l.o.},xf_1} \ominus \alpha_{s_2}^{xf_1}) \\
&= (\beta_{s_0} \ominus \alpha^{f_0}) \otimes \beta_{s_1} \otimes (\beta_{s_2} \ominus \alpha_{s_2}^{f_0}) \\
&= (\beta_{s_0} \ominus \alpha^{f_0}) \otimes \beta_{s_1} \otimes (\beta_{s_2} \ominus ((\alpha_{s_0}^{f_0} \oslash \beta_{s_0}^{\text{l.o.},xf_1})) \\
&= (\beta_{s_0} \ominus \alpha^{f_0}) \otimes \beta_{s_1} \otimes (\beta_{s_2} \ominus (\alpha^{f_0} \oslash \beta_{s_0})) \\
&= (\beta_{20,20} \ominus \gamma_{5,25}) \otimes \beta_{20,20} \otimes (\beta_{20,20} \ominus (\gamma_{5,25} \oslash \beta_{20,20})) \\
&= \beta_{15,28\frac{1}{3}} \otimes \beta_{20,20} \otimes (\beta_{20,20} \ominus \gamma_{5,125}) \\
&= \beta_{15,28\frac{1}{3}} \otimes \beta_{20,20} \otimes \beta_{15,35} \\
&= \beta_{15,83\frac{1}{3}}
\end{aligned}$$

$$\begin{aligned}
D^{f_1} &= \frac{R_{\text{e2e}}^{\text{l.o.},f_1} \cdot T_{\text{e2e}}^{\text{l.o.},f_1} + b^{f_1}}{R_{\text{e2e}}^{\text{l.o.},f_1}} \\
&= \frac{15 \cdot 83\frac{1}{3} + 25}{15} \\
&= 85
\end{aligned}$$

$$\begin{aligned}
B^{f_1} &= \alpha^{f_1}(T_{\text{e2e}}^{\text{l.o.},f_1}) \\
&= 5 \cdot 83\frac{1}{3} + 25 \\
&= 441\frac{2}{3}
\end{aligned}$$

PMOO		ARB_MUX
$s_0$	$\alpha_{s_0}^{x'f_1}$	$= \gamma_{5,25}$
	$\alpha_{s_0}^{xf_1}$	$= \gamma_{5,25}$
$s_1$	$\alpha_{s_0}^{x'f_1}$	$= \gamma_{0,0}$
	$\alpha_{s_0}^{xf_1}$	$= \gamma_{0,0}$
$s_2$	$\alpha_{s_2}^{x'f_1}$	$= \gamma_{5,125}$
	$\alpha_{s_2}^{xf_1}$	$= \gamma_{5,125}$
$\beta_{e2e}^{l.o.f_1} = \beta_{R_{e2e}^{l.o.f_1}, T_{e2e}^{l.o.f_1}}$	$R_{e2e}^{l.o.f_1} = \bigwedge_{i \in \{0,1,2\}} (R_{s_i} - r_{s_i}^{xf_1})$	$= (20 - 5) \wedge (20 - 0) \wedge (20 - 5)$
		$= 15$
	$T_{e2e}^{l.o.f_3} = \sum_{i \in \{0,1,2\}} T_{s_i} + \frac{\sum_{i \in \{0,1,2\}} (b_{s_i}^{x'f_1} + r_{s_i}^{xf_1} \cdot T_{s_i})}{R_{e2e}^{l.o.f_1}}$	$= 20 + 20 + 20 + \frac{25 + 5 \cdot 20 + 0 + 0 \cdot 20 + 125 + 5 \cdot 20}{15}$
		$= 60 + \frac{350}{15}$
	$=$	$= 83\frac{1}{3}$
		$= \beta_{15, 86\frac{1}{3}}$
$D^{f_1}$		$\beta_{e2e}^{l.o.f_1} = b^{f_1}$ $15 \cdot [t - 83\frac{1}{3}]^+ = 25$ $t = 85$
$B^{f_1}$		$\alpha^{f_1}(T_{e2e}^{l.o.f_1}) = 5 \cdot 83\frac{1}{3} + 25$ $= 441\frac{2}{3}$



## References

- [1] Jens B. Schmitt, Frank A. Zdarsky, and Ivan Martinovic. Improving Performance Bounds in Feed-Forward Networks by Paying Multiplexing Only Once. In *14th GI/ITG Conference on Measurement, Modeling, and Evaluation of Computer and Communication Systems (MMB 2008)*, Dortmund, Germany, March 2008. GI/ITG.