Network Calculus Tests – Feed Forward Network Configurations

Version 1.1 (2014-Dec-30)

General Information

- The network calculus analyses presented in this document were created for the purpose of testing the Disco Deterministic Network Calculator (DiscoDNC)[1] – an open-source deterministic network calculus tool developed by the *Distributed Computer Systems (DISCO) Lab* at the University of Kaiserslautern.
- Naming of the individual network configurations depicts the name of the according functional test for the DiscoDNC.
- The naming scheme used in this document is detailed in NetworkCalculus_NamingScheme.pdf.
- Arrival bound computations are equivalent to the `PbooArrivalBound_Output_PerHop.java` class of the DiscoDNC.
- The end-to-end left-over service curve for PBOO arrival bounds can be computed by simply convolving the server-local ones.
- Arrival bounds for `PmooArrivalBound.java` and analyses using them are listed only if results are different to PBOO.

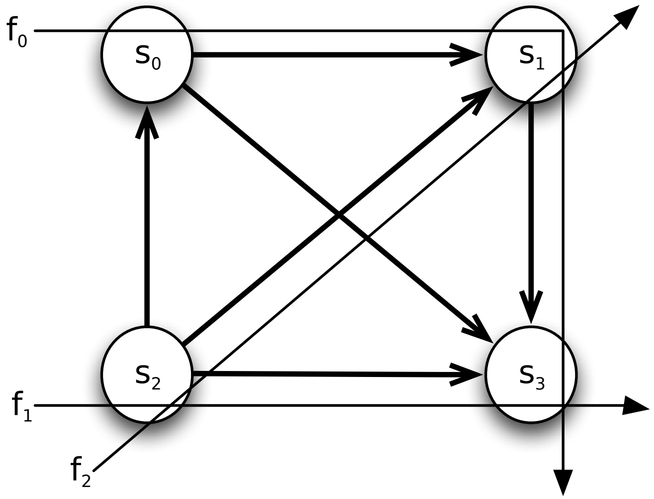
Changelog:

Version 1.1 (2014-Dec-30):

- Streamlined the PMOO left-over latency $T_{\mathrm{e2e}}^{\mathrm{l.o.}f}$ computation.
- Adapted to naming scheme version 1.1.

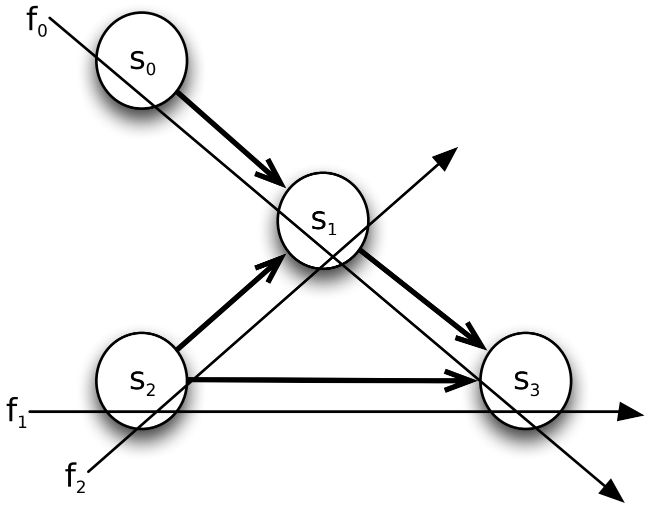
[1] http://disco.cs.uni-kl.de/index.php/projects/disco-dnc

FeedForward_1SC_3Flows_1AC_3Paths



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

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



arrivalBound$(s_3, \{f_1\}, \mathcal{G})$, $\mathcal{G} \in \mathcal{P}(\mathcal{F} \setminus \{f_2\}) = \alpha_{s_3}^{f_1}$ $=$ 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
$\alpha_{s_2}^{f_n} = \alpha_{s_2}^{f_1} = \alpha_{s_2}^{f_2}$		$= \gamma_{5,25}$	
$\alpha_{s_2}^{x(f_1)} = \alpha_{s_2}^{x(f_1)} = \alpha_{s_2}^{x(f_2)} = \alpha^{f_1} = \alpha^{f_2}$, $n \in \{1,2\}$		$= \gamma_{5,25}$	
$\beta_{s_2}^{\text{l.o.}f_n} = \beta_{s_2} \ominus \alpha_{s_2}^{x(f_n)} = \beta_{R_{s_2}^{\text{l.o.}f_n}, T_{s_2}^{\text{l.o.}f_n}}$	$R_{s_2}^{\text{l.o.}f_n}$	$[R_{s_2} - r_{s_2}^{x(f_n)}]^+ = 15$	
	$T_{s_2}^{\text{l.o.}f_n}$	$\beta_{s_2} = b_{s_2}^{x(f_n)}$ $20 \cdot [t-20]^+ = 25$ $t = 21\frac{1}{4}$	$\beta_{s_2} = \alpha_{s_2}^{x(f_n)}$ $20 \cdot [t-20]^+ = 5 \cdot t + 25$ $t = 28\frac{1}{3}$
	$=$	$= \beta_{15,21\frac{1}{4}}$	$= \beta_{15,28\frac{1}{3}}$
$\alpha_{s_1}^{f_2} = \alpha_{s_3}^{f_1} = \alpha^{f_n} \oslash \beta_{s_2}^{\text{l.o.}f_n}$ $= \gamma_{r_{s_1}^{f_2}, b_{s_1}^{f_2}} = \gamma_{r_{s_3}^{f_1}, b_{s_3}^{f_1}}$	$r_{s_1}^{f_2} = r_{s_3}^{f_1}$	$= 5$	
	$b_{s_1}^{f_2} = b_{s_3}^{f_1}$	$\alpha^{f_n}(T_{s_2}^{\text{l.o.}f_n}) = 5 \cdot 21\frac{1}{4} + 25 = 131\frac{1}{4}$	$\alpha^{f_n}(T_{s_2}^{\text{l.o.}f_n}) = 5 \cdot 28\frac{1}{3} + 25 = 166\frac{2}{3}$
	$=$	$= \gamma_{5,131\frac{1}{4}}$	$= \gamma_{5,166\frac{2}{3}}$

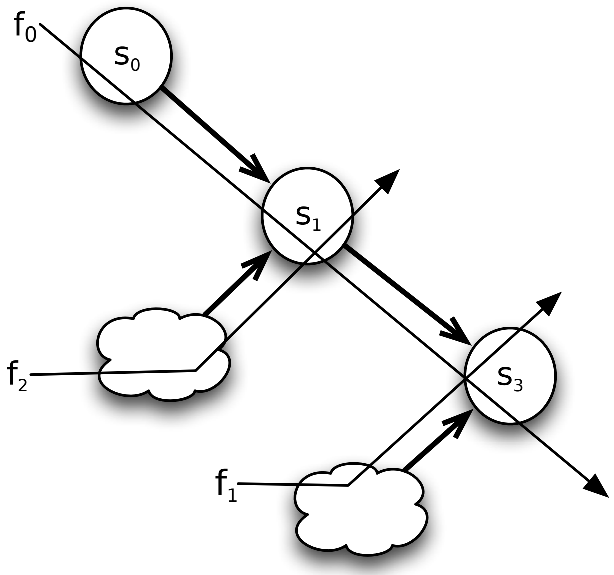
arrivalBound$(s_1, \{f_0\}, \mathcal{G})$, $\mathcal{G} \in \mathcal{P}(\mathcal{F} \setminus \{f_2\}) = \alpha_{s_1}^{f_0}$ $=$ arrivalBound$(s_3, \{f_1\}, \mathcal{G}' \cup \{f_2\})$, $\mathcal{G}' \in \mathcal{P}(\mathcal{F}) = \alpha_{s_3}^{f_1}$ $=$ arrivalBound$(s_1, \{f_2\}, \mathcal{G}'' \cup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

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

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

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:



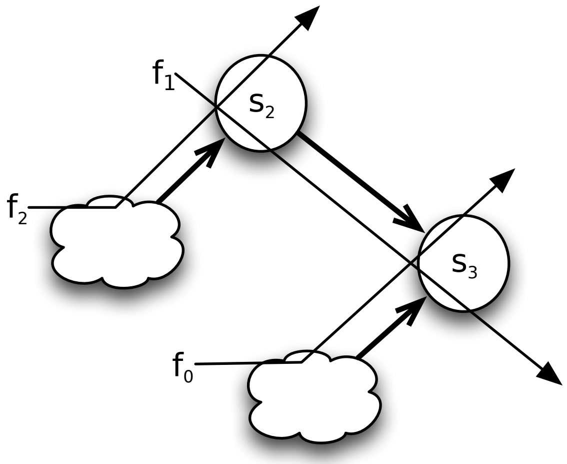
TFA		FIFO_MUX	ARB_MUX
s_0	$\alpha_{s_0} = \alpha^{f_0}_{s_0}$	$= \gamma_{5,25}$	
	$D^{f_0}_{s_0}$	$\beta_{s_0} = b_{s_0}$ $20 \cdot [t-20]^+ = 25$ $t = 21\frac{1}{4}$	FIFO per micro flow $\beta_{s_0} = b_{s_0}$ $20 \cdot [t-20]^+ = 25$ $t = 21\frac{1}{4}$
	$B^{f_0}_{s_0}$	$\alpha_{s_0}(T_{s_0}) = 20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

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

PMOO		ARB_MUX
s_0	$\alpha_{s_0}^{\bar{x}(f_0)}$	$= \gamma_{0,0}$
	$\alpha_{s_0}^{x(f_0)}$	$= \gamma_{0,0}$
s_1	$\alpha_{s_1}^{\bar{x}(f_0)} = \alpha_{s_1}^{f_2}$	$= \gamma_{5,166\frac{2}{3}}$
	$\alpha_{s_1}^{x(f_0)} = \alpha_{s_1}^{f_2}$	$= \gamma_{5,166\frac{2}{3}}$
s_3	$\alpha_{s_3}^{\bar{x}(f_0)} = \alpha_{s_3}^{f_1}$	$= \gamma_{5,166\frac{2}{3}}$
	$\alpha_{s_3}^{x(f_0)} = \alpha_{s_3}^{f_1}$	$= \gamma_{5,166\frac{2}{3}}$
$\beta_{\mathrm{e2e}}^{\mathrm{l.o.}f_0} = \beta_{R_{\mathrm{e2e}}^{\mathrm{l.o.}f_0}, T_{\mathrm{e2e}}^{\mathrm{l.o.}f_0}}$	$R_{\mathrm{e2e}}^{\mathrm{l.o.}f_0} = \bigwedge_{i \in \{0,1,3\}} \left(R_{s_i} - r_{s_i}^{x(f_0)} \right)$	$\begin{aligned} &= (20-5) \wedge (20-5) \wedge (20-5) \\ &= 15 \end{aligned}$
	$T_{\mathrm{e2e}}^{\mathrm{l.o.}f_0} = \sum_{i \in \{0,1,3\}} \left(T_{s_i} + \frac{b_{s_i}^{\bar{x}(f_0)} + r_{s_i}^{x(f_0)} \cdot T_{s_i}}{R_{\mathrm{e2e}}^{\mathrm{l.o.}f_0}} \right)$	$\begin{aligned} &= 20 + \frac{0 + 0 \cdot 20}{15} + 20 + \frac{166\frac{2}{3} + 5 \cdot 20}{15} + 20 + \frac{166\frac{2}{3} + 5 \cdot 20}{15} \\ &= 60 + \frac{533\frac{1}{3}}{15} \\ &= 95\frac{5}{9} \end{aligned}$
	$=$	$= \beta_{15,95\frac{5}{9}}$
D^{f_0}		$\begin{aligned} \beta_{\mathrm{e2e}}^{\mathrm{l.o.}f_0} &= b^{f_0} \\ 15 \cdot [t - 95\frac{5}{9}]^+ &= 25 \\ t &= 97\frac{2}{9} \end{aligned}$
B^{f_0}		$\begin{aligned} \alpha^{f_0}(T_{\mathrm{e2e}}^{\mathrm{l.o.}f_0}) &= 5 \cdot 95\frac{5}{9} + 25 \\ &= 502\frac{7}{9} \end{aligned}$

(See [1] for details)

Flow f_1

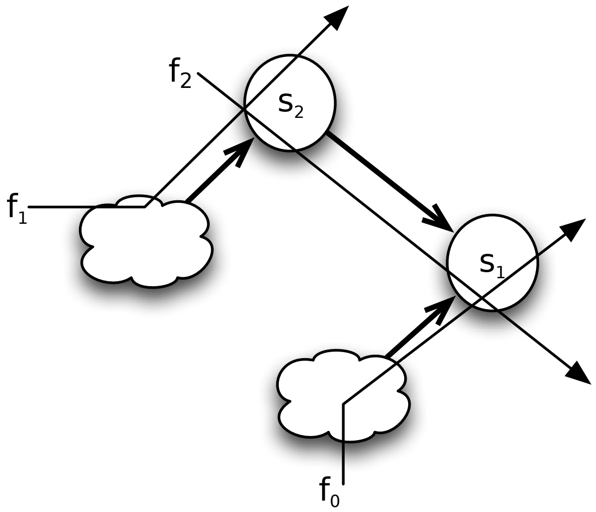


TFA		FIFO_MUX	ARB_MUX
s_2	$\alpha_{s_2} = \alpha_{s_2}^{f_1} + \alpha_{s_2}^{f_2}$	$= \gamma_{10,50}$	
	$D_{s_2}^{f_1}$	$\beta_{s_2} = b_{s_2}$ $20 \cdot [t-20]^+ = 50$ $t = 22\frac{1}{2}$	$\beta_{s_2} = \alpha_{s_2}$ $20 \cdot [t-20]^+ = 10 \cdot t + 50$ $t = 45$
	$B_{s_2}^{f_1}$	$\alpha_{s_2}(T_{s_2}) = 20 \cdot 10 + 50$ $= 250$	
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	$\alpha_{s_2}^{x(f_1)} = \alpha_{s_2}^{f_2} = \alpha^{f_2}$		$= \gamma_{5,25}$	
	$\beta_{s_2}^{\mathrm{l.o.}f_1} = \beta_{s_2} \ominus \alpha_{s_2}^{x(f_1)}$		$= \beta_{15,21\frac{1}{4}}$	$= \beta_{15,28\frac{1}{3}}$
s_3	$\alpha_{s_3}^{x(f_1)} = \alpha_{s_3}^{f_0}$		$= \gamma_{5,256\frac{1}{4}}$	$= \gamma_{5,300}$
	$\beta_{s_3}^{\mathrm{l.o.}f_1} = \beta_{s_3} \ominus \alpha_{s_3}^{x(f_1)} = \beta_{R_{s_3}^{\mathrm{l.o.}f_1}, T_{s_3}^{\mathrm{l.o.}f_1}}$	$R_{s_3}^{\mathrm{l.o.}f_1}$	$[R_{s_3} - r_{s_3}^{x(f_1)}]^+ = 15$	
		$T_{s_3}^{\mathrm{l.o.}f_1}$	$\beta_{s_3} = b_{s_3}^{x(f_1)}$ $20 \cdot [t-20]^+ = 256\frac{1}{4}$ $t = 32\frac{13}{16}$	$\beta_{s_3} = \alpha_{s_3}^{x(f_1)}$ $20 \cdot [t-20]^+ = 5 \cdot t + 300$ $t = 46\frac{2}{3}$
		$=$	$= \beta_{15,32\frac{13}{16}}$	$= \beta_{15,46\frac{2}{3}}$
$\beta_{\mathrm{e2e}}^{\mathrm{l.o.}f_1} = \beta_{R_{\mathrm{e2e}}^{\mathrm{l.o.}f_1}, T_{\mathrm{e2e}}^{\mathrm{l.o.}f_1}}$			$\bigotimes_{i=2}^{3} \beta_{s_i}^{\mathrm{l.o.}f_1} = \beta_{15,54\frac{1}{16}}$	$\bigotimes_{i=2}^{3} \beta_{s_i}^{\mathrm{l.o.}f_1} = \beta_{15,75}$
D^{f_1}			$\beta_{\mathrm{e2e}}^{\mathrm{l.o.}f_1} = b^{f_1}$ $15 \cdot [t - 54\frac{1}{16}]^+ = 25$ $t = 55\frac{35}{48}$	$\beta_{\mathrm{e2e}}^{\mathrm{l.o.}f_1} = b^{f_1}$ $15 \cdot [t-75]^+ = 25$ $t = 76\frac{2}{3}$
B^{f_1}			$\alpha^{f_1}(T_{\mathrm{e2e}}^{\mathrm{l.o.}f_1}) = 5 \cdot 54\frac{1}{16} + 25$ $= 295\frac{5}{16}$	$\alpha^{f_1}(T_{\mathrm{e2e}}^{\mathrm{l.o.}f_1}) = 5 \cdot 75 + 25$ $= 400$

PMOO		ARB_MUX
s_2	$\alpha_{s_2}^{\bar{x}(f_1)} = \alpha_{s_2}^{f_2}$	$= \gamma_{5,25}$
	$\alpha_{s_2}^{x(f_1)} = \alpha_{s_2}^{f_2}$	$= \gamma_{5,25}$
s_3	$\alpha_{s_3}^{\bar{x}(f_1)} = \alpha_{s_3}^{f_0}$	$= \gamma_{5,300}$
	$\alpha_{s_3}^{x(f_1)} = \alpha_{s_3}^{f_0}$	$= \gamma_{5,300}$
$\beta_{\text{e2e}}^{\text{l.o.}f_1} = \beta_{R_{\text{e2e}}^{\text{l.o.}f_1}, T_{\text{e2e}}^{\text{l.o.}f_1}}$	$R_{\text{e2e}}^{\text{l.o.}f_1} = \bigwedge_{i \in \{2,3\}} \left(R_{s_i} - r_{s_i}^{x(f_1)} \right)$	$= (20-5) \wedge (20-5)$ $= 15$
	$T_{\text{e2e}}^{\text{l.o.}f_1} = \sum_{i \in \{2,3\}} \left(T_{s_i} + \frac{b_{s_i}^{\bar{x}(f_1)} + r_{s_i}^{x(f_1)} \cdot T_{s_i}}{R_{\text{e2e}}^{\text{l.o.}f_1}} \right)$	$= 20 + \frac{25 + 5 \cdot 20}{15} + 20 + \frac{300 + 5 \cdot 20}{15}$ $= 40 + \frac{525}{15}$ $= 75$
	$=$	$= \beta_{15,75}$
D^{f_1}		$\beta_{\text{e2e}}^{\text{l.o.}f_1} = b^{f_1}$ $15 \cdot [t - 75]^+ = 25$ $t = 76\frac{2}{3}$
B^{f_1}		$\alpha^{f_1}(T_{\text{e2e}}^{\text{l.o.}f_1}) = 5 \cdot 75 + 25$ $= 400$

Flow f_2

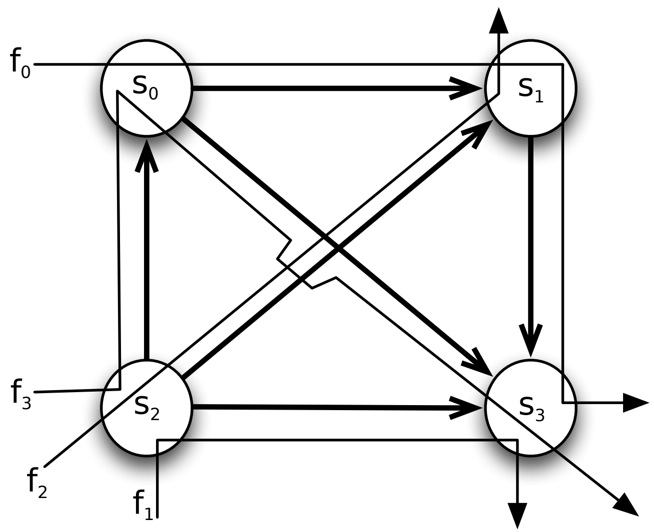


TFA		FIFO_MUX	ARB_MUX
s_2	$\alpha_{s_2} = \alpha^{f_1}_{s_2} + \alpha^{f_2}_{s_2}$	$= \gamma_{10,50}$	
	$D^{f_2}_{s_2}$	$\begin{aligned} \beta_{s_2} &= b_{s_2} \\ 20 \cdot [t-20]^+ &= 50 \\ t &= 22\frac{1}{2} \end{aligned}$	$\begin{aligned} \beta_{s_2} &= \alpha_{s_2} \\ 20 \cdot [t-20]^+ &= 10 \cdot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

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

PMOO		ARB_MUX
s_2	$\alpha_{s_2}^{\bar{x}(f_2)} = \alpha_{s_2}^{f_1}$	$= \gamma_{5,25}$
	$\alpha_{s_2}^{x(f_2)} = \alpha_{s_2}^{f_1}$	$= \gamma_{5,25}$
s_1	$\alpha_{s_1}^{\bar{x}(f_2)} = \alpha_{s_1}^{f_0}$	$= \gamma_{5,125}$
	$\alpha_{s_1}^{x(f_2)} = \alpha_{s_1}^{f_0}$	$= \gamma_{5,125}$
$\beta_{\text{e2e}}^{\text{l.o.}f_2} = \beta_{R_{\text{e2e}}^{\text{l.o.}f_2}, T_{\text{e2e}}^{\text{l.o.}f_2}}$	$R_{\text{e2e}}^{\text{l.o.}f_2} = \bigwedge_{i \in \{2,1\}} \left(R_{s_i} - r_{s_i}^{x(f_2)}\right)$	$= (20-5) \wedge (20-5)$ $= 15$
	$T_{\text{e2e}}^{\text{l.o.}f_2} = \sum_{i \in \{2,1\}} \left(T_{s_i} + \frac{b_{s_i}^{\bar{x}(f_2)} + r_{s_i}^{x(f_2)} \cdot T_{s_i}}{R_{\text{e2e}}^{\text{l.o.}f_2}}\right)$	$= 20 + \frac{25 + 5 \cdot 20}{15} + 20 + \frac{125 + 5 \cdot 20}{15}$ $= 40 + \frac{350}{15}$ $= 63\frac{1}{3}$
	$=$	$= \beta_{15,63\frac{1}{3}}$
D^{f_2}		$\beta_{\text{e2e}}^{\text{l.o.}f_2} = b^{f_2}$ $15 \cdot [t - 63\frac{1}{3}]^+ = 25$ $t = 65$
B^{f_2}		$\alpha^{f_2}(T_{\text{e2e}}^{\text{l.o.}f_2}) = 5 \cdot 63\frac{1}{3} + 25$ $= 341\frac{2}{3}$

FeedForward_1SC_4Flows_1AC_4Paths



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

<table>
<tr><td colspan="2">$\text{arrivalBound}(s_3, \{f_1\}, \mathcal{G}), \mathcal{G} \in \mathcal{P}(\mathcal{F} \setminus \{f_2, f_3\}) = \alpha_{s_3}^{f_1}$
$= \text{arrivalBound}(s_1, \{f_2\}, \mathcal{G}'), \mathcal{G}' \in \mathcal{P}(\mathcal{F} \setminus \{f_1, f_3\}) = \alpha_{s_1}^{f_2}$
$= \text{arrivalBound}(s_0, \{f_3\}, \mathcal{G}''), \mathcal{G}'' \in \mathcal{P}(\mathcal{F} \setminus \{f_1, f_2\}) = \alpha_{s_0}^{f_3}$</td><td>FIFO_MUX</td><td>ARB_MUX</td></tr>
<tr><td colspan="2">$\alpha_{s_2}^{f_1} = \alpha^{f_1} = \alpha_{s_2}^{f_2} = \alpha^{f_2} = \alpha_{s_2}^{f_3} = \alpha^{f_3} = \alpha^{f_n},\ n \in \{1, 2, 3\}$</td><td colspan="2">$= \gamma_{5,25}$</td></tr>
<tr><td colspan="2">$\alpha_{s_2}^{x(f_1)} = \alpha_{s_2}^{x(f_1)} = \alpha_{s_2}^{x(f_2)} = \alpha_{s_2}^{x(f_3)}$</td><td colspan="2">$= \gamma_{10,50}$</td></tr>
<tr><td rowspan="3">$\beta_{s_2}^{\text{l.o.}f_n} = \beta_{s_2} \ominus \alpha^{x(f_n)} = \beta_{R_{s_2}^{\text{l.o.}f_n}, T_{s_2}^{\text{l.o.}f_n}}$</td><td>$R_{s_2}^{\text{l.o.}f_n}$</td><td colspan="2">$[R_{s_2} - r_{s_2}^{x(f_n)}]^+ = 15$</td></tr>
<tr><td>$T_{s_2}^{\text{l.o.}f_n}$</td><td>$\begin{aligned} \beta_{s_2} &= b_{s_2}^{x(f_n)} \\ 20 \cdot [t-20]^+ &= 50 \\ t &= 22\frac{1}{2} \end{aligned}$</td><td>$\begin{aligned} \beta_{s_2} &= \alpha_{s_2}^{x(f_n)} \\ 20 \cdot [t-20]^+ &= 10 \cdot t + 50 \\ t &= 45 \end{aligned}$</td></tr>
<tr><td>$=$</td><td>$= \beta_{10,22\frac{1}{2}}$</td><td>$= \beta_{10,45}$</td></tr>
<tr><td rowspan="3">$\alpha_{s_3}^{f_1} = \alpha^{f_1} \oslash \beta_{s_2}^{\text{l.o.}f_n} = \gamma_{r_{s_3}^{f_1}, b_{s_3}^{f_1}}$
$= \alpha_{s_1}^{f_2} = \alpha^{f_2} \oslash \beta_{s_2}^{\text{l.o.}f_n} = \gamma_{r_{s_1}^{f_2}, b_{s_1}^{f_2}}$
$= \alpha_{s_0}^{f_3} = \alpha^{f_3} \oslash \beta_{s_2}^{\text{l.o.}f_n} = \gamma_{r_{s_0}^{f_3}, b_{s_0}^{f_3}}$</td><td>$r_{s_3}^{f_1} = r_{s_1}^{f_2} = r_{s_0}^{f_3}$</td><td colspan="2">$= 5$</td></tr>
<tr><td>$b_{s_3}^{f_1} = b_{s_1}^{f_2} = b_{s_0}^{f_3}$</td><td>$\alpha^{f_n}(T_{s_2}^{\text{l.o.}f_n}) = 5 \cdot 22\frac{1}{2} + 25 = 137\frac{1}{2}$</td><td>$\alpha^{f_n}(T_{s_2}^{\text{l.o.}f_n}) = 5 \cdot 45 + 25 = 250$</td></tr>
<tr><td>$=$</td><td>$= \gamma_{5,137\frac{1}{2}}$</td><td>$= \gamma_{5,250}$</td></tr>
</table>

<table>
<tr><td colspan="2">$\text{arrivalBound}(s_1, \{f_0\}, \mathcal{G}), \mathcal{G} \in \mathcal{P}(\{f_0\}) = \alpha_{s_1}^{f_0}$</td><td>FIFO_MUX</td><td>ARB_MUX</td></tr>
<tr><td colspan="2">$\alpha_{s_0}^{f_0} = \alpha^{f_0}$</td><td colspan="2">$= \gamma_{5,25}$</td></tr>
<tr><td colspan="2">$\alpha_{s_0}^{x(f_0)} = \alpha_{s_0}^{f_3}$</td><td>$= \gamma_{5,137\frac{1}{2}}$</td><td>$= \gamma_{5,250}$</td></tr>
<tr><td rowspan="3">$\beta_{s_0}^{\text{l.o.}f_0} = \beta_{s_0} \ominus \alpha_{s_0}^{x(f_0)} = \beta_{R_{s_0}^{\text{l.o.}f_0}, T_{s_0}^{\text{l.o.}f_0}}$</td><td>$R_{s_0}^{\text{l.o.}f_0}$</td><td colspan="2">$[R_{s_0} - r_{s_0}^{x(f_0)}]^+ = 15$</td></tr>
<tr><td>$T_{s_0}^{\text{l.o.}f_0}$</td><td>$\begin{aligned} \beta_{s_0} &= b_{s_0}^{x(f_0)} \\ 20 \cdot [t-20]^+ &= 137\frac{1}{2} \\ t &= 26\frac{7}{8} \end{aligned}$</td><td>$\begin{aligned} \beta_{s_0} &= \alpha_{s_0}^{x(f_0)} \\ 20 \cdot [t-20]^+ &= 5 \cdot t + 250 \\ t &= 43\frac{1}{3} \end{aligned}$</td></tr>
<tr><td>$=$</td><td>$= \beta_{15,26\frac{7}{8}}$</td><td>$= \beta_{15,43\frac{1}{3}}$</td></tr>
<tr><td rowspan="3">$\alpha_{s_1}^{f_0} = \alpha^{f_0} \oslash \beta_{s_0}^{\text{l.o.}f_0} = \gamma_{r_{s_1}^{f_0}, b_{s_1}^{f_0}}$</td><td>$r_{s_1}^{f_0}$</td><td colspan="2">$= 5$</td></tr>
<tr><td>$b_{s_1}^{f_0}$</td><td>$\alpha^{f_0}(T_{s_0}^{\text{l.o.}f_0}) = 5 \cdot 26\frac{7}{8} + 25 = 159\frac{3}{8}$</td><td>$\alpha^{f_0}(T_{s_0}^{\text{l.o.}f_0}) = 5 \cdot 43\frac{1}{3} + 25 = 241\frac{2}{3}$</td></tr>
<tr><td>$=$</td><td>$= \gamma_{5,159\frac{3}{8}}$</td><td>$= \gamma_{5,241\frac{2}{3}}$</td></tr>
</table>

PBOO-AB:

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

PMOO-AB, ARB_MUX:

$$
\begin{aligned}
\beta_{\langle s_0,s_2\rangle}^{\text{l.o.}f_3} &= \beta_{R_{\langle s_0,s_2\rangle}^{\text{l.o.}f_3}, T_{\langle s_0,s_2\rangle}^{\text{l.o.}f_3}} \\
\text{with} & \\
R_{\langle s_0,s_2\rangle}^{\text{l.o.}f_3} &= \bigwedge_{i \in \{0,2\}} \left(R_{s_i} - r_{s_i}^{x(f_3)} \right) \\
&= (20-10) \wedge (20-5) \\
&= 10 \\
T_{\langle s_0,s_2\rangle}^{\text{l.o.}f_3} &= \sum_{i \in \{0,2\}} \left(T_{s_i} + \frac{b_{s_i}^{\bar{x}(f_3)} + r_{s_i}^{x(f_3)} \cdot T_{s_i}}{R_{\langle s_0,s_2\rangle}^{\text{l.o.}f_3}} \right) \\
&= 20 + \frac{25 + 5 \cdot 20}{10} + 20 + \frac{50 + 10 \cdot 20}{10} \\
&= 77\frac{1}{2}
\end{aligned}
$$

$$
\begin{aligned}
\alpha_{s_3}^{f_3} &= \alpha^{f_3} \oslash \beta_{\langle s_0,s_2\rangle}^{\text{l.o.}f_3} \\
&= \gamma_{5,25} \oslash \beta_{10,77\frac{1}{2}} \\
&= \gamma_{5,412\frac{1}{2}}
\end{aligned}
$$

arrivalBound$(s_3, \{f_0\}, \mathcal{G})$, $\mathcal{G} \in \mathcal{P}(\{f_0\}) = \alpha^{f_0}_{s_3}$		FIFO_MUX	ARB_MUX
$\alpha^{f_0}_{s_1}$		$= \gamma_{5,159\frac{3}{8}}$	$= \gamma_{5,241\frac{2}{3}}$
$\alpha^{x(f_0)}_{s_1} = \alpha^{f_2}_{s_2 s_1} = (\alpha^{f_2}_{s_2})^*$		$= \gamma_{5,137\frac{1}{2}}$	$= \gamma_{5,250}$
$\beta^{\text{l.o.}f_0}_{s_1} = \beta_{s_1} \otimes \alpha^{x(f_0)}_{s_1} = \beta_{R^{\text{l.o.}f_0}_{s_1}, T^{\text{l.o.}f_0}_{s_1}}$	$R^{\text{l.o.}f_0}_{s_1}$	$[R_{s_1} - r^{x(f_0)}_{s_1}]^+ = 15$	
	$T^{\text{l.o.}f_0}_{s_1}$	$\beta_{s_1} = b^{x(f_0)}_{s_1}$ $20 \cdot [t-20]^+ = 137\frac{1}{2}$ $t = 26\frac{7}{8}$	$\beta_{s_1} = \alpha^{x(f_0)}_{s_1}$ $20 \cdot [t-20]^+ = 5 \cdot t + 250$ $t = 43\frac{1}{3}$
	$=$	$= \beta_{15,26\frac{7}{8}}$	$= \beta_{15,43\frac{1}{3}}$
$\alpha^{f_0}_{s_3} = \alpha^{f_0}_{s_1} \oslash \beta^{\text{l.o.}f_0}_{s_1} = \gamma_{r^{f_0}_{s_3}, b^{f_0}_{s_3}}$	$r^{f_0}_{s_3}$	$= 5$	
	$b^{f_0}_{s_3}$	$\alpha^{f_0}_{s_1}(T^{\text{l.o.}f_0}_{s_1}) = 5 \cdot 26\frac{7}{8} + 159\frac{3}{8} = 293\frac{3}{4}$	$\alpha^{f_0}_{s_1}(T^{\text{l.o.}f_0}_{s_1}) = 5 \cdot 43\frac{1}{3} + 241\frac{2}{3} = 458\frac{1}{3}$
	$=$	$= \gamma_{5,293\frac{3}{4}}$	$= \gamma_{5,458\frac{1}{3}}$

arrivalBound$(s_0, \{f_3\}, \{f_1\})$ $=$ arrivalBound$(s_0, \{f_3\}, \{f_2\}) = \alpha^{f_3}_{s_0}$; arrivalBound$(s_1, \{f_2\}, \{f_1\})$ $=$ arrivalBound$(s_1, \{f_2\}, \{f_3\}) = \alpha^{f_2}_{s_1}$; arrivalBound$(s_3, \{f_1\}, \{f_3\}) = \alpha^{f_1}_{s_3}$		FIFO_MUX	ARB_MUX
$\alpha^{f_n}_{s_2} = \alpha^{f_n}$, $n \in \{1,2,3\}$		$= \gamma_{5,25}$	
$\alpha^{x(f_1)}_{s_2}$		$= \gamma_{5,25}$	
$\beta^{\text{l.o.}f_n}_{s_2} = \beta_{s_2} \ominus \alpha^{x(f_n)}_{s_2} = \beta_{R^{\text{l.o.}f_n}_{s_2}, T^{\text{l.o.}f_n}_{s_2}}$	$R^{\text{l.o.}f_n}_{s_2}$	$[R_{s_2} - r^{x(f_n)}_{s_2}]^+ = 15$	
	$T^{\text{l.o.}f_n}_{s_2}$	$\beta_{s_2} = b^{x(f_n)}_{s_2}$ $20 \cdot [t-20]^+ = 25$ $t = 21\frac{1}{4}$	$\beta_{s_2} = \alpha^{x(f_n)}_{s_2}$ $20 \cdot [t-20]^+ = 5 \cdot t + 25$ $t = 28\frac{1}{3}$
	$=$	$= \beta_{10,21\frac{1}{4}}$	$= \beta_{10,28\frac{1}{3}}$
$\alpha^{f_n}_{s_0} = \alpha^{f_n}_{s_2} \oslash \beta^{\text{l.o.}f_n}_{s_2} = \gamma_{r^{f_n}_{s_0}, b^{f_n}_{s_0}}$	$r^{f_n}_{s_0}$	$= 5$	
	$b^{f_n}_{s_0}$	$\alpha^{f_n}(T^{\text{l.o.}f_n}_{s_2}) = 5 \cdot 21\frac{1}{4} + 25 = 126\frac{1}{4}$	$\alpha^{f_n}(T^{\text{l.o.}f_n}_{s_2}) = 5 \cdot 28\frac{1}{3} + 25 = 166\frac{2}{3}$
	$=$	$= \gamma_{5,131\frac{1}{4}}$	$= \gamma_{5,166\frac{2}{3}}$

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

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

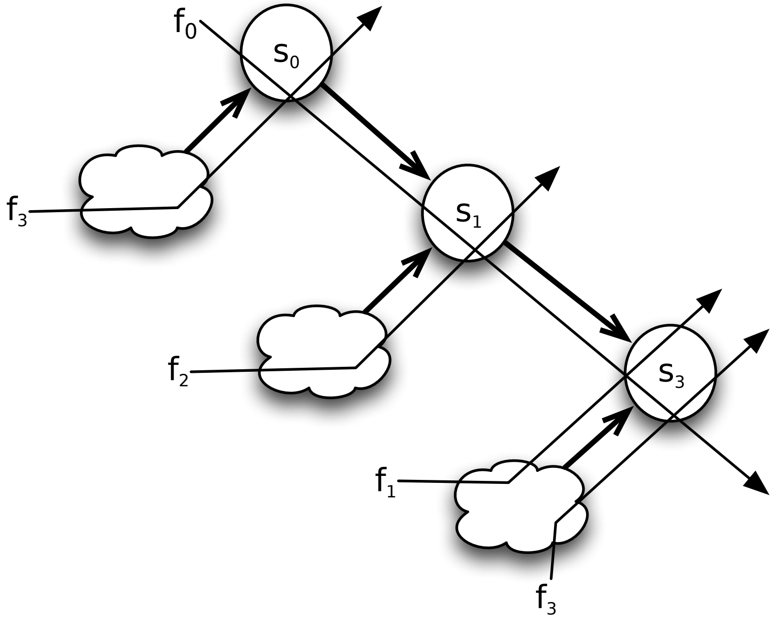
$\text{arrivalBound}(s_3, \{f_0\}, \{f_1\}) = \alpha^{f_0}_{s_3}$		FIFO_MUX	ARB_MUX
$\alpha^{f_0}_{s_1}$		$= \gamma_{5,157\frac{13}{16}}$	$= \gamma_{5,213\frac{8}{9}}$
$\alpha^{x(f_0)}_{s_1} = \alpha^{f_2}_{s_1}$		$= \gamma_{5,131\frac{1}{4}}$	$= \gamma_{5,166\frac{2}{3}}$
$\beta^{\text{l.o.}f_0}_{s_1} = \beta_{s_1} \ominus \alpha^{x(f_0)}_{s_1} = \beta_{R^{\text{l.o.}f_0}_{s_1}, T^{\text{l.o.}f_0}_{s_1}}$	$R^{\text{l.o.}f_0}_{s_1}$	$[R_{s_1} - r^{x(f_0)}_{s_1}]^+ = 15$	
	$T^{\text{l.o.}f_0}_{s_1}$	$\beta_{s_0} = b^{x(f_0)}_{s_0}$ $20 \cdot [t-20]^+ = 131\frac{1}{4}$ $t = 26\frac{9}{16}$	$\beta_{s_0} = \alpha^{x(f_0)}_{s_0}$ $20 \cdot [t-20]^+ = 5 \cdot t + 166\frac{2}{3}$ $t = 37\frac{7}{9}$
	$=$	$= \beta_{15,26\frac{9}{16}}$	$= \beta_{15,37\frac{7}{9}}$
$\alpha^{f_0}_{s_3} = \alpha^{f_0}_{s_1} \oslash \beta^{\text{l.o.}f_0}_{s_1} = \gamma_{r^{f_0}_{s_3}, b^{f_0}_{s_3}}$	$r^{f_0}_{s_3}$	$= 5$	
	$b^{f_0}_{s_3}$	$\alpha^{f_0}_{s_1}(T^{\text{l.o.}f_0}_{s_0}) = 5 \cdot 26\frac{9}{16} + 157\frac{13}{16} = 290\frac{5}{8}$	$\alpha^{f_0}_{s_1}(T^{\text{l.o.}f_0}_{s_0}) = 5 \cdot 37\frac{7}{9} + 213\frac{8}{9} = 402\frac{7}{9}$
	$=$	$= \gamma_{5,290\frac{5}{8}}$	$= \gamma_{5,402\frac{7}{9}}$

$\text{arrivalBound}(s_3, \{f_3\}, \{f_0\}) = \alpha^{f_3}_{s_3}$		FIFO_MUX	ARB_MUX
$\alpha^{f_3}_{s_0}$		$= \gamma_{5,137\frac{1}{2}}$	$= \gamma_{5,250}$
$\alpha^{x(f_3)}_{s_0}$		$= \gamma_{0,0}$	
$\beta^{\text{l.o.}f_3}_{s_0} = \beta_{s_0} = \beta_{R^{\text{l.o.}f_3}_{s_0}, T^{\text{l.o.}f_3}_{s_0}}$		$= \beta_{20,20}$	
$\alpha^{f_3}_{s_3} = \alpha^{f_3}_{s_0} \oslash \beta^{\text{l.o.}f_3}_{s_0} = \gamma_{r^{f_3}_{s_3}, b^{f_3}_{s_3}}$	$r^{f_3}_{s_3}$	$= 5$	
	$b^{f_3}_{s_3}$	$\alpha^{f_3}_{s_0}(T^{\text{l.o.}f_3}_{s_0}) = 5 \cdot 20 + 137\frac{1}{2} = 237\frac{1}{2}$	$\alpha^{f_3}_{s_0}(T^{\text{l.o.}f_3}_{s_0}) = 5 \cdot 20 + 250 = 350$
	$=$	$= \gamma_{5,237\frac{1}{2}}$	$= \gamma_{5,350}$

$\text{arrivalBound}(s_1, \{f_0\}, \{f_3\}) = \alpha^{f_0}_{s_1}$		FIFO_MUX	ARB_MUX
$\alpha^{f_0}_{s_0} = \alpha^{f_0}$		$= \gamma_{5,25}$	
$\alpha^{x(f_0)}_{s_0}$		$= \gamma_{0,0}$	
$\beta^{\text{l.o.}f_0}_{s_0} = \beta_{s_0} \ominus \alpha^{x(f_0)}_{s_0}$		$= \beta_{20,20}$	
$\alpha^{f_0}_{s_1} = \alpha^{f_0}_{s_0} \oslash \beta^{\text{l.o.}f_0}_{s_0} = \gamma_{r^{f_0}_{s_0 s_1}, b^{f_0}_{s_0 s_1}}$	$r^{f_0}_{s_0 s_1}$	$= 5$	
	$b^{f_0}_{s_0 s_1}$	$\alpha^{f_0}(T^{\text{l.o.}f_0}_{s_0}) = 5 \cdot 20 + 25 = 125$	
	$=$	$= \gamma_{5,125}$	

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

Flow f_0



Using the PBOO-ABs:

	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^{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^{f_0}	$\max\{B_{s_0}^{f_0}, B_{s_1}^{f_0}, B_{s_3}^{f_0}\} = 975$	$\max\{B_{s_0}^{f_0}, B_{s_1}^{f_0}, B_{s_3}^{f_0}\} = 1400$

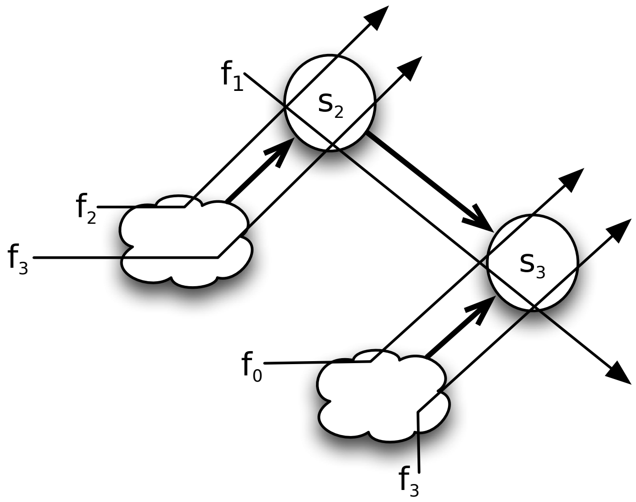
Using the PMOO-ABs:

TFA		ARB_MUX
s_0	$\alpha_{s_0} = \alpha_{s_0}^{f_0} + \alpha_{s_0}^{f_3}$	$= \gamma_{5,25} + \gamma_{5,250} = \gamma_{10,275}$
	$D_{s_0}^{f_0}$	$\begin{aligned} \beta_{s_0} &= \alpha_{s_0} \\ 20 \cdot [t-20]^+ &= 10 \cdot t + 275 \\ t &= 67\frac{1}{2} \end{aligned}$
	$B_{s_0}^{f_0}$	$\begin{aligned} \alpha_{s_0}(T_{s_0}) &= 10 \cdot 20 + 275 \\ &= 475 \end{aligned}$
s_1	$\alpha_{s_1} = \alpha_{s_1}^{f_0} + \alpha_{s_1}^{f_2}$	$= \gamma_{5,241\frac{2}{3}} + \gamma_{5,250} = \gamma_{10,491\frac{2}{3}}$
	$D_{s_1}^{f_0}$	$\begin{aligned} \beta_{s_1} &= \alpha_{s_1} \\ 20 \cdot [t-20]^+ &= 10 \cdot t + 491\frac{2}{3} \\ t &= 89\frac{1}{6} \end{aligned}$
	$B_{s_1}^{f_0}$	$\begin{aligned} \alpha_{s_1}(T_{s_1}) &= 10 \cdot 20 + 491\frac{2}{3} \\ &= 691\frac{2}{3} \end{aligned}$
s_3	$\alpha_{s_3} = \alpha_{s_3}^{f_0} + \alpha_{s_3}^{f_1} + \alpha_{s_3}^{f_3}$	$= \gamma_{5,458\frac{1}{3}} + \gamma_{5,250} + \gamma_{5,412\frac{1}{2}} = \gamma_{15,1120\frac{5}{6}}$
	$D_{s_3}^{f_0}$	$\begin{aligned} \beta_{s_3} &= \alpha_{s_3} \\ 20 \cdot [t-20]^+ &= 15 \cdot t + 1120\frac{5}{6} \\ t &= 304\frac{1}{6} \end{aligned}$
	$B_{s_3}^{f_0}$	$\begin{aligned} \alpha_{s_3}(T_{s_3}) &= 15 \cdot 20 + 1120\frac{5}{6} \\ &= 1420\frac{5}{6} \end{aligned}$
D^{f_0}		$D_{s_0}^{f_0} + D_{s_1}^{f_0} + D_{s_3}^{f_0} = 460\frac{5}{6}$
B^{f_0}		$\max\{B_{s_0}^{f_0}, B_{s_1}^{f_0}, B_{s_3}^{f_0}\} = 1420\frac{5}{6}$

SFA			FIFO_MUX	ARB_MUX
s_0	$\alpha_{s_0}^{x(f_0)} = \alpha_{s_0}^{f_3}$		$= \gamma_{5,137\frac{1}{2}}$	$= \gamma_{5,250}$
	$\beta_{s_0}^{\text{l.o.}f_0} = \beta_{s_0} \ominus \alpha_{s_0}^{x(f_3)}$		$= \beta_{15,26\frac{7}{8}}$	$= \beta_{15,43\frac{1}{3}}$
s_1	$\alpha_{s_1}^{x(f_0)} = \alpha_{s_1}^{f_1}$		$= \gamma_{5,137\frac{1}{2}}$	$= \gamma_{5,250}$
	$\beta_{s_1}^{\text{l.o.}f_0} = \beta_{s_1} \ominus \alpha_{s_1}^{x(f_0)}$		$= \beta_{15,26\frac{7}{8}}$	$= \beta_{15,43\frac{1}{3}}$
s_3	$\alpha_{s_3}^{x(f_0)} = \alpha_{s_3}^{f_2} + \alpha_{s_3}^{f_3}$		$= \gamma_{5,137\frac{1}{2}} + \gamma_{5,237\frac{1}{2}} = \gamma_{10,375}$	$= \gamma_{5,250} + \gamma_{5,350} = \gamma_{10,600}$
	$\beta_{s_3}^{\text{l.o.}f_0} = \beta_{s_3} \ominus \alpha_{s_3}^{x(f_0)} = \beta_{R_{s_3}^{\text{l.o.}f_0}, T_{s_3}^{\text{l.o.}f_0}}$	$R_{s_3}^{\text{l.o.}f_0}$	$[R_{s_3} - r_{s_3}^{x(f_0)}]^+ = 10$	
		$T_{s_3}^{\text{l.o.}f_0}$	$\begin{aligned} \beta_{s_3} &= b_{s_3}^{x(f_0)} \\ 20 \cdot [t-20]^+ &= 375 \\ t &= 38\frac{3}{4} \end{aligned}$	$\begin{aligned} \beta_{s_3} &= \alpha_{s_3}^{x(f_0)} \\ 20 \cdot [t-20]^+ &= 10 \cdot t + 600 \\ t &= 100 \end{aligned}$
		$=$	$= \beta_{10,38\frac{3}{4}}$	$= \beta_{10,100}$
$\beta_{\text{e2e}}^{\text{l.o.}f_0} = \beta_{R_{\text{e2e}}^{\text{l.o.}f_0}, T_{\text{e2e}}^{\text{l.o.}f_0}}$			$\bigotimes_{i=\{0,1,3\}} \beta_{s_i}^{\text{l.o.}f_0} = \beta_{10,92\frac{1}{2}}$	$\bigotimes_{i=\{0,1,3\}} \beta_{s_i}^{\text{l.o.}f_0} = \beta_{10,186\frac{2}{3}}$
D^{f_0}			$\begin{aligned} \beta_{\text{e2e}}^{\text{l.o.}f_0} &= b^{f_0} \\ 10 \cdot [t - 92\frac{1}{2}]^+ &= 25 \\ t &= 95 \end{aligned}$	$\begin{aligned} \beta_{\text{e2e}}^{\text{l.o.}f_0} &= b^{f_0} \\ 10 \cdot [t - 186\frac{2}{3}]^+ &= 25 \\ t &= 189\frac{1}{6} \end{aligned}$
B^{f_0}			$\begin{aligned} \alpha^{f_0}(T_{\text{e2e}}^{\text{l.o.}f_0}) &= 5 \cdot 92\frac{1}{2} + 25 \\ &= 487\frac{1}{2} \end{aligned}$	$\begin{aligned} \alpha^{f_0}(T_{\text{e2e}}^{\text{l.o.}f_0}) &= 5 \cdot 186\frac{2}{3} + 25 \\ &= 958\frac{1}{3} \end{aligned}$

PMOO		ARB_MUX
s_0	$\alpha_{s_0}^{\bar{x}(f_0)} = \alpha_{s_0}^{f_3}$	$= \gamma_{5,250}$
	$\alpha_{s_0}^{x(f_0)} = \alpha_{s_0}^{f_3}$	$= \gamma_{5,250}$
s_1	$\alpha_{s_1}^{\bar{x}(f_0)} = \alpha_{s_1}^{f_2}$	$= \gamma_{5,250}$
	$\alpha_{s_1}^{x(f_0)} = \alpha_{s_1}^{f_2}$	$= \gamma_{5,250}$
s_3	$\alpha_{s_3}^{\bar{x}(f_0)} = \alpha_{s_3}^{f_2} + \alpha_{s_3}^{f_3}$	$= \gamma_{5,250} + \gamma_{5,350} = \gamma_{10,600}$
	$\alpha_{s_3}^{x(f_0)} = \alpha_{s_3}^{f_2} + \alpha_{s_3}^{f_3}$	$= \gamma_{5,250} + \gamma_{5,350} = \gamma_{10,600}$
$\beta_{\text{e2e}}^{\text{l.o.}f_0} = \beta_{R_{\text{e2e}}^{\text{l.o.}f_0}, T_{\text{e2e}}^{\text{l.o.}f_0}}$	$R_{\text{e2e}}^{\text{l.o.}f_0} = \bigwedge_{i \in \{0,1,3\}} \left(R_{s_i} - r_{s_i}^{x(f_0)} \right)$	$\begin{aligned} &= (20-5) \wedge (20-5) \wedge (20-10) \\ &= 10 \end{aligned}$
	$T_{\text{e2e}}^{\text{l.o.}f_0} = \sum_{i \in \{0,1,3\}} \left(T_{s_i} + \frac{b_{s_i}^{\bar{x}(f_0)} + r_{s_i}^{x(f_0)} \cdot T_{s_i}}{R_{\text{e2e}}^{\text{l.o.}f_0}} \right)$	$\begin{aligned} &= 20 + \frac{250 + 5 \cdot 20}{10} + 20 + \frac{250 + 5 \cdot 20}{10} + 20 + \frac{250 + 10 \cdot 20}{10} \\ &= 60 + \frac{1500}{10} \\ &= 210 \end{aligned}$
	$=$	$= \beta_{10,210}$
D^{f_0}		$\begin{aligned} \beta_{\text{e2e}}^{\text{l.o.}f_0} &= b^{f_0} \\ 10 \cdot [t - 210]^+ &= 25 \\ t &= 212\frac{1}{2} \end{aligned}$
B^{f_0}		$\begin{aligned} \alpha^{f_0}(T_{\text{e2e}}^{\text{l.o.}f_0}) &= 5 \cdot 210 + 25 \\ &= 1075 \end{aligned}$

Flow f_1



Using the PBOO-ABs:

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

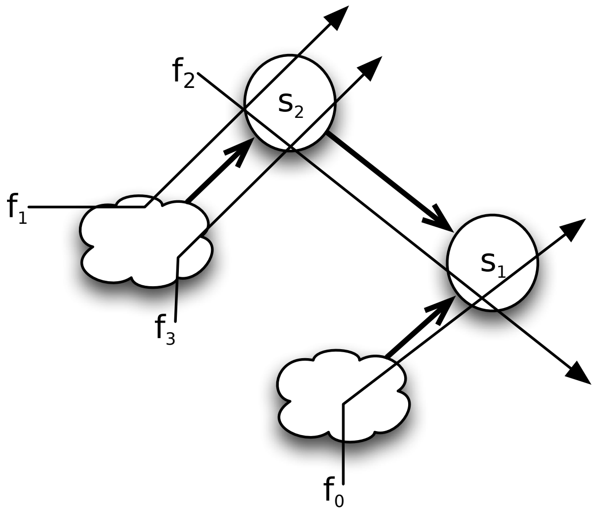
Using the PMOO-ABs:

	TFA	ARB_MUX
s_2	$\alpha_{s_2} = \alpha_{s_2}^{f_1} + \alpha_{s_2}^{f_2} + \alpha_{s_2}^{f_3}$	$= 3 \cdot \gamma_{5,25} = \gamma_{15,75}$
	$D_{s_2}^{f_1}$	$\beta_{s_2} = \alpha_{s_2}$ $20 \cdot [t-20]^+ = 15 \cdot t + 75$ $t = 95$
	$B_{s_2}^{f_1}$	$\alpha_{s_2}(T_{s_2}) = 15 \cdot 20 + 75$ $= 375$
s_3	$\alpha_{s_3} = \alpha_{s_3}^{f_0} + \alpha_{s_3}^{f_1} + \alpha_{s_3}^{f_3}$	$= \gamma_{5,250} + \gamma_{5,458\frac{1}{3}} + \gamma_{5,420\frac{1}{2}} = \gamma_{15,1120\frac{5}{6}}$
	$D_{s_3}^{f_1}$	$\beta_{s_3} = \alpha_{s_3}$ $20 \cdot [t-20]^+ = 15 \cdot t + 1120\frac{5}{6}$ $t = 304\frac{1}{6}$
	$B_{s_3}^{f_1}$	$\alpha_{s_3}(T_{s_3}) = 15 \cdot 20 + 1120\frac{5}{6}$ $= 1420\frac{5}{6}$
	D^{f_1}	$D_{s_2}^{f_1} + D_{s_3}^{f_1} = 399\frac{1}{6}$
	B^{f_1}	$\max\{B_{s_2}^{f_1}, B_{s_3}^{f_1}\} = 1420\frac{5}{6}$

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

PMOO		ARB_MUX
s_2	$\alpha_{s_2}^{\bar{x}(f_1)} = \alpha_{s_2}^{f_2} + \alpha_{s_2}^{f_3}$	$= 2 \cdot \gamma_{5,25} = \gamma_{10,50}$
	$\alpha_{s_2}^{x(f_1)} = \alpha_{s_2}^{f_2} + \alpha_{s_2}^{f_3}$	$= 2 \cdot \gamma_{5,25} = \gamma_{10,50}$
s_3	$\alpha_{s_3}^{\bar{x}(f_1)} = \alpha_{s_3}^{f_0} + \alpha_{s_3}^{f_3}$	$= \gamma_{5,402\frac{7}{9}} + \gamma_{5,308\frac{1}{3}} = \gamma_{10,711\frac{1}{9}}$
	$\alpha_{s_3}^{x(f_1)} = \alpha_{s_3}^{f_0} + \alpha_{s_3}^{f_3}$	$= \gamma_{5,402\frac{7}{9}} + \gamma_{5,308\frac{1}{3}} = \gamma_{10,711\frac{1}{9}}$
$\beta_{\mathrm{e2e}}^{\mathrm{l.o.}f_1} = \beta_{R_{\mathrm{e2e}}^{\mathrm{l.o.}f_1}, T_{\mathrm{e2e}}^{\mathrm{l.o.}f_1}}$	$R_{\mathrm{e2e}}^{\mathrm{l.o.}f_1} = \bigwedge_{i \in \{2,3\}} \left(R_{s_i} - r_{s_i}^{x(f_1)} \right)$	$= (20 - 10) \wedge (20 - 10)$ $= 10$
	$T_{\mathrm{e2e}}^{\mathrm{l.o.}f_1} = \sum_{i \in \{2,3\}} \left(T_{s_i} + \frac{b_{s_i}^{\bar{x}(f_1)} + r_{s_i}^{x(f_1)} \cdot T_{s_i}}{R_{\mathrm{e2e}}^{\mathrm{l.o.}f_1}} \right)$	$= 20 + \frac{50 + 10 \cdot 20}{10} + 20 + \frac{711\frac{1}{9} + 10 \cdot 20}{10}$ $= 40 + \frac{961\frac{1}{9}}{10}$ $= 156\frac{1}{9}$
	$=$	$= \beta_{10,156\frac{1}{9}}$
D^{f_1}		$\beta_{\mathrm{e2e}}^{\mathrm{l.o.}f_1} = b^{f_1}$ $10 \cdot [t - 156\frac{1}{9}]^+ = 25$ $t = 158\frac{11}{18}$
B^{f_1}		$\alpha^{f_1}(T_{\mathrm{e2e}}^{\mathrm{l.o.}f_1}) = 5 \cdot 156\frac{1}{9} + 25$ $= 805\frac{5}{9}$

Flow f_2

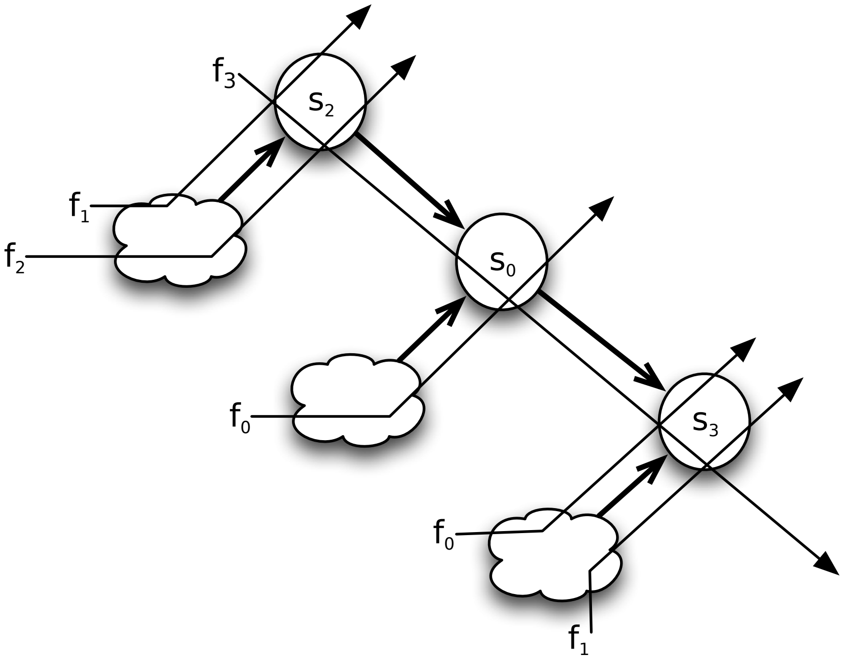


TFA		FIFO_MUX	ARB_MUX
s_2	$\alpha_{s_2} = \alpha_{s_2}^{f_2} + \alpha_{s_2}^{f_1} + \alpha_{s_2}^{f_3}$	$= 3 \cdot \gamma_{5,25} = \gamma_{15,75}$	
	$D_{s_2}^{f_2}$	$\beta_{s_2} = b_{s_2}$ $20 \cdot [t-20]^+ = 75$ $t = 23\frac{3}{4}$	$\beta_{s_2} = \alpha_{s_2}$ $20 \cdot [t-20]^+ = 15 \cdot t + 75$ $t = 95$
	$B_{s_2}^{f_2}$	$\alpha_{s_2}(T_{s_2}) = 15 \cdot 20 + 75$ $= 375$	
s_1	$\alpha_{s_1} = \alpha_{s_1}^{f_2} + \alpha_{s_1}^{f_0}$	$= \gamma_{5,137\frac{1}{2}} + \gamma_{5,159\frac{3}{8}} = \gamma_{10,296\frac{7}{8}}$	$= \gamma_{5,250} + \gamma_{5,241\frac{2}{3}} = \gamma_{10,491\frac{2}{3}}$
	$D_{s_1}^{f_2}$	$\beta_{s_1} = b_{s_1}$ $20 \cdot [t-20]^+ = 296\frac{7}{8}$ $t = 34\frac{27}{32}$	$\beta_{s_1} = \alpha_{s_1}$ $20 \cdot [t-20]^+ = 10 \cdot t + 491\frac{2}{3}$ $t = 89\frac{1}{6}$
	$B_{s_1}^{f_2}$	$\alpha_{s_1}(T_{s_1}) = 10 \cdot 20 + 296\frac{7}{8}$ $= 496\frac{7}{8}$	$\alpha_{s_1}(T_{s_1}) = 10 \cdot 20 + 491\frac{2}{3}$ $= 691\frac{2}{3}$
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	$\alpha_{s_2}^{x(f_2)} = \alpha_{s_2}^{f_1} + \alpha_{s_2}^{f_3}$		$= 2 \cdot \gamma_{5,25} = \gamma_{10,50}$	
	$\beta_{s_2}^{\mathrm{l.o.}f_2} = \beta_{s_2} \ominus \alpha_{s_2}^{x(f_2)}$		$= \beta_{10,22\frac{1}{2}}$	$= \beta_{10,45}$
s_1	$\alpha_{s_1}^{x(f_2)} = \alpha_{s_1}^{f_0}$		$= \gamma_{5,157\frac{13}{16}}$	$= \gamma_{5,213\frac{8}{9}}$
	$\beta_{s_1}^{\mathrm{l.o.}f_2} = \beta_{s_1} \ominus \alpha_{s_1}^{x(f_2)} = \beta_{R_{s_1}^{\mathrm{l.o.}f_2}, T_{s_1}^{\mathrm{l.o.}f_2}}$	$R_{s_1}^{\mathrm{l.o.}f_2}$	$[R_{s_2} - r_{s_2}^{x(f_2)}]^+ = 15$	
		$T_{s_1}^{\mathrm{l.o.}f_2}$	$\beta_{s_1} = b_{s_1}^{x(f_2)}$ $20 \cdot [t-20]^+ = 157\frac{13}{16}$ $t = 27\frac{57}{64}$	$\beta_{s_1} = \alpha_{s_1}^{x(f_2)}$ $20 \cdot [t-20]^+ = 5 \cdot t + 213\frac{8}{9}$ $t = 40\frac{25}{27}$
		$=$	$= \beta_{10,27\frac{57}{64}}$	$= \beta_{10,40\frac{25}{27}}$
	$\beta_{\mathrm{e2e}}^{\mathrm{l.o.}f_2} = \beta_{R_{\mathrm{e2e}}^{\mathrm{l.o.}f_2}, T_{\mathrm{e2e}}^{\mathrm{l.o.}f_2}}$		$\bigotimes_{i=1}^{2} \beta_{s_i}^{\mathrm{l.o.}f_2} = \beta_{10,50\frac{25}{64}}$	$\bigotimes_{i=1}^{2} \beta_{s_i}^{\mathrm{l.o.}f_2} = \beta_{10,85\frac{25}{27}}$
	D^{f_2}		$\beta_{\mathrm{e2e}}^{\mathrm{l.o.}f_2} = b^{f_2}$ $10 \cdot [t - 50\frac{25}{64}]^+ = 25$ $t = 52\frac{57}{64}$	$\beta_{\mathrm{e2e}}^{\mathrm{l.o.}f_2} = b^{f_2}$ $10 \cdot [t - 85\frac{25}{27}]^+ = 25$ $t = 88\frac{23}{54}$
	B^{f_2}		$\alpha^{f_2}(T_{\mathrm{e2e}}^{\mathrm{l.o.}f_2}) = 5 \cdot 50\frac{25}{64} + 25$ $= 276\frac{61}{64}$	$\alpha^{f_2}(T_{\mathrm{e2e}}^{\mathrm{l.o.}f_2}) = 5 \cdot 85\frac{25}{27} + 25$ $= 454\frac{17}{27}$

PMOO		ARB_MUX
s_2	$\alpha_{s_2}^{\bar{x}(f_2)} = \alpha_{s_2}^{f_1} + \alpha_{s_2}^{f_3}$	$= 2 \cdot \gamma_{5,25} = \gamma_{10,50}$
	$\alpha_{s_2}^{x(f_2)} = \alpha_{s_2}^{f_1} + \alpha_{s_2}^{f_3}$	$= 2 \cdot \gamma_{5,25} = \gamma_{10,50}$
s_1	$\alpha_{s_1}^{\bar{x}(f_2)} = \alpha_{s_1}^{f_0}$	$= \gamma_{5,213\frac{8}{9}}$
	$\alpha_{s_1}^{x(f_2)} = \alpha_{s_1}^{f_0}$	$= \gamma_{5,213\frac{8}{9}}$
$\beta_{\mathrm{e2e}}^{\mathrm{l.o.}f_2} = \beta_{R_{\mathrm{e2e}}^{\mathrm{l.o.}f_2}, T_{\mathrm{e2e}}^{\mathrm{l.o.}f_2}}$	$R_{\mathrm{e2e}}^{\mathrm{l.o.}f_2} = \bigwedge_{i \in \{2,1\}} \left(R_{s_i} - r_{s_i}^{x(f_2)} \right)$	$\begin{aligned} &= (20-10) \wedge (20-5) \\ &= 10 \end{aligned}$
	$T_{\mathrm{e2e}}^{\mathrm{l.o.}f_2} = \sum_{i \in \{2,1\}} \left(T_{s_i} + \frac{b_{s_i}^{\bar{x}(f_2)} + r_{s_i}^{x(f_2)} \cdot T_{s_i}}{R_{\mathrm{e2e}}^{\mathrm{l.o.}f_2}} \right)$	$\begin{aligned} &= 20 + \frac{50 + 10 \cdot 20}{10} + 20 + \frac{213\frac{8}{9} + 5 \cdot 20}{10} \\ &= 40 + \frac{563\frac{8}{9}}{10} \\ &= 96\frac{7}{18} \end{aligned}$
	$=$	$= \beta_{10,96\frac{7}{18}}$
D^{f_2}		$\begin{aligned} \beta_{\mathrm{e2e}}^{\mathrm{l.o.}f_2} &= b^{f_2} \\ 10 \cdot [t - 96\frac{7}{18}]^+ &= 25 \\ t &= 98\frac{8}{9} \end{aligned}$
B^{f_2}		$\begin{aligned} \alpha^{f_2}(T_{\mathrm{e2e}}^{\mathrm{l.o.}f_2}) &= 5 \cdot 96\frac{7}{18} + 25 \\ &= 506\frac{17}{18} \end{aligned}$

Flow f_3



Using the PBOO-ABs:

	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	$\alpha_{s_0} = \alpha_{s_0}^{f_0} + \alpha_{s_0}^{f_3}$	$= \gamma_{5,25} + \gamma_{5,137\frac{1}{2}} = \gamma_{10,162\frac{1}{2}}$	$= \gamma_{5,25} + \gamma_{5,250} = \gamma_{10,275}$
	$D_{s_0}^{f_3}$	$\beta_{s_0} = b_{s_0}$ $20 \cdot [t-20]^+ = 162\frac{1}{2}$ $t = 28\frac{1}{8}$	$\beta_{s_0} = \alpha_{s_0}$ $20 \cdot [t-20]^+ = 10 \cdot t + 275$ $t = 67\frac{1}{2}$
	$B_{s_0}^{f_3}$	$\alpha_{s_0}(T_{s_0}) = 10 \cdot 20 + 162\frac{1}{2}$ $= 262\frac{1}{2}$	$\alpha_{s_0}(T_{s_0}) = 10 \cdot 20 + 275$ $= 475$
s_3	$\alpha_{s_3} = \alpha_{s_3}^{f_0} + \alpha_{s_3}^{f_1} + \alpha_{s_3}^{f_3}$	$= \gamma_{5,293\frac{3}{4}} + \gamma_{5,137\frac{1}{2}} + \gamma_{5,243\frac{3}{4}} = \gamma_{15,675}$	$= \gamma_{5,458\frac{1}{3}} + \gamma_{5,250} + \gamma_{5,391\frac{2}{3}} = \gamma_{15,1100}$
	$D_{s_3}^{f_3}$	$\beta_{s_3} = b_{s_3}$ $20 \cdot [t-20]^+ = 675$ $t = 53\frac{3}{4}$	$\beta_{s_3} = \alpha_{s_3}$ $20 \cdot [t-20]^+ = 15 \cdot t + 1100$ $t = 300$
	$B_{s_3}^{f_3}$	$\alpha_{s_3}(T_{s_3}) = 15 \cdot 20 + 675$ $= 975$	$\alpha_{s_3}(T_{s_3}) = 15 \cdot 20 + 1100$ $= 1400$
	D^{f_3}	$D_{s_2}^{f_3} + D_{s_0}^{f_3} + D_{s_3}^{f_3} = 105\frac{5}{8}$	$D_{s_2}^{f_3} + D_{s_0}^{f_3} + D_{s_3}^{f_3} = 462\frac{1}{2}$
	B^{f_3}	$\max\{B_{s_2}^{f_3}, B_{s_0}^{f_3}, B_{s_3}^{f_3}\} = 975$	$\max\{B_{s_2}^{f_3}, B_{s_0}^{f_3}, B_{s_3}^{f_3}\} = 1400$

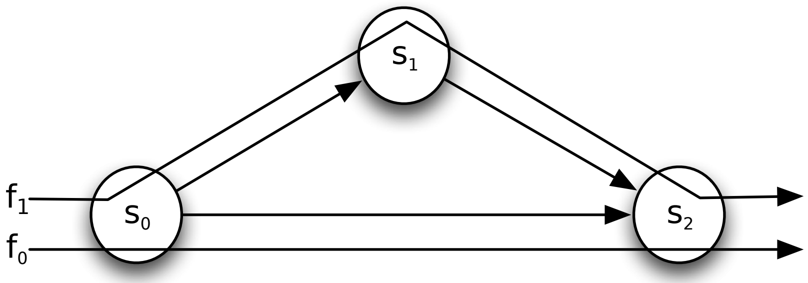
Using the PMOO-ABs:

	TFA	ARB_MUX
s_2	$\alpha_{s_2} = \alpha_{s_2}^{f_3} + \alpha_{s_2}^{f_1} + \alpha_{s_2}^{f_2}$	$= 3 \cdot \gamma_{5,25} = \gamma_{15,75}$
	$D_{s_2}^{f_3}$	$\beta_{s_2} = \alpha_{s_2}$ $20 \cdot [t-20]^+ = 15 \cdot t + 75$ $t = 95$
	$B_{s_2}^{f_3}$	$\alpha_{s_2}(T_{s_2}) = 15 \cdot 20 + 75$ $= 375$
s_0	$\alpha_{s_0} = \alpha_{s_0}^{f_0} + \alpha_{s_0}^{f_3}$	$= \gamma_{5,25} + \gamma_{5,250} = \gamma_{10,275}$
	$D_{s_0}^{f_3}$	$\beta_{s_0} = \alpha_{s_0}$ $20 \cdot [t-20]^+ = 10 \cdot t + 275$ $t = 67\frac{1}{2}$
	$B_{s_0}^{f_3}$	$\alpha_{s_0}(T_{s_0}) = 10 \cdot 20 + 275$ $= 475$
s_3	$\alpha_{s_3} = \alpha_{s_3}^{f_0} + \alpha_{s_3}^{f_1} + \alpha_{s_3}^{f_3}$	$= \gamma_{5,458\frac{1}{3}} + \gamma_{5,250} + \gamma_{5,412\frac{1}{2}} = \gamma_{15,1120\frac{5}{6}}$
	$D_{s_3}^{f_3}$	$\beta_{s_3} = \alpha_{s_3}$ $20 \cdot [t-20]^+ = 15 \cdot t + 1120\frac{5}{6}$ $t = 304\frac{1}{6}$
	$B_{s_3}^{f_3}$	$\alpha_{s_3}(T_{s_3}) = 15 \cdot 20 + 1120\frac{5}{6}$ $= 1420\frac{5}{6}$
D^{f_3}		$D_{s_2}^{f_3} + D_{s_0}^{f_3} + D_{s_3}^{f_3} = 466\frac{2}{3}$
B^{f_3}		$\max\{B_{s_2}^{f_3}, B_{s_0}^{f_3}, B_{s_3}^{f_3}\} = 1420\frac{5}{6}$

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

PMOO		ARB_MUX
s_2	$\alpha_{s_2}^{\bar{x}(f_3)} = \alpha_{s_2}^{f_1} + \alpha_{s_2}^{f_2}$	$= 2 \cdot \gamma_{5,25} = \gamma_{10,50}$
	$\alpha_{s_2}^{x(f_3)} = \alpha_{s_2}^{f_1} + \alpha_{s_2}^{f_2}$	$= 2 \cdot \gamma_{5,25} = \gamma_{10,50}$
s_0	$\alpha_{s_0}^{\bar{x}(f_3)} = \alpha_{s_0}^{f_0}$	$= \gamma_{5,25}$
	$\alpha_{s_0}^{x(f_3)} = \alpha_{s_0}^{f_0}$	$= \gamma_{5,25}$
s_3	$\alpha_{s_3}^{\bar{x}(f_3)} = \alpha_{s_3}^{f_0} + \alpha_{s_3}^{f_1}$	$= \gamma_{5,313\frac{8}{9}} + \gamma_{5,166\frac{2}{3}} = \gamma_{10,480\frac{5}{9}}$
	$\alpha_{s_3}^{x(f_3)} = \alpha_{s_3}^{f_0} + \alpha_{s_3}^{f_1}$	$= \gamma_{5,313\frac{8}{9}} + \gamma_{5,166\frac{2}{3}} = \gamma_{10,480\frac{5}{9}}$
$\beta_{\text{e2e}}^{\text{l.o.}f_3} = \beta_{R_{\text{e2e}}^{\text{l.o.}f_3}, T_{\text{e2e}}^{\text{l.o.}f_3}}$	$R_{\text{e2e}}^{\text{l.o.}f_3} = \bigwedge_{i\in\{2,0,3\}} \left(R_{s_i} - r_{s_i}^{x(f_3)}\right)$	$= (20-10) \wedge (20-5) \wedge (20-10)$ $= 10$
	$T_{\text{e2e}}^{\text{l.o.}f_3} = \sum_{i\in\{2,0,3\}} \left(T_{s_i} + \frac{b_{s_i}^{\bar{x}(f_3)} + r_{s_i}^{x(f_3)} \cdot T_{s_i}}{R_{\text{e2e}}^{\text{l.o.}f_3}}\right)$	$= 20 + \frac{50 + 10 \cdot 20}{10} + 20 + \frac{25 + 5 \cdot 20}{10} + 20 + \frac{480\frac{5}{9} + 10 \cdot 20}{10}$ $= 60 + \frac{1055\frac{5}{9}}{10}$ $= 165\frac{5}{9}$
	$=$	$= \beta_{10,165\frac{5}{9}}$
D^{f_3}		$\beta_{\text{e2e}}^{\text{l.o.}f_3} = b^{f_3}$ $10 \cdot [t - 165\frac{5}{9}]^+ = 25$ $t = 168\frac{1}{18}$
B^{f_3}		$\alpha^{f_3}(T_{\text{e2e}}^{\text{l.o.}f_3}) = 5 \cdot 165\frac{5}{9} + 25$ $= 852\frac{7}{9}$

FeedForward_1SC_2Flows_1AC_2Paths



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

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

<table>
<tr><th colspan="2">arrivalBound$(s_2, \{f_1\}, \mathcal{G})$, $\mathcal{G} = \mathcal{P}(\{f_1\}) = \alpha_{s_2}^{f_1}$</th><th>FIFO_MUX</th><th>ARB_MUX</th></tr>
<tr><td colspan="2">$\alpha_{s_1} = \alpha_{s_1}^{f_1}$</td><td>$= \gamma_{5,131\frac{1}{4}}$</td><td>$= \gamma_{5,166\frac{2}{3}}$</td></tr>
<tr><td colspan="2">$\alpha_{s_1}^{x(f_1)}$</td><td colspan="2">$= \gamma_{0,0}$</td></tr>
<tr><td colspan="2">$\beta_{s_1}^{\mathrm{l.o.}f_1} = \beta_{s_1} \ominus \alpha_{s_1}^{x(f_1)}$</td><td colspan="2">$=\beta_{20,20}$</td></tr>
<tr><td rowspan="3">$\alpha_{s_2}^{f_1} = \alpha_{s_1}^{f_1} \oslash \beta_{s_1}^{\mathrm{l.o.}f_1} = \alpha^{f_1} \oslash \beta_{s_1}^{\mathrm{l.o.}f_1}$</td><td>$r_{s_2}^{f_1}$</td><td colspan="2">$= 5$</td></tr>
<tr><td>$b_{s_2}^{f_1}$</td><td>$\alpha^{f_0}(T_{s_0}^{\mathrm{l.o.}f_0}) = 231\frac{1}{4}$</td><td>$\alpha^{f_0}(T_{s_0}^{\mathrm{l.o.}f_0}) = 266\frac{2}{3}$</td></tr>
<tr><td>$=$</td><td>$= \gamma_{5,231\frac{1}{4}}$</td><td>$= \gamma_{5,266\frac{2}{3}}$</td></tr>
</table>

<table>
<tr><th colspan="2">arrivalBound$(s_2, \{f_0\}, \{f_1\}) = \alpha_{s_2}^{f_0}$</th><th>FIFO_MUX</th><th>ARB_MUX</th></tr>
<tr><td colspan="2">$\alpha_{s_0}^{f_0}$</td><td colspan="2">$= \gamma_{5,25}$</td></tr>
<tr><td colspan="2">$\alpha_{s_0}^{x(f_0)}$</td><td colspan="2">$= \gamma_{0,0}$</td></tr>
<tr><td colspan="2">$\beta_{s_0}^{\mathrm{SFA\ l.o.}f_0} = \beta_{s_0} \ominus \alpha_{s_0}^{x(f_0)}$</td><td colspan="2">$=\beta_{20,20}$</td></tr>
<tr><td rowspan="3">$\alpha_{s_2}^{f_0} = \alpha^{f_0} \oslash \beta_{s_0}^{\mathrm{l.o.}f_0}$</td><td>$r_{s_2}^{f_0}$</td><td colspan="2">$= 5$</td></tr>
<tr><td>$b_{s_2}^{f_0}$</td><td colspan="2">$\alpha^{f_0}(T_{s_0}^{\mathrm{l.o.}f_0}) = 125$</td></tr>
<tr><td>$=$</td><td colspan="2">$= \gamma_{5,125}$</td></tr>
</table>

Flow f_0

TFA		FIFO_MUX	ARB_MUX
s_0	$\alpha_{s_0} = \alpha^{f_0}_{s_0} + \alpha^{f_1}_{s_0}$	$= \gamma_{10,50}$	
	$D^{f_0}_{s_0}$	$\beta_{s_0} = b_{s_0}$ $20 \cdot [t-20]^+ = 50$ $t = 22\frac{1}{2}$	$\beta_{s_0} = \alpha_{s_0}$ $20 \cdot [t-20]^+ = 10 \cdot t + 50$ $t = 45$
	$B^{f_0}_{s_0}$	$\alpha_{s_0}(T_{s_0}) = 10 \cdot 20 + 50$ $= 250$	
s_2	$\alpha_{s_2} = \alpha^{f_0}_{s_2} + \alpha^{f_1}_{s_2}$	$= \gamma_{10,362\frac{1}{2}}$	$= \gamma_{10,433\frac{1}{3}}$
	$D^{f_0}_{s_2}$	$\beta_{s_2} = b_{s_2}$ $20 \cdot [t-20]^+ = 362\frac{1}{2}$ $t = 38\frac{1}{8}$	$\beta_{s_2} = \alpha_{s_2}$ $20 \cdot [t-20]^+ = 10 \cdot t + 433\frac{1}{3}$ $t = 83\frac{1}{3}$
	$B^{f_0}_{s_2}$	$\alpha_{s_2}(T_{s_2}) = 10 \cdot 20 + 362\frac{1}{2}$ $= 562\frac{1}{2}$	$\alpha_{s_2}(T_{s_2}) = 10 \cdot 20 + 433\frac{1}{3}$ $= 633\frac{1}{3}$
D^{f_0}		$= 60\frac{5}{8}$	$= 128\frac{1}{3}$
B^{f_0}		$\max_{i=\{0,2\}} b^{f_0}_{s_i} = 562\frac{1}{2}$	$\max_{i=\{0,2\}} b^{f_0}_{s_i} = 633\frac{1}{3}$

SFA FIFO_MUX:

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

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

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

SFA ARB_MUX:

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

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

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

PMOO		ARB_MUX
s_0	$\alpha_{s_0}^{\bar{x}(f_0)}$	$= \gamma_{5,25}$
	$\alpha_{s_0}^{x(f_0)}$	$= \gamma_{5,25}$
s_2	$\alpha_{s_2}^{\bar{x}(f_0)}$	$= \gamma_{5,266\frac{2}{3}}$
	$\alpha_{s_2}^{x(f_0)}$	$= \gamma_{5,266\frac{2}{3}}$
$\beta_{\text{e2e}}^{\text{l.o.}f_0} = \beta_{R_{\text{e2e}}^{\text{l.o.}f_0},T_{\text{e2e}}^{\text{l.o.}f_0}}$	$R_{\text{e2e}}^{\text{l.o.}f_0} = \bigwedge_{i\in\{0,2\}} \left(R_{s_i} - r_{s_i}^{x(f_0)}\right)$	$= (20-5) \wedge (20-5)$ $= 15$
	$T_{\text{e2e}}^{\text{l.o.}f_0} = \sum_{i\in\{0,2\}} \left(T_{s_i} + \frac{b_{s_i}^{\bar{x}(f_0)} + r_{s_i}^{x(f_0)} \cdot T_{s_i}}{R_{\text{e2e}}^{\text{l.o.}f_0}}\right)$	$= 20 + \frac{25+5\cdot 20}{15} + 20 + \frac{266\frac{2}{3} + +5\cdot 20}{15}$ $= 40 + \frac{491\frac{2}{3}}{15}$ $= 72\frac{7}{9}$
	$=$	$= \beta_{15,72\frac{7}{9}}$
D^{f_0}		$\beta_{\text{e2e}}^{\text{l.o.}f_0} = b^{f_0}$ $15 \cdot [t - 72\frac{7}{9}]^+ = 25$ $t = 74\frac{4}{9}$
B^{f_0}		$\alpha^{f_0}(T_{\text{e2e}}^{\text{l.o.}f_0}) = 5 \cdot 72\frac{7}{9} + 25$ $= 388\frac{8}{9}$

Flow f_1

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

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

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

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

SFA ARB_MUX:

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

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

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

PMOO		ARB_MUX
s_0	$\alpha_{s_0}^{\bar{x}(f_1)}$	$= \gamma_{5,25}$
	$\alpha_{s_0}^{x(f_1)}$	$= \gamma_{5,25}$
s_1	$\alpha_{s_0}^{\bar{x}(f_1)}$	$= \gamma_{0,0}$
	$\alpha_{s_0}^{x(f_1)}$	$= \gamma_{0,0}$
s_2	$\alpha_{s_2}^{\bar{x}(f_1)}$	$= \gamma_{5,125}$
	$\alpha_{s_2}^{x(f_1)}$	$= \gamma_{5,125}$
$\beta_{\text{e2e}}^{\text{l.o.}f_1} = \beta_{R_{\text{e2e}}^{\text{l.o.}f_1}, T_{\text{e2e}}^{\text{l.o.}f_1}}$	$R_{\text{e2e}}^{\text{l.o.}f_1} = \bigwedge_{i \in \{0,1,2\}} \left(R_{s_i} - r_{s_i}^{x(f_1)} \right)$	$\begin{aligned} &= (20-5) \wedge (20-0) \wedge (20-5) \\ &= 15 \end{aligned}$
	$T_{\text{e2e}}^{\text{l.o.}f_3} = \sum_{i \in \{0,1,2\}} \left(T_{s_i} + \frac{b_{s_i}^{\bar{x}(f_1)} + r_{s_i}^{x(f_1)} \cdot T_{s_i}}{R_{\text{e2e}}^{\text{l.o.}f_1}} \right)$	$\begin{aligned} &= 20 + \frac{25+5\cdot 20}{15} + 20 + \frac{0+0\cdot 20}{15} + 20 + \frac{25+5\cdot 20}{15} \\ &= 60 + \frac{350}{15} \\ &= 83\frac{1}{3} \end{aligned}$
	$=$	$= \beta_{15,86\frac{1}{9}}$
D^{f_1}		$\begin{aligned} \beta_{\text{e2e}}^{\text{l.o.}f_1} &= b^{f_1} \\ 15 \cdot [t - 83\frac{1}{3}]^+ &= 25 \\ t &= 85 \end{aligned}$
B^{f_1}		$\begin{aligned} \alpha^{f_1}(T_{\text{e2e}}^{\text{l.o.}f_1}) &= 5 \cdot 83\frac{1}{3} + 25 \\ &= 441\frac{2}{3} \end{aligned}$

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.