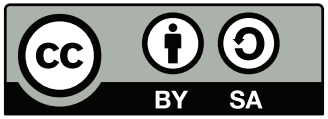
Network Calculus Tests – Single Server Network Configurations

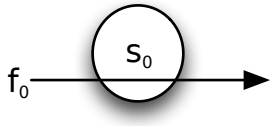


General Information

- The network calculus analyses documented in this paper were created for the purpose of functional testing the Disco Deterministic Network Calculator (DiscoDNC)[1] – an open-source deterministic network calculus tool developed by the *distributed computer system* / *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 nomenclature used in this document is detailed in NetworkCalculus_Nomenclature.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.

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

Single_1Flow



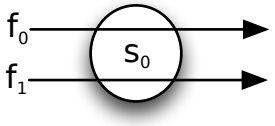
- $\beta_{s_0} = \beta_{R_{s_0},T_{s_0}} = \beta_{10,10}$
- $\mathcal{F} = \{f_0\}$
- $\alpha^{f_0} = \gamma_{r^{f_0},b^{f_0}} = \gamma_{5,25}$

TFA		FIFO_MUX	ARB_MUX
s_0	$\alpha_{s_0} = \alpha^{f_0}$	$= \gamma_{5,25}$	
	D^{f_0}	$\beta_{s_0} = b_{s_o}$ $10 \cdot [t-10]^+ = 25$ $t = 12\frac{1}{2}$	FIFO per micro flow $\beta_{s_0} = b_{s_o}$ $10 \cdot [t-10]^+ = 25$ $t = 12\frac{1}{2}$
	B^{f_0}	$\alpha_{s_0}(T_{s_0}) = 5 \cdot 10 + 25$ $= 75$	

SFA		FIFO_MUX	ARB_MUX
s_0	$\alpha_{s_0}^{xf_0}$	$= \gamma_{0,0}$	
	$\beta_{\text{e2e}}^{\text{l.o.}f_0} = [\beta_{s_0} - \alpha_{s_0}^{xf_0}]^+ = \beta_{R_{\text{e2e}}^{\text{l.o.}f_0},T_{\text{e2e}}^{\text{l.o.}f_0}} = \beta_{s_0}$	$= \beta_{10,10}$	
	D^{f_0}	$\beta_{\text{e2e}}^{\text{l.o.}f_0} = b^{f_0}$ $10 \cdot [t-10]^+ = 25$ $t = 12\frac{1}{2}$	
	B^{f_0}	$\alpha^{f_0}(T_{\text{e2e}}^{\text{l.o.}f_0}) = 5 \cdot 10 + 25$ $= 75$	

PMOO		ARB_MUX
s_0	$\alpha_{s_0}^{x'f_0}$	$= \gamma_{0,0}$
	$\alpha_{s_0}^{xf_0}$	$= \gamma_{0,0}$
$\beta_{\text{e2e}}^{\text{l.o.}f_0} = \beta_{R_{\text{e2e}}^{\text{l.o.}f_0}, T_{\text{e2e}}^{\text{l.o.}f_0}}$	$R_{\text{e2e}}^{\text{l.o.}f_0} = R_{s_0} - r_{s_0}^{xf_0}$	$= 10 - 5$ $= 10$
	$T_{\text{e2e}}^{\text{l.o.}f_0} = T_{s_0} + \frac{b_{s_0}^{x'f_0} + r_{s_0}^{xf_0} \cdot T_{s_0}}{R_{\text{e2e}}^{\text{l.o.}f_0}}$	$= 10 + \frac{0 + 0 \cdot 10}{10}$ $= 10$
	$=$	$= \beta_{10,10}$
D^{f_0}		$\beta_{\text{e2e}}^{\text{l.o.}f_0} = b^{f_0}$ $10 \cdot [t - 10]^+ = 25$ $t = 12\frac{1}{2}$
B^{f_0}		$\alpha^{f_0}(T_{\text{e2e}}^{\text{l.o.}f_0}) = 5 \cdot 10 + 25$ $= 75$

Single_2Flows_1AC



- $\beta_{s_0} = \beta_{R_{s_0},T_{s_0}} = \beta_{10,10}$
- $\mathcal{F} = \{f_0, f_1\}$
- $\alpha^{f_0} = \alpha^{f_1} = \gamma_{r^{f_i},b^{f_i}} = \gamma_{5,25}$, $i \in \{0,1\}$

Flows f_i, $i \in \{0,1\}$

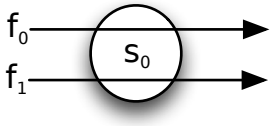
TFA results will be equal for all flows as they share the same path of servers.

<table>
<tr><th colspan="2">TFA</th><th>FIFO_MUX</th><th>ARB_MUX</th></tr>
<tr><td rowspan="3">s_0</td><td>$\alpha_{s_0} = \alpha^{f_0} + \alpha^{f_1}$</td><td colspan="2">$= \gamma_{10,50}$</td></tr>
<tr><td>D^{f_i}</td><td>$\beta_{s_0} = b_{s_0}$
$10 \cdot [t-10]^+ = 50$
$t = 15$</td><td>$\beta_{s_0} = \alpha_{s_0}$
$10 \cdot [t-10]^+ = 10 \cdot t + 50$
$0 \cdot t = 150$
$\Rightarrow D^{f_i} = \infty$</td></tr>
<tr><td>B^{f_i}</td><td colspan="2">$\alpha_{s_0}(T_{s_0}) = 10 \cdot 10 + 50$
$= 150$</td></tr>
</table>

SFA			FIFO_MUX	ARB_MUX
s_0	$\alpha_{s_0}^{xf_i} = \alpha^{f_i}$		$= \gamma_{5,25}$	
	$\beta_{s_0}^{\text{l.o.}f_i} = \beta_{s_0} \ominus \alpha_{s_0}^{xf_i} = \beta_{R_{s_0}^{\text{l.o.}f_i}, T_{s_0}^{\text{l.o.}f_i}}$	$R_{s_0}^{\text{l.o.}f_i}$	$[\, R_{s_0} - r_{s_0}^{xf_i}]^+ = \quad 5$	
		$T_{s_0}^{\text{l.o.}f_i}$	$\beta_{s_0} = \quad b_{s_0}^{xf_i}$ $10 \cdot [t-10]^+ = \quad 25$ $t = \quad 12\frac{1}{2}$	$\beta_{s_0} = \quad \alpha_{s_0}^{xf_i}$ $10 \cdot [t-10]^+ = \quad 5 \cdot t + 25$ $t = \quad 25$
		$=$	$=\beta_{5,12\frac{1}{2}}$	$=\beta_{5,25}$
	$\beta_{\text{e2e}}^{\text{l.o.}f_i} = \beta_{s_0}^{\text{l.o.}f_i}$		$= \beta_{5,12\frac{1}{2}}$	$= \beta_{5,25}$
	D^{f_i}		$\beta_{\text{e2e}}^{\text{l.o.}f_i} = \quad b^{f_i}$ $5 \cdot [t - 12\frac{1}{2}]^+ = \quad 25$ $t = \quad 17\frac{1}{2}$	$\beta_{\text{e2e}}^{\text{l.o.}f_i} = \quad b^{f_i}$ $5 \cdot [t-25]^+ = \quad 25$ $t = \quad 30$
	B^{f_i}		$\alpha^{f_i}(T_{\text{e2e}}^{\text{l.o.}f_i}) = \quad 5 \cdot 12\frac{1}{2} + 25$ $= \quad 87\frac{1}{2}$	$\alpha^{f_i}(T_{\text{e2e}}^{\text{l.o.}f_i}) = \quad 5 \cdot 25 + 25$ $= \quad 150$

PMOO		ARB_MUX
s_0	$\alpha_{s_0}^{x'f_i} = \alpha^{f_i}$	$= \gamma_{5,25}$
	$\alpha_{s_0}^{xf_i} = \alpha^{f_i}$	$= \gamma_{5,25}$
$\beta_{\text{e2e}}^{\text{l.o.}f_i} = \beta_{R_{\text{e2e}}^{\text{l.o.}f_i}, T_{\text{e2e}}^{\text{l.o.}f_i}}$	$R_{\text{e2e}}^{\text{l.o.}f_i} = R_{s_0} - r_{s_0}^{xf_i}$	$= \quad 10 - 5$ $= \quad 5$
	$T_{\text{e2e}}^{\text{l.o.}f_i} = T_{s_0} + \frac{b_{s_0}^{x'f_i} + r_{s_0}^{xf_i} \cdot T_{s_0}}{R_{\text{e2e}}^{\text{l.o.}f_0}}$	$= \quad 10 + \frac{25 + 5 \cdot 10}{5}$ $= \quad 25$
	$=$	$= \beta_{5,25}$
D^{f_i}		$\beta_{\text{e2e}}^{\text{l.o.}f_i} = \quad b^{f_i}$ $5 \cdot [t - 25]^+ = \quad 25$ $t = \quad 30$
B^{f_i}		$\alpha^{f_i}(T_{\text{e2e}}^{\text{l.o.}f_i}) = \quad 5 \cdot 25 + 25$ $= \quad 150$

Single_2Flow_2ACs



- $\beta_{s_0} = \beta_{R_{s_0},T_{s_0}} = \beta_{10,10}$
- $\mathcal{F} = \{f_0, f_1\}$
- $\alpha^{f_0} = \gamma_{r^{f_0},b^{f_0}} = \gamma_{4,10}$
- $\alpha^{f_1} = \gamma_{r^{f_1},b^{f_1}} = \gamma_{5,25}$

Flows f_i, $i \in \{0,1\}$

TFA results will be equal for all flows as they share the same path of servers.

TFA		FIFO_MUX	ARB_MUX
s_0	$\alpha_{s_0} = \alpha^{f_0} + \alpha^{f_1}$	$= \gamma_{9,35}$	
	D^{f_i}	$\beta_{s_0} = b_{s_0}$ $10 \cdot [t-10]^+ = 35$ $t = 13\frac{1}{2}$	$\beta_{s_0} = \alpha_{s_0}$ $10 \cdot [t-10]^+ = 9 \cdot t + 35$ $t = 135$
	B^{f_i}	$\alpha_{s_0}(T_{s_0}) = 9 \cdot 10 + 35$ $= 125$	

Flow f_0

SFA			FIFO_MUX	ARB_MUX
s_0	$\alpha_{s_0}^{xf_0} = \alpha^{f_1}$		$= \gamma_{5,25}$	
	$\beta_{s_0}^{\text{l.o.}f_0} = \beta_{s_0} \ominus \alpha_{s_0}^{xf_0} = \beta_{R_{s_0}^{\text{l.o.}f_0}, T_{s_0}^{\text{l.o.}f_0}}$	$R_{s_0}^{\text{l.o.}f_0}$	$[R_{s_0} - r_{s_0}^{xf_0}]^+ = 5$	
		$T_{s_0}^{\text{l.o.}f_0}$	$\beta_{s_0} = b_{s_0}^{xf_0}$ $10 \cdot [t-10]^+ = 25$ $t = 12\frac{1}{2}$	$\beta_{s_0} = \alpha_{s_0}^{xf_0}$ $10 \cdot [t-10]^+ = 5 \cdot t + 25$ $t = 25$
		$=$	$=\beta_{5,12\frac{1}{2}}$	$=\beta_{5,25}$
	$\beta_{\text{e2e}}^{\text{l.o.}f_0} = \beta_{R_{\text{e2e}}^{\text{l.o.}f_0}, T_{\text{e2e}}^{\text{l.o.}f_0}} = \beta_{s_0}^{\text{l.o.}f_0}$		$=\beta_{5,12\frac{1}{2}}$	$= \beta_{5,25}$
	D^{f_0}		$\beta_{\text{e2e}}^{\text{l.o.}f_0} = b^{f_0}$ $5 \cdot [t-12\frac{1}{2}]^+ = 10$ $t = 14\frac{1}{2}$	$\beta_{\text{e2e}}^{\text{l.o.}f_0} = b^{f_0}$ $5 \cdot [t-25]^+ = 10$ $t = 27$
	B^{f_0}		$\alpha^{f_0}(T_{\text{e2e}}^{\text{l.o.}f_0}) = 4 \cdot 12\frac{1}{2} + 10$ $= 60$	$\alpha^{f_0}(T_{\text{e2e}}^{\text{l.o.}f_0}) = 4 \cdot 25 + 10$ $= 110$

PMOO		ARB_MUX
s_0	$\alpha_{s_0}^{x'f_0} = \alpha^{f_1}$	$= \gamma_{5,25}$
	$\alpha_{s_0}^{xf_0} = \alpha^{f_1}$	$= \gamma_{5,25}$
$\beta_{s_0}^{\text{l.o.}f_0} = \beta_{R_{s_0}^{\text{l.o.}f_0}, T_{s_0}^{\text{l.o.}f_0}}$	$R_{\text{e2e}}^{\text{l.o.}f_0} = R_{s_0} - r_{s_0}^{xf_0}$	$= 10 - 5$ $= 5$
	$T_{\text{e2e}}^{\text{l.o.}f_0} = T_{s_0} + \frac{b_{s_0}^{x'f_0} + r_{s_0}^{xf_0} \cdot T_{s_0}}{R_{\text{e2e}}^{\text{l.o.}f_0}}$	$= 10 + \frac{25 + 5 \cdot 10}{5}$ $= 25$
	$=$	$= \beta_{5,25}$
D^{f_0}		$\beta_{\text{e2e}}^{\text{l.o.}f_0} = b^{f_0}$ $5 \cdot [t - 25]^+ = 10$ $t = 27$
B^{f_0}		$\alpha^{f_0}(T_{\text{e2e}}^{\text{l.o.}f_0}) = 4 \cdot 25 + 10$ $= 110$

Flow f_1

SFA			FIFO_MUX	ARB_MUX
s_0	$\alpha_{s_0}^{xf_1} = \alpha^{f_0}$		$= \gamma_{4,10}$	
	$\beta_{s_0}^{\text{l.o.}f_1} = \beta_{s_0} \ominus \alpha_{s_0}^{xf_1} = \beta_{R_{s_0}^{\text{l.o.}f_1}, T_{s_0}^{\text{l.o.}f_1}}$	$R_{s_0}^{\text{l.o.}f_1}$	$[R_{s_0} - r_{s_0}^{xf_1}]^+ = 6$	
		$T_{s_0}^{\text{l.o.}f_1}$	$\beta_{s_0} = b_{s_0}^{xf_1}$ $10 \cdot [t-10]^+ = 10$ $t = 11$	$\beta_{s_0} = \alpha_{s_0}^{xf_1}$ $10 \cdot [t-10]^+ = 4 \cdot t + 10$ $t = 18\frac{1}{3}$
		$=$	$=\beta_{6,11}$	$=\beta_{6,18\frac{1}{3}}$
	$\beta_{\text{e2e}}^{\text{l.o.}f_1} = \beta_{R_{\text{e2e}}^{\text{l.o.}f_1}, T_{\text{e2e}}^{\text{l.o.}f_1}} = \beta_{s_0}^{\text{l.o.}f_1}$		$=\beta_{6,11}$	$= \beta_{6,18\frac{1}{3}}$
	D^{f_1}		$\beta_{\text{e2e}}^{\text{l.o.}f_1} = b^{f_1}$ $6 \cdot [t-11]^+ = 25$ $t = 15\frac{1}{6}$	$\beta_{\text{e2e}}^{\text{l.o.}f_1} = b^{f_1}$ $6 \cdot [t-18\frac{1}{3}]^+ = 25$ $t = 22\frac{1}{2}$
	B^{f_1}		$\alpha^{f_1}(T_{\text{e2e}}^{\text{l.o.}f_1}) = 5 \cdot 11 + 25$ $= 80$	$\alpha^{f_1}(T_{\text{e2e}}^{\text{l.o.}f_1}) = 5 \cdot 18\frac{1}{3} + 25$ $= 116\frac{2}{3}$

PMOO		ARB_MUX
s_0	$\alpha_{s_0}^{x'f_1} = \alpha^{f_0}$	$= \gamma_{4,10}$
	$\alpha_{s_0}^{xf_1} = \alpha^{f_0}$	$= \gamma_{4,10}$
$\beta_{s_0}^{\text{l.o.}f_1} = \beta_{R_{s_0}^{\text{l.o.}f_1}, T_{s_0}^{\text{l.o.}f_1}}$	$R_{\text{e2e}}^{\text{l.o.}f_1} = R_{s_0} - r_{s_0}^{xf_1}$	$= 10 - 4$ $= 6$
	$T_{\text{e2e}}^{\text{l.o.}f_1} = T_{s_0} + \frac{b_{s_0}^{x'f_1} + r_{s_0}^{xf_1} \cdot T_{s_0}}{R_{\text{e2e}}^{\text{l.o.}f_0}}$	$= 10 + \frac{10 + 4 \cdot 10}{6}$ $= 18\frac{1}{3}$
	$=$	$= \beta_{6,18\frac{1}{3}}$
D^{f_1}		$\beta_{\text{e2e}}^{\text{l.o.}f_1} = b^{f_1}$ $6 \cdot [t - 18\frac{1}{3}]^+ = 25$ $t = 22\frac{1}{2}$
B^{f_1}		$\alpha^{f_1}(T_{\text{e2e}}^{\text{l.o.}f_1}) = 5 \cdot 18\frac{1}{3} + 25$ $= 116\frac{2}{3}$

Single_10Flow_10ACs

- $\beta_{s_0} = \beta_{R_{s_0},T_{s_0}} = \beta_{10,10}$
- $\mathcal{F} = \{f_0, f_1, f_2, f_3, f_4, f_5, f_6, f_7, f_8, f_9\}$
- for $i = 0$ to 9: $\alpha^{f_i} = \gamma_{r^{f_i},b^{f_i}} = \gamma_{\frac{1}{10}\cdot(i+1),1\cdot(i+1)}$

Flows f_i, $i \in \{0, \ldots, 9\}$

TFA results will be equal for all flows as they share the same path of servers.

<table>
<tr><th colspan="2">TFA</th><th>FIFO_MUX</th><th>ARB_MUX</th></tr>
<tr><td rowspan="3">s_0</td><td>$\alpha_{s_0} = \sum_{i=0}^{9} \alpha_i$</td><td colspan="2">$= \gamma_{5\frac{1}{2},55}$</td></tr>
<tr><td>D^{f_i}</td><td>$\beta_{s_0} = b_{s_0}$
$10 \cdot [t-10]^+ = 55$
$t = 15\frac{1}{2}$</td><td>$\beta_{s_0} = \alpha_{s_0}$
$10 \cdot [t-10]^+ = 5\frac{1}{2} \cdot t + 55$
$t = 34\frac{4}{9}$</td></tr>
<tr><td>B^{f_i}</td><td colspan="2">$\alpha_{s_0}(T_{s_0}) = 5\frac{1}{2} \cdot 10 + 55$
$= 110$</td></tr>
</table>

Flow f_0

SFA			FIFO_MUX	ARB_MUX
s_0	$\alpha_{s_0}^{xf_0} = \sum_{i=1}^{9} \alpha^{f_i} = \gamma_{r_{s_0}^{xf_0}, b_{s_0}^{xf_0}}$	$r_{s_0}^{xf_0}$	$\sum_{i=1}^{9} r^{f_i} = 5\frac{2}{5}$	
		$b_{s_0}^{xf_0}$	$\sum_{i=1}^{9} b^{f_i} = 54$	
		$=$	$=\gamma_{5\frac{2}{5},54}$	
	$\beta_{s_0}^{\text{l.o.}f_0} = R_{s_0} \ominus \alpha_{s_0}^{xf_0} = \beta_{R_{s_0}^{\text{l.o.}f_0}, T_{s_0}^{\text{l.o.}f_0}}$	$R_{s_0}^{\text{l.o.}f_0}$	$[R_{s_0} - r_{s_0}^{xf_0}]^+ = 4\frac{3}{5}$	
		$T_{s_0}^{\text{l.o.}f_0}$	$\beta_{s_0} = b_{s_0}^{xf_0}$ $10 \cdot [t-10]^+ = 54$ $t = 15\frac{2}{5}$	$\beta_{s_0} = \alpha_{s_0}^{xf_0}$ $10 \cdot [t-10]^+ = 5\frac{2}{5} \cdot t + 54$ $t = 33\frac{11}{23}$
		$=$	$=\beta_{4\frac{3}{5}, 15\frac{2}{5}}$	$=\beta_{4\frac{3}{5}, 33\frac{11}{23}}$
	$\beta_{\text{e2e}}^{\text{l.o.}f_0} = \beta_{R_{\text{e2e}}^{\text{l.o.}f_0}, T_{\text{e2e}}^{\text{l.o.}f_0}} = \beta_{s_0}^{\text{l.o.}f_0}$		$=\beta_{4\frac{3}{5}, 15\frac{2}{5}}$	$= \beta_{4\frac{3}{5}, 33\frac{11}{23}}$
	D^{f_0}		$\beta_{\text{e2e}}^{\text{l.o.}f_0} = b^{f_0}$ $4\frac{3}{5} \cdot [t - 15\frac{2}{5}]^+ = 1$ $t = 15\frac{71}{115}$	$\beta_{\text{e2e}}^{\text{l.o.}f_0} = b^{f_0}$ $4\frac{3}{5} \cdot [t - 33\frac{11}{23}]^+ = 1$ $t = 33\frac{16}{23}$
	B^{f_0}		$\alpha^{f_0}(T_{\text{e2e}}^{\text{l.o.}f_0}) = \frac{1}{10} \cdot 15\frac{2}{5} + 1$ $= 2\frac{27}{50}$	$\alpha^{f_0}(T_{\text{e2e}}^{\text{l.o.}f_0}) = \frac{1}{10} \cdot 33\frac{11}{23} + 1$ $= 4\frac{8}{23}$

PMOO		ARB_MUX
s_0	$\alpha_{s_0}^{x'f_0} = \sum_{i=1}^{9} \alpha^{f_i} = \gamma_{r_{s_0}^{xf_0}, b_{s_0}^{xf_0}}$	$=\gamma_{5\frac{2}{5},54}$
	$\alpha_{s_0}^{xf_0} = \sum_{i=1}^{9} \alpha^{f_i} = \gamma_{r_{s_0}^{xf_0}, b_{s_0}^{xf_0}}$	$=\gamma_{5\frac{2}{5},54}$
$\beta_{s_0}^{\text{l.o.}f_0} = \beta_{R_{s_0}^{\text{l.o.}f_0}, T_{s_0}^{\text{l.o.}f_0}}$	$R_{\text{e2e}}^{\text{l.o.}f_0} = R_{s_0} - r_{s_0}^{xf_0}$	$= 10 - 5\frac{2}{5}$ $= 4\frac{3}{5}$
	$T_{\text{e2e}}^{\text{l.o.}f_0} = T_{s_0} + \frac{b_{s_0}^{x'f_0} + r_{s_0}^{xf_0} \cdot T_{s_0}}{R_{\text{e2e}}^{\text{l.o.}f_0}}$	$= 10 + \frac{54 + 5\frac{2}{5} \cdot 10}{4\frac{3}{5}}$ $= 10 + \frac{108}{4\frac{3}{5}}$ $= 33\frac{11}{23}$
	$=$	$= \beta_{4\frac{3}{5}, 33\frac{11}{23}}$
D^{f_0}		$\beta_{\text{e2e}}^{\text{l.o.}f_0} = b^{f_0}$ $4\frac{3}{5} \cdot [t - 33\frac{11}{23}]^+ = 1$ $t = 33\frac{16}{23}$
B^{f_0}		$\alpha^{f_0}(T_{\text{e2e}}^{\text{l.o.}f_0}) = \frac{1}{10} \cdot 33\frac{11}{23} + 1$ $= 4\frac{8}{23}$

Flow f_6

SFA			FIFO_MUX	ARB_MUX
s_0	$\alpha^{xf_6} = \sum_{i=0}^{5} \alpha^{f_i} + \sum_{i=7}^{9} \alpha^{f_i} = \gamma_{r_{s_0}^{xf_6}, b_{s_0}^{xf_6}}$	$r_{s_0}^{xf_6}$	$(\sum_{i=0}^{9} r^{f_i}) - r^{f_6} = 4\frac{4}{5}$	
		$b_{s_0}^{xf_6}$	$(\sum_{i=0}^{9} b^{f_i}) - b^{f_6} = 48$	
		$=$	$=\gamma_{4\frac{4}{5},48}$	
	$\beta_{s_0}^{\text{l.o.}f_6} = \beta_{s_0} \ominus \alpha_{s_0}^{xf_6} = \beta_{R_{s_0}^{\text{l.o.}f_6}, T_{s_0}^{\text{l.o.}f_6}}$	$R_{s_0}^{\text{l.o.}f_6}$	$[R_{s_0} - r_{s_0}^{xf_6}]^+ = 5\frac{1}{5}$	
		$T_{s_0}^{\text{l.o.}f_6}$	$\beta_{s_0} = b_{s_0}^{xf_6}$ $10 \cdot [t-10]^+ = 48$ $t = 14\frac{4}{5}$	$\beta_{s_0} = \alpha_{s_0}^{xf_6}$ $10 \cdot [t-10]^+ = 4\frac{4}{5} \cdot t + 48$ $t = 28\frac{6}{13}$
		$=$	$=\beta_{5\frac{1}{5}, 14\frac{4}{5}}$	$=\beta_{5\frac{1}{5}, 28\frac{6}{13}}$
	$\beta_{\text{e2e}}^{\text{l.o.}f_6} = \beta_{R_{\text{e2e}}^{\text{l.o.}f_6}, T_{\text{e2e}}^{\text{l.o.}f_6}}$		$=\beta_{5\frac{1}{5}, 14\frac{4}{5}}$	$= \beta_{5\frac{1}{5}, 28\frac{6}{13}} = \beta_{s_0}^{\text{l.o.}f_6}$
	D^{f_6}		$\beta_{\text{e2e}}^{\text{l.o.}f_6} = b^{f_6}$ $5\frac{1}{5} \cdot [t - 14\frac{4}{5}]^+ = 7$ $t = 16\frac{19}{130}$	$\beta_{\text{e2e}}^{\text{l.o.}f_6} = b^{f_6}$ $5\frac{1}{5} \cdot [t - 28\frac{6}{13}]^+ = 7$ $t = 29\frac{21}{26}$
	B^{f_6}		$\alpha^{f_6}(T_{\text{e2e}}^{\text{l.o.}f_6}) = \frac{7}{10} \cdot 14\frac{4}{5} + 7$ $= 17\frac{9}{25}$	$\alpha^{f_6}(T_{\text{e2e}}^{\text{l.o.}f_6}) = \frac{7}{10} \cdot 28\frac{6}{13} + 7$ $= 26\frac{12}{13}$

PMOO		ARB_MUX
s_0	$\alpha^{x'f_6} = \sum_{i=0}^{5} \alpha^{f_i} + \sum_{i=7}^{9} \alpha^{f_i} = \gamma_{r_{s_0}^{xf_6}, b_{s_0}^{xf_6}}$	$=\gamma_{4\frac{4}{5},48}$
	$\alpha^{xf_6} = \sum_{i=0}^{5} \alpha^{f_i} + \sum_{i=7}^{9} \alpha^{f_i} = \gamma_{r_{s_0}^{xf_6}, b_{s_0}^{xf_6}}$	$=\gamma_{4\frac{4}{5},48}$
$\beta_{s_0}^{\text{l.o.}f_6} = \beta_{R_{s_0}^{\text{l.o.}f_6}, T_{s_0}^{\text{l.o.}f_6}}$	$R_{\text{e2e}}^{\text{l.o.}f_6} = R_{s_0} - r_{s_0}^{xf_6}$	$= \quad 10 - 4\frac{4}{5}$ $= \quad 5\frac{1}{5}$
	$T_{\text{e2e}}^{\text{l.o.}f_6} = T_{s_0} + \frac{b_{s_0}^{x'f_6} + r_{s_0}^{xf_6} \cdot T_{s_0}}{R_{\text{e2e}}^{\text{l.o.}f_0}}$	$= \quad 10 + \frac{48 + 4\frac{4}{5} \cdot 10}{5\frac{1}{5}}$ $= \quad 10 + \frac{96}{5\frac{1}{5}}$ $= \quad 28\frac{6}{13}$
	$=$	$=\beta_{5\frac{1}{5}, 28\frac{6}{13}}$
D^{f_6}		$\beta_{\text{e2e}}^{\text{l.o.}f_6} = \quad b^{f_6}$ $5\frac{1}{5} \cdot [t - 28\frac{6}{13}]^+ = \quad 7$ $t = \quad 29\frac{21}{26}$
B^{f_6}		$\alpha^{f_6}(T_{\text{e2e}}^{\text{l.o.}f_6}) = \quad \frac{7}{10} \cdot 28\frac{6}{13} + 7$ $= \quad 26\frac{12}{13}$