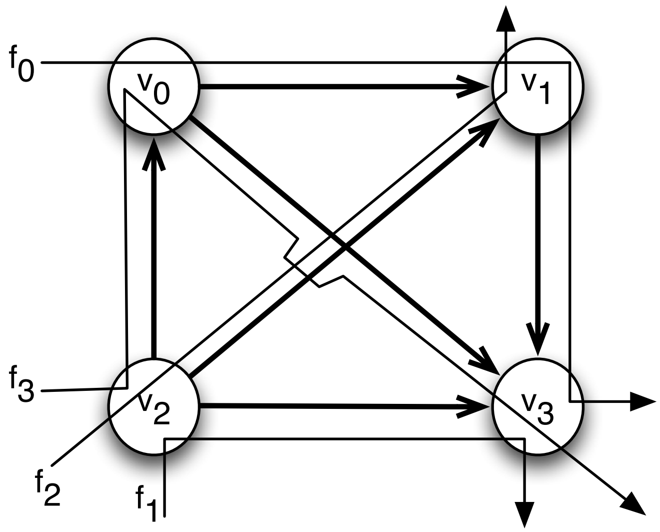
Nomenclature

$$\text{variable}^{\text{semantic\_quantifier}}_{\text{local\_quantifier}}$$

- variables:
  - α: arrival curve
  - β: service curve, rate latency curve
  - γ: affine curve
  - b: burst
  - B: backlog bound
  - D: delay bound
  - T: latency
  - r, R: rate
- semantic quantifiers for arrival curves and related variables:
  - f_n: arrival curve of flow f_n
  - $f_n + \ldots + f_m$: sum of arrival curves of flow $f_n, \ldots, f_m$
  - xf_n: arrival curve of all crossflows of flow f_n (needs local quantification)
  - $*$: output bound (needs local quantification)
  - no quantifier given: sum of all arrivals (needs local quantification)
- semantic quantifiers for service curves and related vaiables:
  - l.o.f_n: left-over for flow f_n (needs local restriction as well)
    - SFA l.o.f_n: SFA left-over for flow f_n (needs local restriction)
  - no quantifier given: unaltered variable (needs local quantification)
- local quantifiers:
  - v_n: at vertex v_n
  - $v_n v_m$: on sub-path (see semantic quantifier) between v_n and v_m:
    - α: data arrivals on link from v_n to v_m, i.e., there must be a direct link
    - β: convolved service curve on the path from v_n to v_m (both included)
  - e2e: end-to-end (only in conjunction with β as well as it's rate R and latency T)

Examples



- $\alpha^{f_0} = \alpha^{f_0}_{v_0} = \alpha^{xf_3}_{v_0}$
- $\alpha^{f_2}_{v_1} = \alpha^{f_2}_{v_2 v_1} = (\alpha^{f_2}_{v_2})^* = (\alpha^{f_2})^*$
- $\alpha^{xf_2}_{v_1} = \alpha^{f_0}_{v_0 v_1} = (\alpha^{f_0}_{v_0})^* = (\alpha^{f_0})^*$
- $\alpha^{xf_1}_{v_2} = \alpha^{f_2+f_3} = \alpha^{f_2} + \alpha^{f_3}$
- $\alpha_{v_2} = \alpha^{f_1}_{v_2} + \alpha^{f_2}_{v_2} + \alpha^{f_3}_{v_2} = \sum_{i=1}^{3} \alpha^{f_i}_{v_2} = \sum_{i=1}^{3} \alpha^{f_i} = \alpha^{f_1+f_2}_{v_2} + \alpha^{f_3} = \alpha^{f_1+xf_1}$
- $\alpha_{v_2} = \alpha^{f_i} + \alpha^{xf_i}_{v_2},\ i \in \{1,2,3\}$
- $\alpha_{v_3} = \alpha_{v_0 v_3} + \alpha_{v_1 v_3} + \alpha_{v_2 v_3} = \alpha^{f_3}_{v_0 v_3} + \alpha^{f_0}_{v_1 v_3} + \alpha^{f_1}_{v_2 v_3} = (\alpha^{f_3}_{v_0})^* + (\alpha^{f_0}_{v_1})^* + (\alpha^{f_1}_{v_2})^*$
- $\alpha^{xf_0}_{v_3} = (\alpha^{xf_0}_{v_0})^* + (\alpha_{v_0} - \alpha^{xf_1}_{v_0})^* = ((\alpha^{f_3})^*)^* + (\alpha^{f_1})^*$
- $\alpha^{xf_3}_{v_3} = \alpha_{v_3} - \alpha^{f_3}_{v_3} = \left(\alpha^{f_3}_{v_0 v_3} + \alpha^{f_0}_{v_1 v_3} + \alpha^{f_1}_{v_2 v_3}\right) - \alpha^{f_3}_{v_0 v_3} = \alpha^{f_0}_{v_1 v_3} + \alpha^{f_1}_{v_2 v_3}$

- $\beta^{\mathrm{l.o.}f_0}_{v_0} = [\beta_{v_0} - \alpha^{xf_0}_{v_0}]^+ = [\beta_{v_0} - (\alpha^{f_3}_{v_2})^*]^+ = [\beta_{v_0} - (\alpha^{f_3} \oslash \beta^{\mathrm{l.o.}f_3}_{v_2})]^+$
- $\beta^{\mathrm{l.o.}f_0}_{\mathrm{e2e}} = \beta^{\mathrm{l.o.}f_0}_{v_0} \otimes \beta^{\mathrm{l.o.}f_0}_{v_1} \otimes \beta^{\mathrm{l.o.}f_0}_{v_3} = [\beta_{v_0} - \alpha^{xf_0}_{v_0}]^+ \otimes [\beta_{v_2} - \alpha^{xf_0}_{v_2}]^+ \otimes [\beta_{v_3} - \alpha^{xf_0}_{v_3}]^+$
- $\beta^{\mathrm{l.o.}f_0}_{\mathrm{e2e}} = \beta^{\mathrm{l.o.}f_0}_{v_0 v_3} = \beta^{\mathrm{l.o.}f_0}_{v_0 v_1} \otimes \beta^{\mathrm{l.o.}f_0}_{v_3}$
- $\beta_{v_0 v_1} = \beta_{v_0} \otimes \beta_{v_1} = \bigotimes_{i=0}^{1} \beta_i$
- $\beta_{v_2 v_3} = \beta_{v_2} \otimes \beta_{v_3} = \bigotimes_{i=2}^{3} \beta_i$
- $\beta^{f_3}_{v_2 v_3} = \beta_{v_2} \otimes \beta_{v_0} \otimes \beta_{v_3} = \bigotimes_{i=\{2,0,3\}} \beta_i$