

## **es\_realizer\_object\_directory<sup>0,22</sup>**

ABS: Realizer **es\_realizer**

STM: es\_realizer\_wf

ABS: · **Rnone**

STM: Rnone\_wf

ABS: *left*  $\oplus$  *right* **Rplus**

STM: Rplus\_wf

ABS: @loc *x* initially *v:T* **Rinit**

STM: Rinit\_wf

ABS: @loc only events in *L* change *x:T* **Rframe**

STM: Rframe\_wf

ABS: only events in *L* send on *lnk* with *tag* **Rsframe**

STM: Rsframe\_wf

ABS: @loc effect *knd(v:T) x := f State(ds) v* **Reffect**

STM: Reffect\_wf

ABS: sends *knd(v:T)* on *l:tagged(g,State(ds),v):dt* **Rsend**

STM: Rsend\_wf

ABS: @loc precondition for *a(v:T):P State(ds) v* **Rpre**

STM: Rpre\_wf

ABS: @loc: *k* writes only members of *L* **Raframe**

STM: Raframe\_wf

ABS: @loc: *k* sends only on links in *L* **Rbframe**

STM: Rbframe\_wf

ABS: @loc: only members of *L* read *x* **Rrframe**

STM: Rrframe\_wf

ABS: case *x<sub>1</sub>* of  
    **Rnone** => *none*

```

Rplus(left,right)=>rec1,rec2.plus(left,right;rec1;rec2)
Rinit(loc,T,x,v)=> init(loc;T;x;v)
Rframe(loc,T,x,L)=> frame(loc;T;x;L)
Rsframe(lnk,tag,L)=> sframe(lnk;tag;L)
Reffect(loc,ds,knd,T,x,f)=> effect(loc;ds;knd;T;x;f)
Rsends(ds,knd,T,l,dt,g)=> sends(ds;knd;T;l;dt;g)
Rpre(loc,ds,a,T,P)=> pre(loc;ds;a;T;P)
Raframe(loc,k,L)=> aframe(loc;k;L)
Rbframe(loc,k,L)=> bframe(loc;k;L)
Rrframe(loc,x,L)=> rframe(loc;x;L)

```

**es\_realizer\_ind**

STM: es\_realizer\_ind\_wf

STM: es\_realizer-induction

ABS: es\_realizer\_ind\_Rnone{es\_realizer\_ind\_Rnone\_compseq\_tag\_def:ObjectId}

```

(v11,v12,v13.rframe(v11;v12;v13);
 v21,v22,v23.bframe(v21;v22;v23);
 v31,v32,v33.aframe(v31;v32;v33);
 v41,v42,v43,v44,v45.pre(v41;v42;v43;v44;v45);
 v51,v52,v53,v54,v55,v56.sends(v51;v52;v53;v54;v55;v56);
 v61,v62,v63,v64,v65,v66.effect(v61;v62;v63;v64;v65;v66);
 v71,v72,v73.sframe(v71;v72;v73);
 v81,v82,v83,v84.frame(v81;v82;v83;v84);
 v91,v92,v93,v94.init(v91;v92;v93;v94);
 v101,v102,v103,v104.plus(v101;v102;v103;v104);
 none)

```

**es\_realizer\_ind\_Rnone\_compseq\_tag\_def**

ABS: es\_realizer\_ind\_Rplus{es\_realizer\_ind\_Rplus\_compseq\_tag\_def:ObjectId}

```

(v11,v12,v13.rframe(v11;v12;v13);
 v21,v22,v23.bframe(v21;v22;v23);
 v31,v32,v33.aframe(v31;v32;v33);
 v41,v42,v43,v44,v45.pre(v41;v42;v43;v44;v45);
 v51,v52,v53,v54,v55,v56.sends(v51;v52;v53;v54;v55;v56);
 v61,v62,v63,v64,v65,v66.effect(v61;v62;v63;v64;v65;v66);
 v71,v72,v73.sframe(v71;v72;v73);
 v81,v82,v83,v84.frame(v81;v82;v83;v84);
 v91,v92,v93,v94.init(v91;v92;v93;v94);
 v101,v102,v103,v104.plus(v101;v102;v103;v104);
 none;

```

*right*;  
*left*)

### es\_realizer\_ind\_Rplus\_compseq\_tag\_def

ABS: es\_realizer\_ind\_Rinit{es\_realizer\_ind\_Rinit\_compseq\_tag\_def:ObjectId}  
(*v*<sub>11</sub>,*v*<sub>12</sub>,*v*<sub>13</sub>.*rframe*(*v*<sub>11</sub>;*v*<sub>12</sub>;*v*<sub>13</sub>);  
*v*<sub>21</sub>,*v*<sub>22</sub>,*v*<sub>23</sub>.*bframe*(*v*<sub>21</sub>;*v*<sub>22</sub>;*v*<sub>23</sub>);  
*v*<sub>31</sub>,*v*<sub>32</sub>,*v*<sub>33</sub>.*aframe*(*v*<sub>31</sub>;*v*<sub>32</sub>;*v*<sub>33</sub>);  
*v*<sub>41</sub>,*v*<sub>42</sub>,*v*<sub>43</sub>,*v*<sub>44</sub>,*v*<sub>45</sub>.*pre*(*v*<sub>41</sub>;*v*<sub>42</sub>;*v*<sub>43</sub>;*v*<sub>44</sub>;*v*<sub>45</sub>);  
*v*<sub>51</sub>,*v*<sub>52</sub>,*v*<sub>53</sub>,*v*<sub>54</sub>,*v*<sub>55</sub>,*v*<sub>56</sub>.*sends*(*v*<sub>51</sub>;*v*<sub>52</sub>;*v*<sub>53</sub>;*v*<sub>54</sub>;*v*<sub>55</sub>;*v*<sub>56</sub>);  
*v*<sub>61</sub>,*v*<sub>62</sub>,*v*<sub>63</sub>,*v*<sub>64</sub>,*v*<sub>65</sub>,*v*<sub>66</sub>.*effect*(*v*<sub>61</sub>;*v*<sub>62</sub>;*v*<sub>63</sub>;*v*<sub>64</sub>;*v*<sub>65</sub>;*v*<sub>66</sub>);  
*v*<sub>71</sub>,*v*<sub>72</sub>,*v*<sub>73</sub>.*sframe*(*v*<sub>71</sub>;*v*<sub>72</sub>;*v*<sub>73</sub>);  
*v*<sub>81</sub>,*v*<sub>82</sub>,*v*<sub>83</sub>,*v*<sub>84</sub>.*frame*(*v*<sub>81</sub>;*v*<sub>82</sub>;*v*<sub>83</sub>;*v*<sub>84</sub>);  
*v*<sub>91</sub>,*v*<sub>92</sub>,*v*<sub>93</sub>,*v*<sub>94</sub>.*init*(*v*<sub>91</sub>;*v*<sub>92</sub>;*v*<sub>93</sub>;*v*<sub>94</sub>);  
*v*<sub>101</sub>,*v*<sub>102</sub>,*v*<sub>103</sub>,*v*<sub>104</sub>.*plus*(*v*<sub>101</sub>;*v*<sub>102</sub>;*v*<sub>103</sub>;*v*<sub>104</sub>);  
*none*;  
*v*;  
*x*;  
*T*;  
*loc*)

### es\_realizer\_ind\_Rinit\_compseq\_tag\_def

ABS: es\_realizer\_ind\_Rframe{es\_realizer\_ind\_Rframe\_compseq\_tag\_def:ObjectId}  
(*v*<sub>11</sub>,*v*<sub>12</sub>,*v*<sub>13</sub>.*rframe*(*v*<sub>11</sub>;*v*<sub>12</sub>;*v*<sub>13</sub>);  
*v*<sub>21</sub>,*v*<sub>22</sub>,*v*<sub>23</sub>.*bframe*(*v*<sub>21</sub>;*v*<sub>22</sub>;*v*<sub>23</sub>);  
*v*<sub>31</sub>,*v*<sub>32</sub>,*v*<sub>33</sub>.*aframe*(*v*<sub>31</sub>;*v*<sub>32</sub>;*v*<sub>33</sub>);  
*v*<sub>41</sub>,*v*<sub>42</sub>,*v*<sub>43</sub>,*v*<sub>44</sub>,*v*<sub>45</sub>.*pre*(*v*<sub>41</sub>;*v*<sub>42</sub>;*v*<sub>43</sub>;*v*<sub>44</sub>;*v*<sub>45</sub>);  
*v*<sub>51</sub>,*v*<sub>52</sub>,*v*<sub>53</sub>,*v*<sub>54</sub>,*v*<sub>55</sub>,*v*<sub>56</sub>.*sends*(*v*<sub>51</sub>;*v*<sub>52</sub>;*v*<sub>53</sub>;*v*<sub>54</sub>;*v*<sub>55</sub>;*v*<sub>56</sub>);  
*v*<sub>61</sub>,*v*<sub>62</sub>,*v*<sub>63</sub>,*v*<sub>64</sub>,*v*<sub>65</sub>,*v*<sub>66</sub>.*effect*(*v*<sub>61</sub>;*v*<sub>62</sub>;*v*<sub>63</sub>;*v*<sub>64</sub>;*v*<sub>65</sub>;*v*<sub>66</sub>);  
*v*<sub>71</sub>,*v*<sub>72</sub>,*v*<sub>73</sub>.*sframe*(*v*<sub>71</sub>;*v*<sub>72</sub>;*v*<sub>73</sub>);  
*v*<sub>81</sub>,*v*<sub>82</sub>,*v*<sub>83</sub>,*v*<sub>84</sub>.*frame*(*v*<sub>81</sub>;*v*<sub>82</sub>;*v*<sub>83</sub>;*v*<sub>84</sub>);  
*v*<sub>91</sub>,*v*<sub>92</sub>,*v*<sub>93</sub>,*v*<sub>94</sub>.*init*(*v*<sub>91</sub>;*v*<sub>92</sub>;*v*<sub>93</sub>;*v*<sub>94</sub>);  
*v*<sub>101</sub>,*v*<sub>102</sub>,*v*<sub>103</sub>,*v*<sub>104</sub>.*plus*(*v*<sub>101</sub>;*v*<sub>102</sub>;*v*<sub>103</sub>;*v*<sub>104</sub>);  
*none*;  
*L*;  
*x*;  
*T*;  
*loc*)

### es\_realizer\_ind\_Rframe\_compseq\_tag\_def

ABS: `es_realizer_ind_Rsframe`{`es_realizer_ind_Rsframe_compseq_tag_def:ObjectId`}

```

(v11,v12,v13.rframe(v11;v12;v13);
v21,v22,v23.bframe(v21;v22;v23);
v31,v32,v33.iframe(v31;v32;v33);
v41,v42,v43,v44,v45.pre(v41;v42;v43;v44;v45);
v51,v52,v53,v54,v55,v56.sends(v51;v52;v53;v54;v55;v56);
v61,v62,v63,v64,v65,v66.effect(v61;v62;v63;v64;v65;v66);
v71,v72,v73.sframe(v71;v72;v73);
v81,v82,v83,v84.frame(v81;v82;v83;v84);
v91,v92,v93,v94.init(v91;v92;v93;v94);
v101,v102,v103,v104.plus(v101;v102;v103;v104);
none;
L;
tag;
lnk)

```

### `es_realizer_ind_Rsframe_compseq_tag_def`

ABS: `es_realizer_ind_Reffect`{`es_realizer_ind_Reffect_compseq_tag_def:ObjectId`}

```

(v11,v12,v13.rframe(v11;v12;v13);
v21,v22,v23.bframe(v21;v22;v23);
v31,v32,v33.iframe(v31;v32;v33);
v41,v42,v43,v44,v45.pre(v41;v42;v43;v44;v45);
v51,v52,v53,v54,v55,v56.sends(v51;v52;v53;v54;v55;v56);
v61,v62,v63,v64,v65,v66.effect(v61;v62;v63;v64;v65;v66);
v71,v72,v73.sframe(v71;v72;v73);
v81,v82,v83,v84.frame(v81;v82;v83;v84);
v91,v92,v93,v94.init(v91;v92;v93;v94);
v101,v102,v103,v104.plus(v101;v102;v103;v104);
none;
f;
x;
T;
knd;
ds;
loc)

```

### `es_realizer_ind_Reffect_compseq_tag_def`

ABS: `es_realizer_ind_Rsends`{`es_realizer_ind_Rsends_compseq_tag_def:ObjectId`}

```

(v11,v12,v13.rframe(v11;v12;v13);
v21,v22,v23.bframe(v21;v22;v23);
v31,v32,v33.iframe(v31;v32;v33);
v41,v42,v43,v44,v45.pre(v41;v42;v43;v44;v45);

```

```

v51,v52,v53,v54,v55,v56.sends(v51;v52;v53;v54;v55;v56);
v61,v62,v63,v64,v65,v66.effect(v61;v62;v63;v64;v65;v66);
v71,v72,v73.sframe(v71;v72;v73);
v81,v82,v83,v84.frame(v81;v82;v83;v84);
v91,v92,v93,v94.init(v91;v92;v93;v94);
v101,v102,v103,v104.plus(v101;v102;v103;v104);
none;
g;
dt;
l;
T;
knd;
ds)

```

### es\_realizer\_ind\_Rsends\_compseq\_tag\_def

ABS: es\_realizer\_ind\_Rpre{es\_realizer\_ind\_Rpre\_compseq\_tag\_def:ObjectId}

```

(v11,v12,v13.rframe(v11;v12;v13);
v21,v22,v23.bframe(v21;v22;v23);
v31,v32,v33.aframe(v31;v32;v33);
v41,v42,v43,v44,v45.pre(v41;v42;v43;v44;v45);
v51,v52,v53,v54,v55,v56.sends(v51;v52;v53;v54;v55;v56);
v61,v62,v63,v64,v65,v66.effect(v61;v62;v63;v64;v65;v66);
v71,v72,v73.sframe(v71;v72;v73);
v81,v82,v83,v84.frame(v81;v82;v83;v84);
v91,v92,v93,v94.init(v91;v92;v93;v94);
v101,v102,v103,v104.plus(v101;v102;v103;v104);
none;
P;
T;
a;
ds;
loc)

```

### es\_realizer\_ind\_Rpre\_compseq\_tag\_def

ABS: es\_realizer\_ind\_Raframe{es\_realizer\_ind\_Raframe\_compseq\_tag\_def:ObjectId}

```

(v11,v12,v13.rframe(v11;v12;v13);
v21,v22,v23.bframe(v21;v22;v23);
v31,v32,v33.aframe(v31;v32;v33);
v41,v42,v43,v44,v45.pre(v41;v42;v43;v44;v45);
v51,v52,v53,v54,v55,v56.sends(v51;v52;v53;v54;v55;v56);
v61,v62,v63,v64,v65,v66.effect(v61;v62;v63;v64;v65;v66);
v71,v72,v73.sframe(v71;v72;v73);

```

```

v81,v82,v83,v84.frame(v81;v82;v83;v84);
v91,v92,v93,v94.init(v91;v92;v93;v94);
v101,v102,v103,v104.plus(v101;v102;v103;v104);
none;
L;
k;
loc)

```

### es\_realizer\_ind\_Raframe\_compseq\_tag\_def

```

ABS: es_realizer_ind_Rbframe{es_realizer_ind_Rbframe_compseq_tag_def:ObjectId}
(v11,v12,v13.rframe(v11;v12;v13);
v21,v22,v23.bframe(v21;v22;v23);
v31,v32,v33.aframe(v31;v32;v33);
v41,v42,v43,v44,v45.pre(v41;v42;v43;v44;v45);
v51,v52,v53,v54,v55,v56.sends(v51;v52;v53;v54;v55;v56);
v61,v62,v63,v64,v65,v66.effect(v61;v62;v63;v64;v65;v66);
v71,v72,v73.sframe(v71;v72;v73);
v81,v82,v83,v84.frame(v81;v82;v83;v84);
v91,v92,v93,v94.init(v91;v92;v93;v94);
v101,v102,v103,v104.plus(v101;v102;v103;v104);
none;
L;
k;
loc)

```

### es\_realizer\_ind\_Rbframe\_compseq\_tag\_def

```

ABS: es_realizer_ind_Rrframe{es_realizer_ind_Rrframe_compseq_tag_def:ObjectId}
(v11,v12,v13.rframe(v11;v12;v13);
v21,v22,v23.bframe(v21;v22;v23);
v31,v32,v33.aframe(v31;v32;v33);
v41,v42,v43,v44,v45.pre(v41;v42;v43;v44;v45);
v51,v52,v53,v54,v55,v56.sends(v51;v52;v53;v54;v55;v56);
v61,v62,v63,v64,v65,v66.effect(v61;v62;v63;v64;v65;v66);
v71,v72,v73.sframe(v71;v72;v73);
v81,v82,v83,v84.frame(v81;v82;v83;v84);
v91,v92,v93,v94.init(v91;v92;v93;v94);
v101,v102,v103,v104.plus(v101;v102;v103;v104);
none;
L;
x;
loc)

```

**es\_realizer\_ind\_Rrframe\_compseq\_tag\_def**

ABS: Rnone?( $x_1$ ) **Rnone?**

STM: Rnone?\_wf

ABS: Rplus?( $x_1$ ) **Rplus?**

STM: Rplus?\_wf

ABS: Rplus-left( $x_1$ ) **Rplus-left**

STM: Rplus-left\_wf

ABS: Rplus-right( $x_1$ ) **Rplus-right**

STM: Rplus-right\_wf

ABS: Rinit?( $x_1$ ) **Rinit?**

STM: Rinit?\_wf

ABS: Rinit-loc( $x_1$ ) **Rinit-loc**

STM: Rinit-loc\_wf

ABS: Rinit-T( $x_1$ ) **Rinit-T**

STM: Rinit-T\_wf

ABS: Rinit-x( $x_1$ ) **Rinit-x**

STM: Rinit-x\_wf

ABS: Rinit-v( $x_1$ ) **Rinit-v**

STM: Rinit-v\_wf

ABS: Rframe?( $x_1$ ) **Rframe?**

STM: Rframe?\_wf

ABS: Rframe-loc( $x_1$ ) **Rframe-loc**

STM: Rframe-loc\_wf

ABS: Rframe-T( $x_1$ ) **Rframe-T**

STM: Rframe-T\_wf

ABS: Rframe-x( $x_1$ ) **Rframe-x**

STM: Rframe-x\_wf  
 ABS: Rframe-L( $x_1$ ) **Rframe-L**  
 STM: Rframe-L\_wf  
 ABS: Rsframe?( $x_1$ ) **Rsframe?**  
 STM: Rsframe?\_wf  
 ABS: Rsframe-lnk( $x_1$ ) **Rsframe-lnk**  
 STM: Rsframe-lnk\_wf  
 ABS: Rsframe-tag( $x_1$ ) **Rsframe-tag**  
 STM: Rsframe-tag\_wf  
 ABS: Rsframe-L( $x_1$ ) **Rsframe-L**  
 STM: Rsframe-L\_wf  
 ABS: Reffect?( $x_1$ ) **Reffect?**  
 STM: Reffect?\_wf  
 ABS: Reffect-loc( $x_1$ ) **Reffect-loc**  
 STM: Reffect-loc\_wf  
 ABS: Reffect-ds( $x_1$ ) **Reffect-ds**  
 STM: Reffect-ds\_wf  
 ABS: Reffect-knd( $x_1$ ) **Reffect-knd**  
 STM: Reffect-knd\_wf  
 ABS: Reffect-T( $x_1$ ) **Reffect-T**  
 STM: Reffect-T\_wf  
 ABS: Reffect-x( $x_1$ ) **Reffect-x**  
 STM: Reffect-x\_wf  
 ABS: Reffect-f( $x_1$ ) **Reffect-f**  
 STM: Reffect-f\_wf  
 ABS: Rsends?( $x_1$ ) **Rsends?**  
 STM: Rsends?\_wf



ABS:  $\text{Rsend-ds}(x_1)$  **Rsend-ds**  
 STM:  $\text{Rsend-ds\_wf}$   
 ABS:  $\text{Rsend-knd}(x_1)$  **Rsend-knd**  
 STM:  $\text{Rsend-knd\_wf}$   
 ABS:  $\text{Rsend-T}(x_1)$  **Rsend-T**  
 STM:  $\text{Rsend-T\_wf}$   
 ABS:  $\text{Rsend-l}(x_1)$  **Rsend-l**  
 STM:  $\text{Rsend-l\_wf}$   
 ABS:  $\text{Rsend-dt}(x_1)$  **Rsend-dt**  
 STM:  $\text{Rsend-dt\_wf}$   
 ABS:  $\text{Rsend-g}(x_1)$  **Rsend-g**  
 STM:  $\text{Rsend-g\_wf}$   
 ABS:  $\text{Rpre?}(x_1)$  **Rpre?**  
 STM:  $\text{Rpre?\_wf}$   
 ABS:  $\text{Rpre-loc}(x_1)$  **Rpre-loc**  
 STM:  $\text{Rpre-loc\_wf}$   
 ABS:  $\text{Rpre-ds}(x_1)$  **Rpre-ds**  
 STM:  $\text{Rpre-ds\_wf}$   
 ABS:  $\text{Rpre-a}(x_1)$  **Rpre-a**  
 STM:  $\text{Rpre-a\_wf}$   
 ABS:  $\text{Rpre-T}(x_1)$  **Rpre-T**  
 STM:  $\text{Rpre-T\_wf}$   
 ABS:  $\text{Rpre-P}(x_1)$  **Rpre-P**  
 STM:  $\text{Rpre-P\_wf}$   
 ABS:  $\text{Rframe?}(x_1)$  **Rframe?**  
 STM:  $\text{Rframe?\_wf}$   
 ABS:  $\text{Rframe-loc}(x_1)$  **Rframe-loc**

STM: Riframe-loc\_wf  
ABS: Riframe-k( $x_1$ ) **Riframe-k**  
STM: Riframe-k\_wf  
ABS: Riframe-L( $x_1$ ) **Riframe-L**  
STM: Riframe-L\_wf  
ABS: Riframe?( $x_1$ ) **Riframe?**  
STM: Riframe?\_wf  
ABS: Riframe-loc( $x_1$ ) **Riframe-loc**  
STM: Riframe-loc\_wf  
ABS: Riframe-k( $x_1$ ) **Riframe-k**  
STM: Riframe-k\_wf  
ABS: Riframe-L( $x_1$ ) **Riframe-L**  
STM: Riframe-L\_wf  
ABS: Riframe?( $x_1$ ) **Riframe?**  
STM: Riframe?\_wf  
ABS: Riframe-loc( $x_1$ ) **Riframe-loc**  
STM: Riframe-loc\_wf  
ABS: Riframe-x( $x_1$ ) **Riframe-x**  
STM: Riframe-x\_wf  
ABS: Riframe-L( $x_1$ ) **Riframe-L**  
STM: Riframe-L\_wf