

Transfers in Network Calculations

- Transfers: 2 Cases
- Hierarchy Tree
- Expressions
- Generalized Transfer Selection
- Result Aggregation

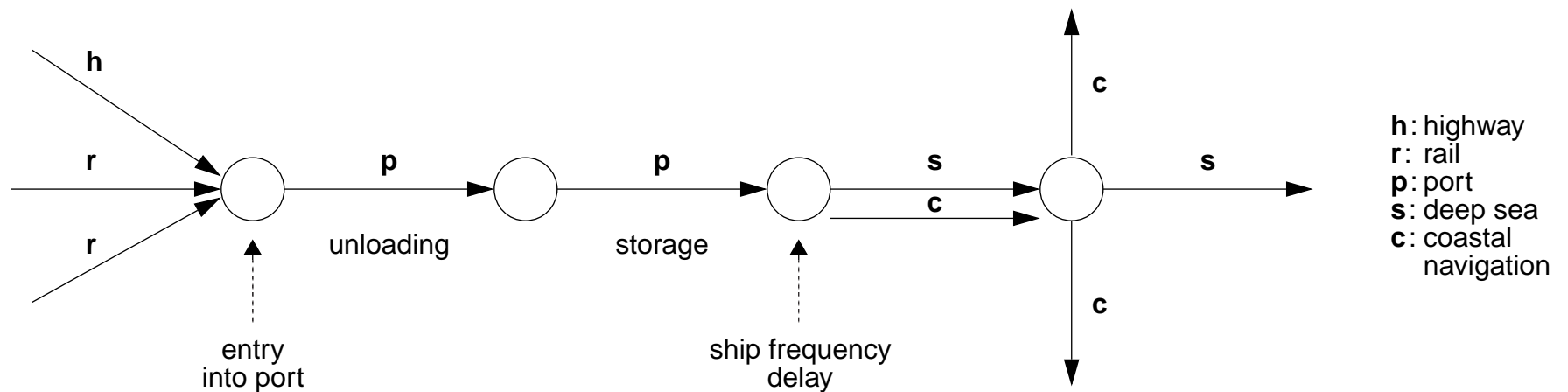
Presented by

Diane Larin, INRO Consultants Inc.

2nd STAN Workshop – Stockholm, Sweden, 1999

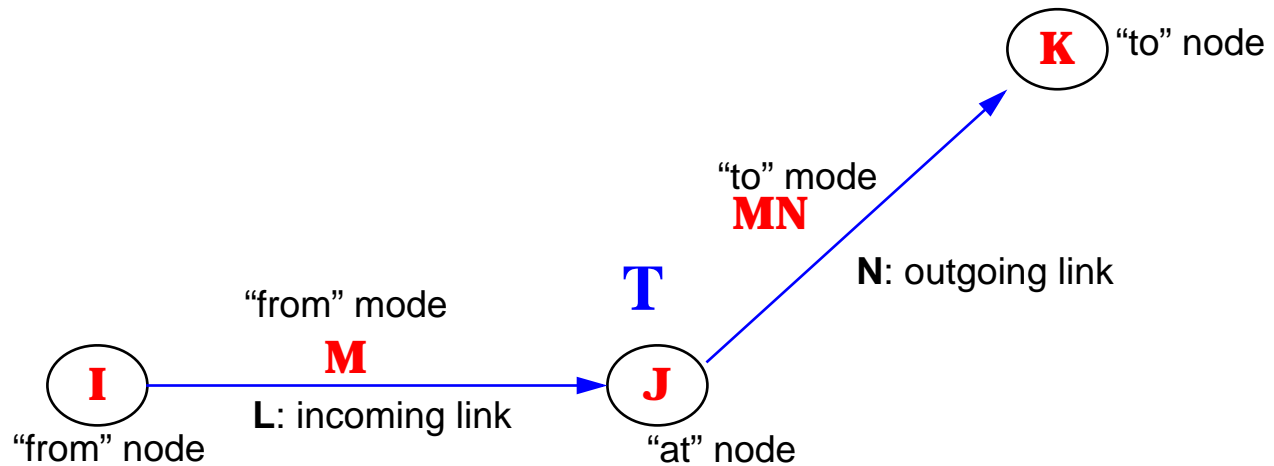
Transfers: 2 Cases

- Link-to-link
 - each transfer is independent of others at the same node
e.g. “independent” operations, aggregation of several facilities, “border” crossings, node penalties, etc.
- Common facility case
 - several transfers at the same node “pass through” the same facility
 - the performance of each transfer depends upon the total flow transferred
e.g. rail yards, port entry points, loading/unloading facilities, etc.



⇒ NEED for transfer calculations

Network “View”

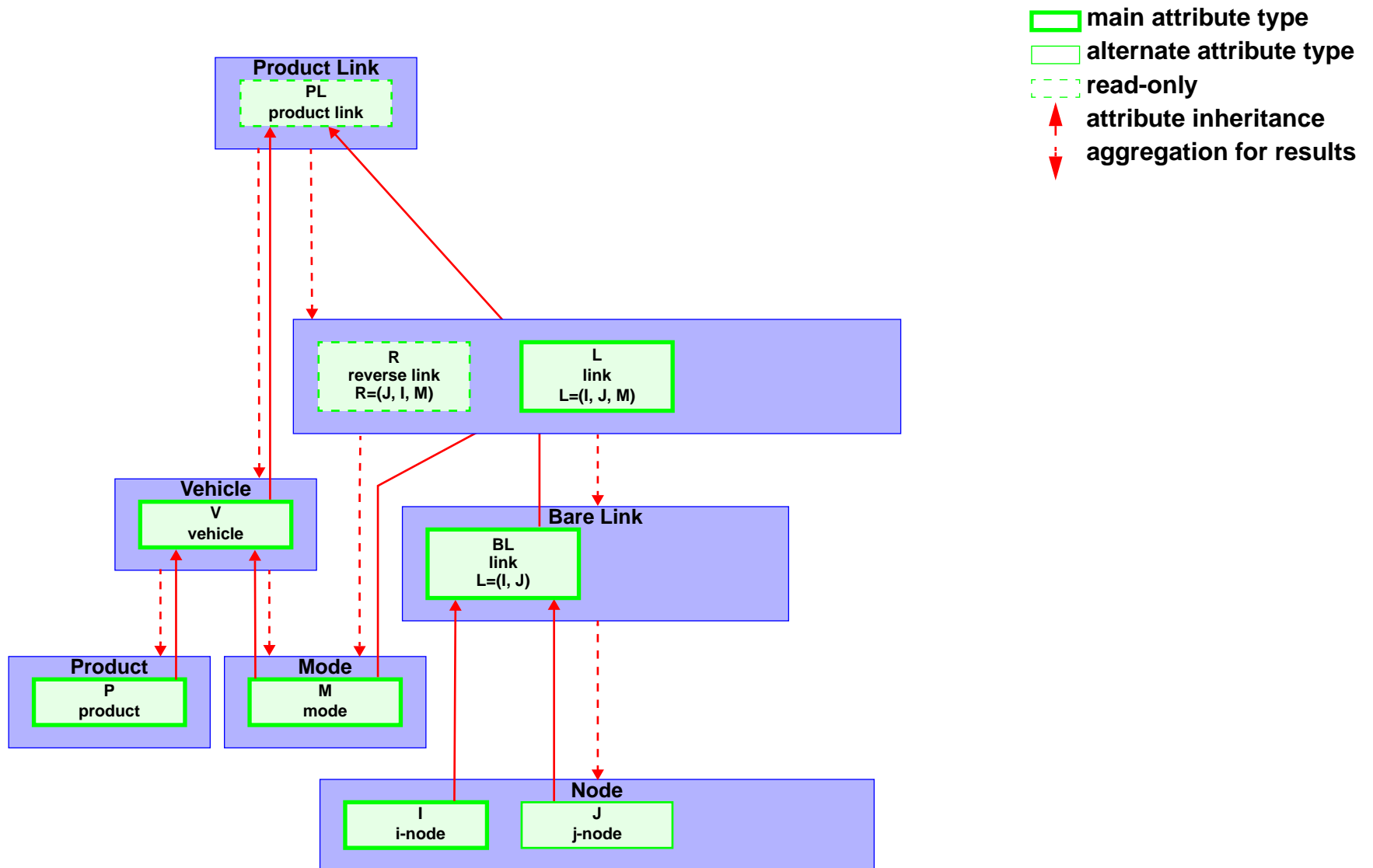


- I I-node, from-node of transfer
- J J-node, at-node of transfer
- K K-node, to-node of transfer
- M Mode of link, from-mode of transfer
- MN Mode of next link, to-mode of transfer
- L Link, incoming link of transfer = (I, M, J)
- N Next link of transfer = (J, MN, K)
- T Transfer = (I, M, J, MN, K)

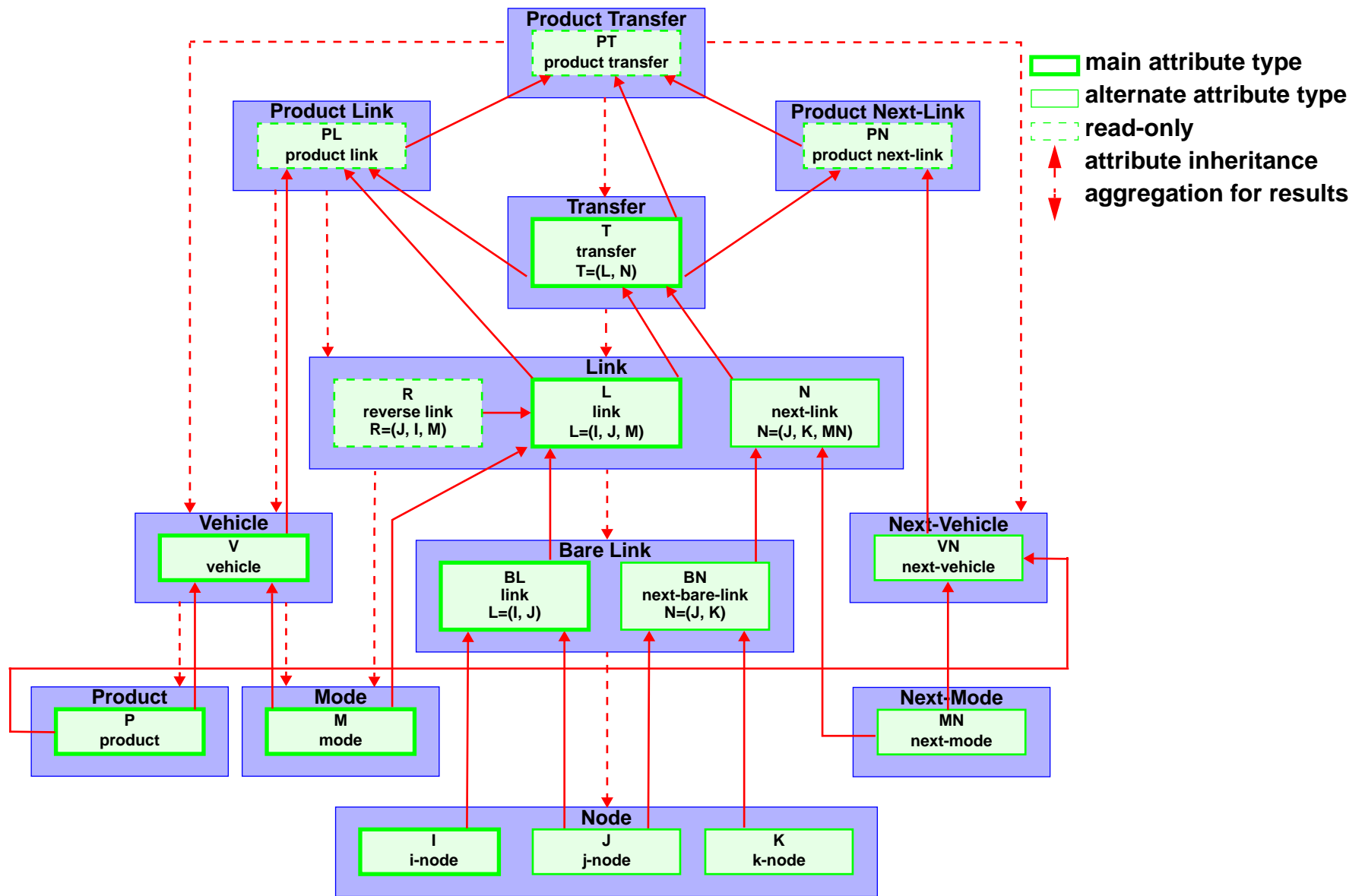
Transfers in Network Calculations

- To evaluate expression containing transfer attributes
 - Transfer attributes
 - Transfer identifiers
 - I-node (**from** node)
 - mode of incoming link
 - J-node (**at** node): transfer node number ⇒ Selection default attribute
 - K-node (**to** node)
 - mode of outgoing link
 - Function set
 - 1 special coefficient
 - 3 user data
 - Extra attributes (optional)
 - Results: product volumes, unit cost and unit marginal costs
- ⇒ Higher level of complexity of the hierarchy tree

Hierarchy Tree



Hierarchy Tree (Complete)



Expressions

- Evaluated only for the elements **selected** by the user
 - combination of the mode and attribute-based selections
- Availability of attributes depends on
 - whether an assignment has been performed
 - the extra and temporary attributes defined
- Evaluation rules when various attribute types are combined (hierarchy tree):
 - attribute inheritance
 - data expansion from bottom to top
 - a link also inherits all attributes of its reverse link
 - expression type = type of data at the root of the smallest subtree which contains all attributes involved (including result attribute)
 - aggregation from top to bottom (when result is lower type than expression)

Attributes available for computations

Available attributes:

I: i xi yi ui1 ui2 ui3

J: j xj yj uj1 uj2 uj3

K: k xk yk uk1 uk2 uk3

BL: ub1 ub2 ub3

L: len fct typ cap ul1 ul2 ul3 beta phil vt v1 v2 v3 v4 v5 c1 c2 c3 c4 c5
mc1 mc2 mc3 mc4 mc5 train strain dtrain vht

R: lenr fctr typr capr ul1r ul2r ul3r betar philr vtr v1r v2r v3r v4r v5r
c1r c2r c3r c4r c5r mc1r mc2r mc3r mc4r mc5r trainr strainr dtrainr vhtr

BN: ub1n ub2n ub3n

N: lenn fctn typn capn ul1n ul2n ul3n betan philn vtn v1n v2n v3n v4n v5n
c1n c2n c3n c4n c5n mc1n mc2n mc3n mc4n mc5n trainn strainn dtrainn vhtn

T: phit fctt ut1 ut2 ut3 vtt v1t v2t v3t v4t v5t c1t c2t c3t c4t c5t mc1t
mc2t mc3t mc4t mc5t

M: um1 um2 um3 phim

P: up1 up2 up3

V: cwt wbv vwt uv1 uv2 uv3

MN: um1n um2n um3n phimn

VN: cwt n wbn vwn uv1n uv2n uv3n

PL: vp cp mcp vhp

PN: vpn cpn mcpn vhp n

PT: vpt cpt mcpt

-: index1 index2 index3

+ Extra attributes (@xxxxx)

+ Temporary attributes (**tmp**tn)

Examples of transfer type expressions

- Expressions involving K-node attributes
 $1*(k>1000 \text{ .and. } k\leq 1010) + 2*(k>1010)$
- Expressions involving **next** mode attributes (MN)
 $u11 * (um1 < um1n)$
- Saving in next bare link attributes (BN)
 $ub1n = vt$
- Expressions involving transfer attributes
 $c1t * v1t$

Generalized Transfer Selection

Enter: Selected transfer nodes or attributes (from, to)
=

- The nodes of a transfer: (**i**, **j**, **k**)
J-node (**at** node) is the selection default attribute
- Ingoing link attributes: as in link selection
- Outgoing link or **next** link attributes: suffix **n**
- Transfer attributes: suffix **t**
- A given transfer = an ingoing link + an outgoing link

Enter: Selected transfer nodes or attributes (from, to)

=?=

len=	fct=	typ=	cap=	ul1=	ul2=	ul3=	beta=
phil=	vt=	v1=	v2=	v3=	v4=	v5=	c1=
c2=	c3=	c4=	c5=	mc1=	mc2=	mc3=	mc4=
mc5=	lenn=	fctn=	typn=	capn=	ul1n=	ul2n=	ul3n=
betan=	philn=	vtn=	v1n=	v2n=	v3n=	v4n=	v5n=
c1n=	c2n=	c3n=	c4n=	c5n=	mc1n=	mc2n=	mc3n=
mc4n=	mc5n=	j=	xj=	yj=	uj1=	uj2=	uj3=
i=	xi=	yi=	ui1=	ui2=	ui3=	k=	xk=
yk=	uk1=	uk2=	uk3=	phit=	fctt=	ut1=	ut2=
ut3=	vtt=	v1t=	v2t=	v3t=	v4t=	v5t=	c1t=
c2t=	c3t=	c4t=	c5t=	mc1t=	mc2t=	mc3t=	mc4t=
mc5t=	l=	ln=	mod=	modn=	mset=	msetn=	lbi=
lbj=	lbk=	ci=	ck=	set1=			

Continue transfer selection:

=

Examples of transfer selections

1. Transfers from links of mode **r** to all links of other modes, at nodes 2900 through 2920

j=2900,2920 ⇒ specified transfer nodes
and mod=r ⇒ mode of incoming links
and not modn=r ⇒ mode of outgoing links

2. Transfer at node 1707 arriving from node 1505 on mode **p** and going towards node 1749 on mode **r**

link=1505 1707 p ⇒ incoming link
and linkn=1707 1749 r ⇒ outgoing (next) link

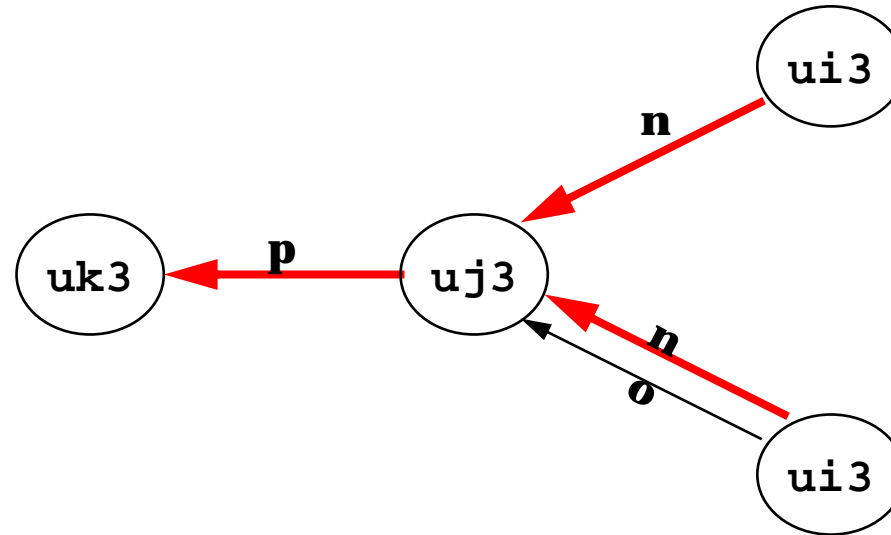
3. Transfers from port or ferry modes (**fh**) to links of the rail modes (**pno**)

mod=f ⇒ incoming links of mode **f** placed in **set1**
mod=h ⇒ incoming links of mode **h** added to current set
new modn=p ⇒ start a new set with outgoing links of mode **p**
modn=o ⇒ outgoing links of mode **o** added to new set
modn=n ⇒ outgoing links of mode **n** added to new set
and set1=1 ⇒ intersection of the two sets
and not vtt=0 ⇒ transfers with volumes

Result Aggregation

- When result is lower type than expression
 - Aggregation chosen from
 - minimum value
 - maximum value
 - average value
 - sum
 - bitwise OR
 - bitwise AND
- ⇒ Choose result attribute wisely!

Example: total volume of given products transferred between two modes



- ⇒ **transfer to node** aggregation
- save result in a node attribute (for example, $uj3$)
- expression: vpt
- aggregation: **sum**
- product, mode and transfer selections

- alternate expression: $v1t + v3t$
 - ⇒ only mode and transfer selections
- warning: $v1t$ may not be equal to vpt for product 1

Ex: Compute the total product volume leaving the port on large ships

- Attribute to save result in: **up2**

- Expression to calculate result:
`vpn * (vwtn > 1000)`

- Type of aggregation: **sum**

- Product selection: as desired

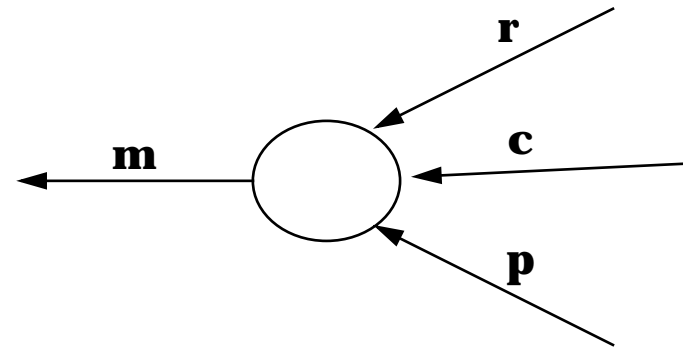
- Modes: *

- Transfer selection: **modn=m**

- Report: save summary in scalars

Enter: Scalar to hold maximum result value `nnnnnn=`

Enter: Scalar to hold product number with maximum result `P=`



Conclusion

- 8 new types of attributes in the network calculator
- Transfer attributes may be accessed in several different ways
- Systematic modification of transfer data
- Easier access to transfer data and results
- Powerful tool for transfer analyses