# Rapid introduction to the architecture of the ALADIN code with a focus on NH aspects

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# SUMMARY

- Computations organizations
- Data flows
- NH aspects

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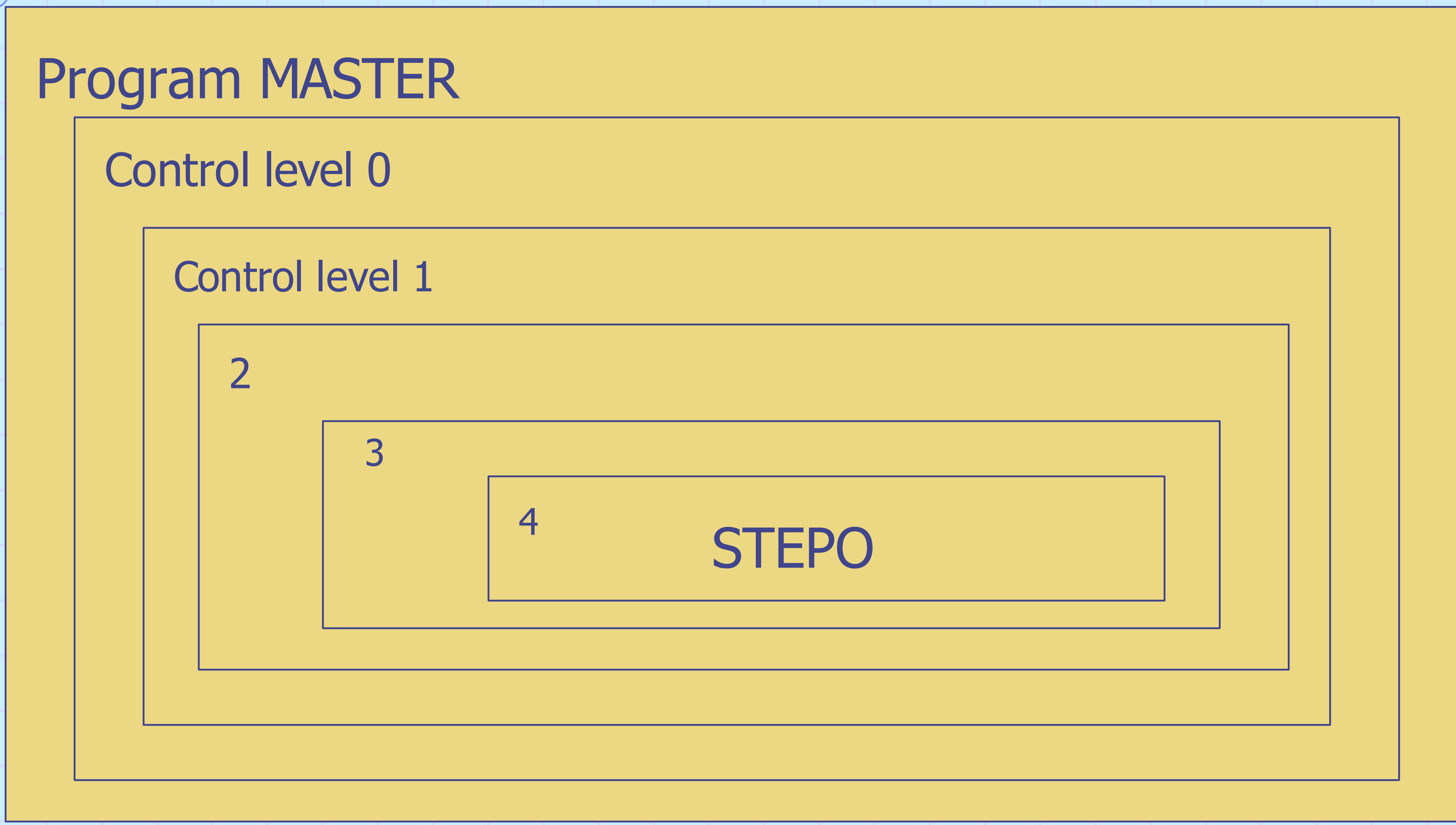
# General organization



# ALADIN Code in ARPEGE/IFS

- Embedded inside ARP/IFS
- Specific control keys [LELAM and LRPLANE (plane geometry)]
- « E » Rule
- Duplicated routines (6)

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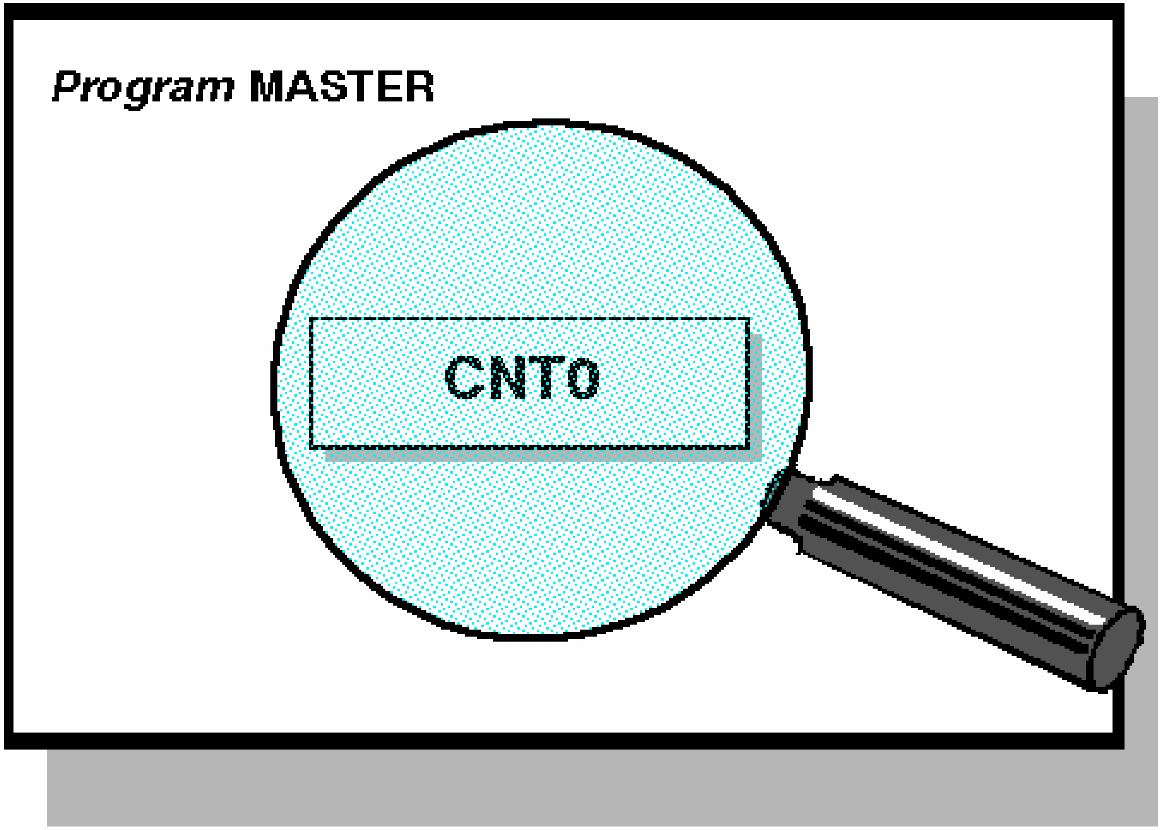
# Computations organisation



# CONTROL LEVEL 0

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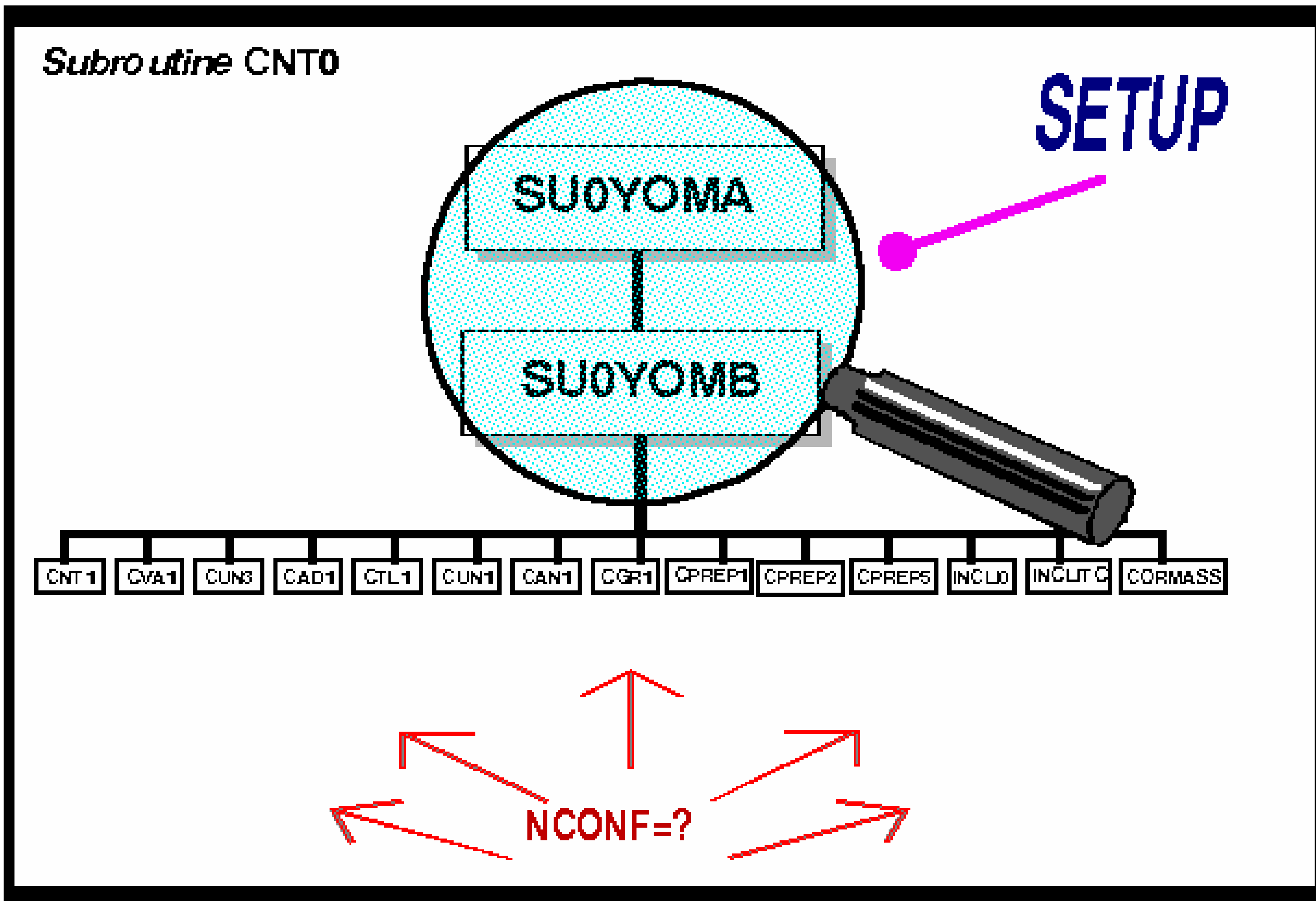

# THE SETUP

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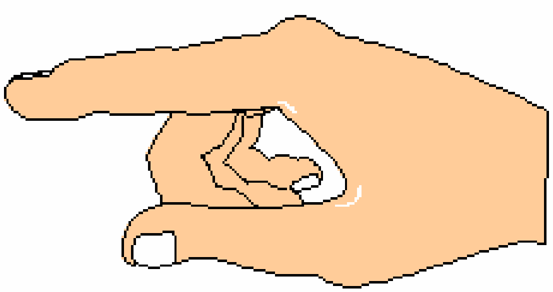
- To read the parameters controlled by the user
- To initialize all constants (ex : $\pi$ )
- To allocate and initialize all working arrays

*INTERNAL CONSISTANCY OF THE SETUP IS OF PRIME NECESSITY !*



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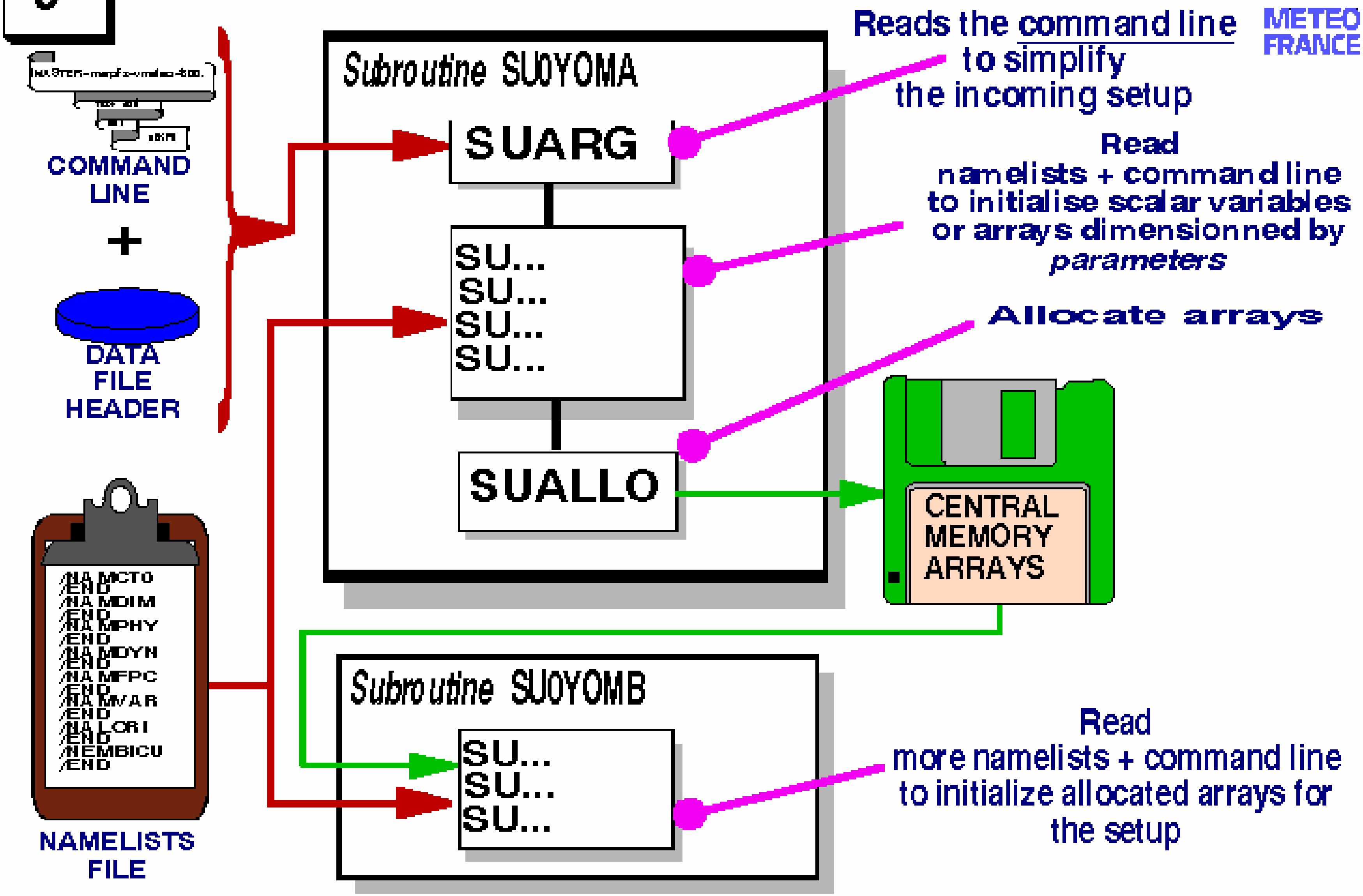
# SETUP ORGANIZATION



# FRAMEWORK OF A SETUP SUBROUTINE

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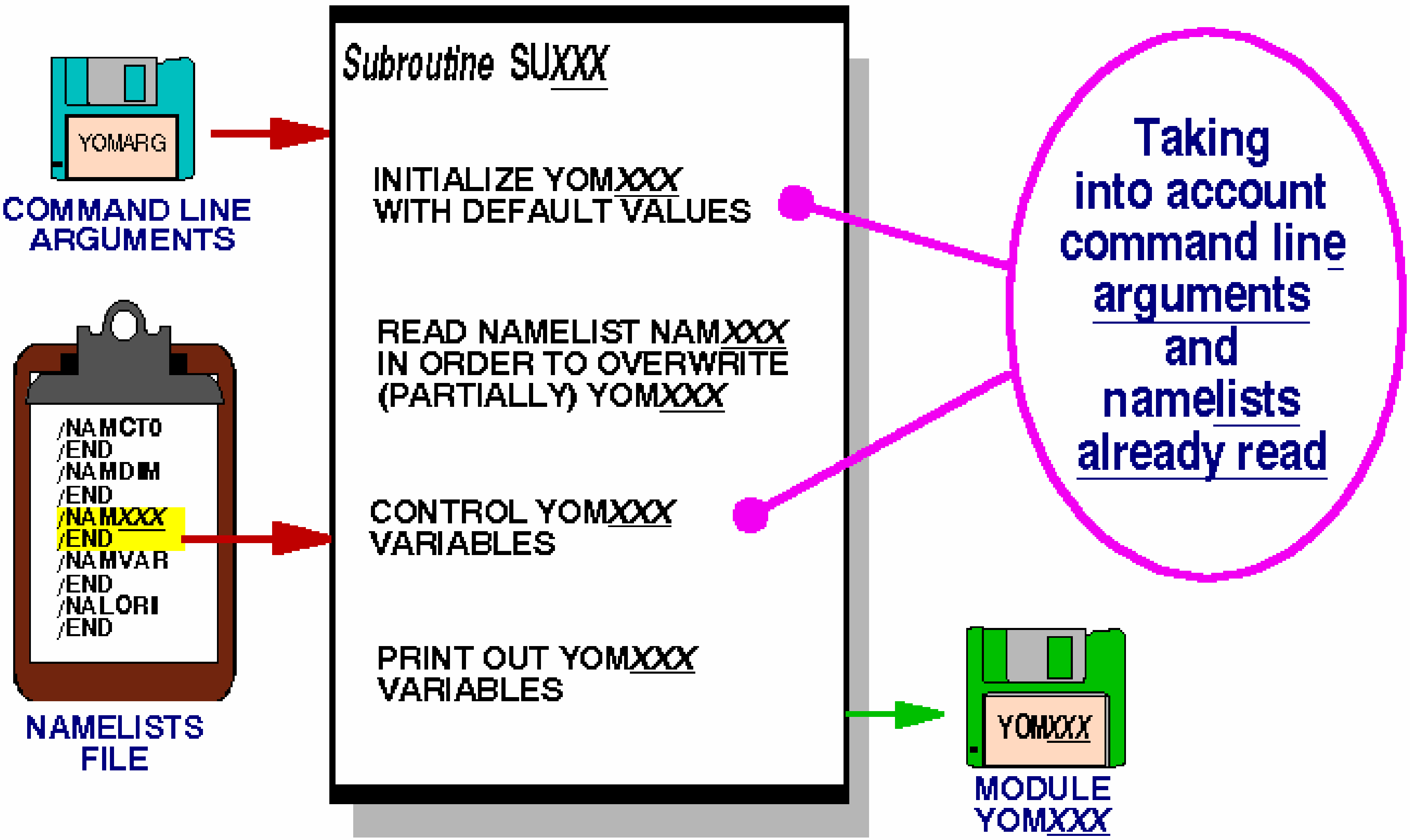

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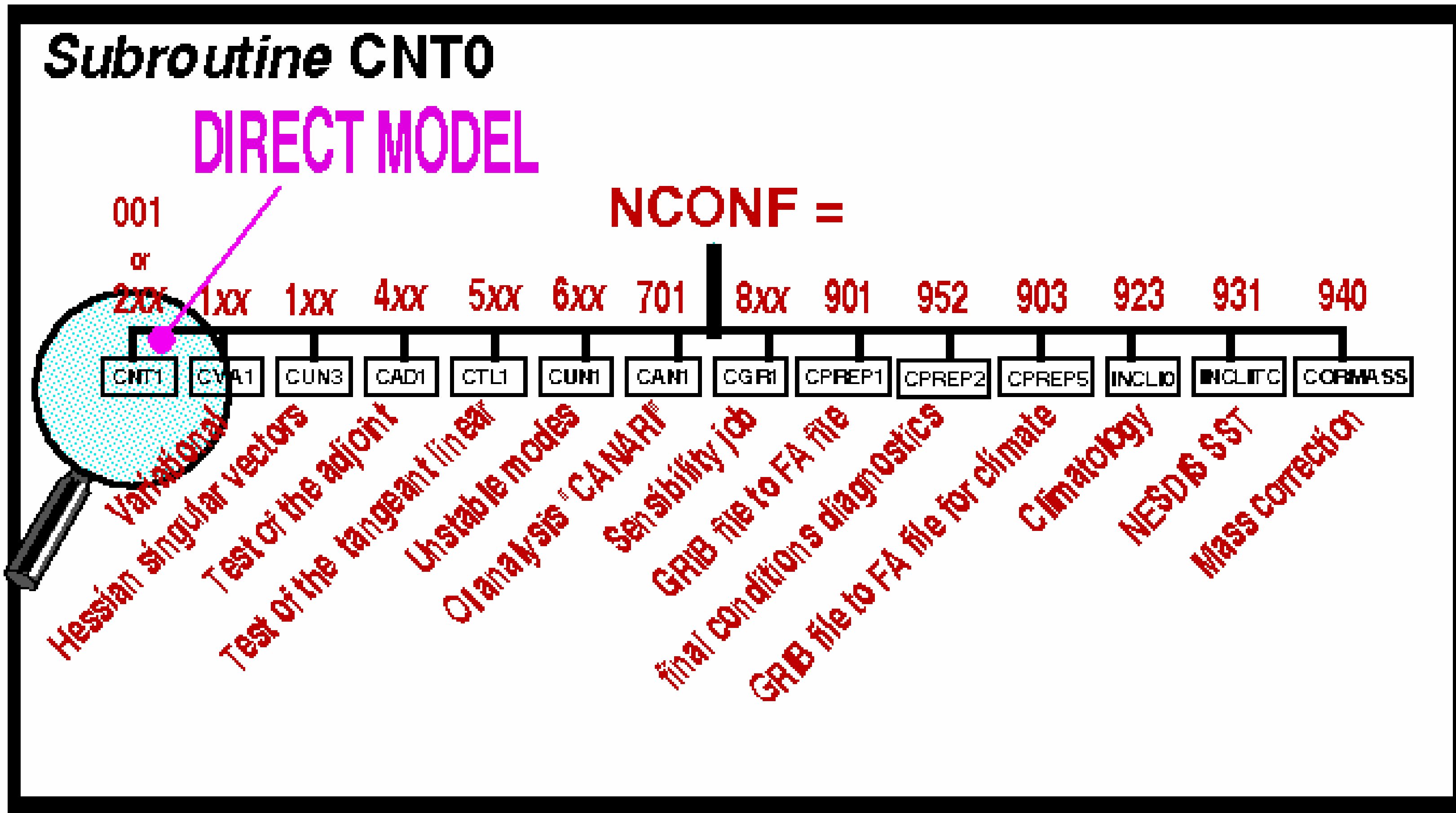
# WHICH CONFIGURATION OF WORK ?

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# The direct model : CNT1

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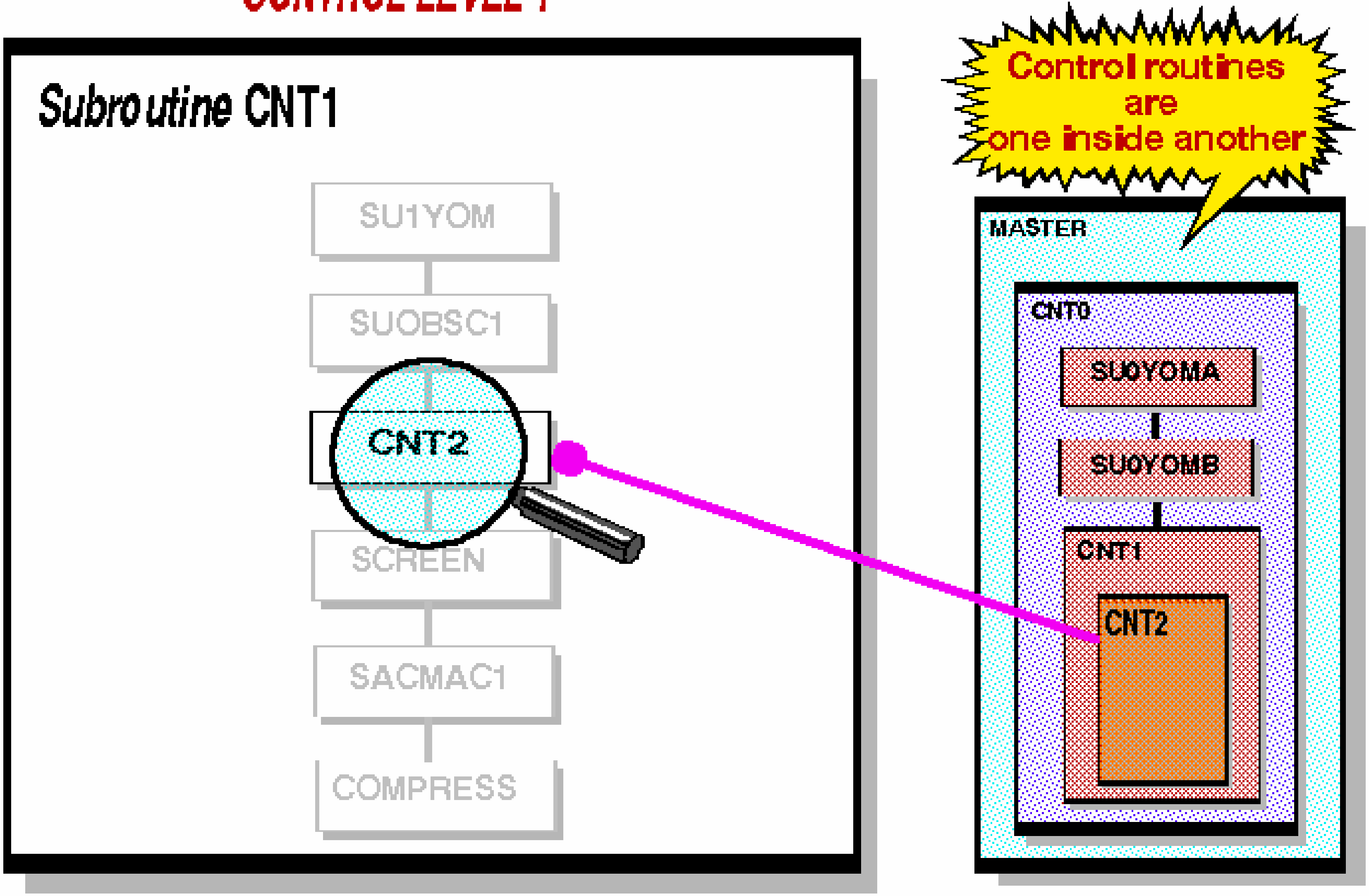
"CONTROL LEVEL 1"



# The direct model : CNT2

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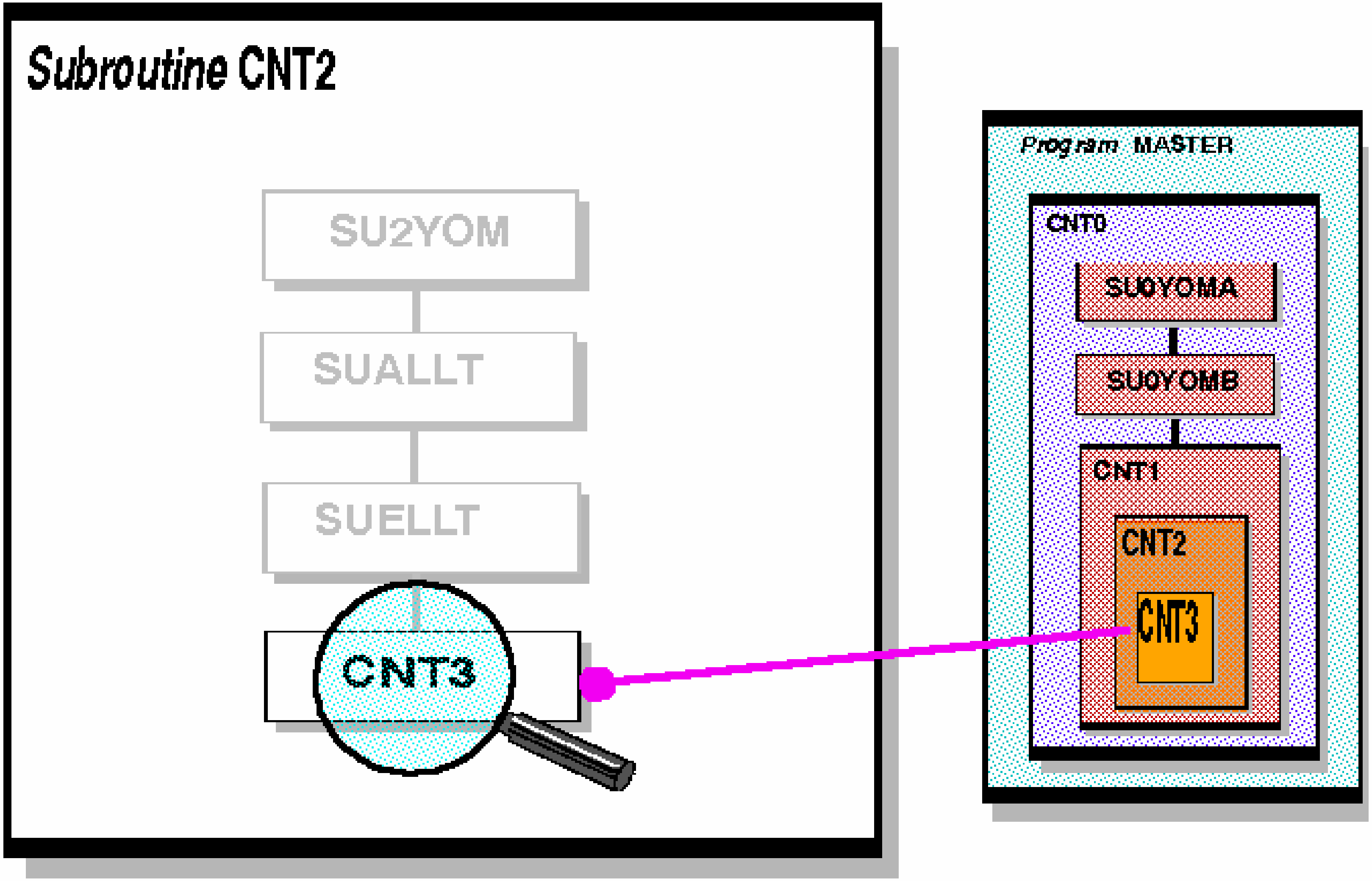
"CONTROL LEVEL 2"



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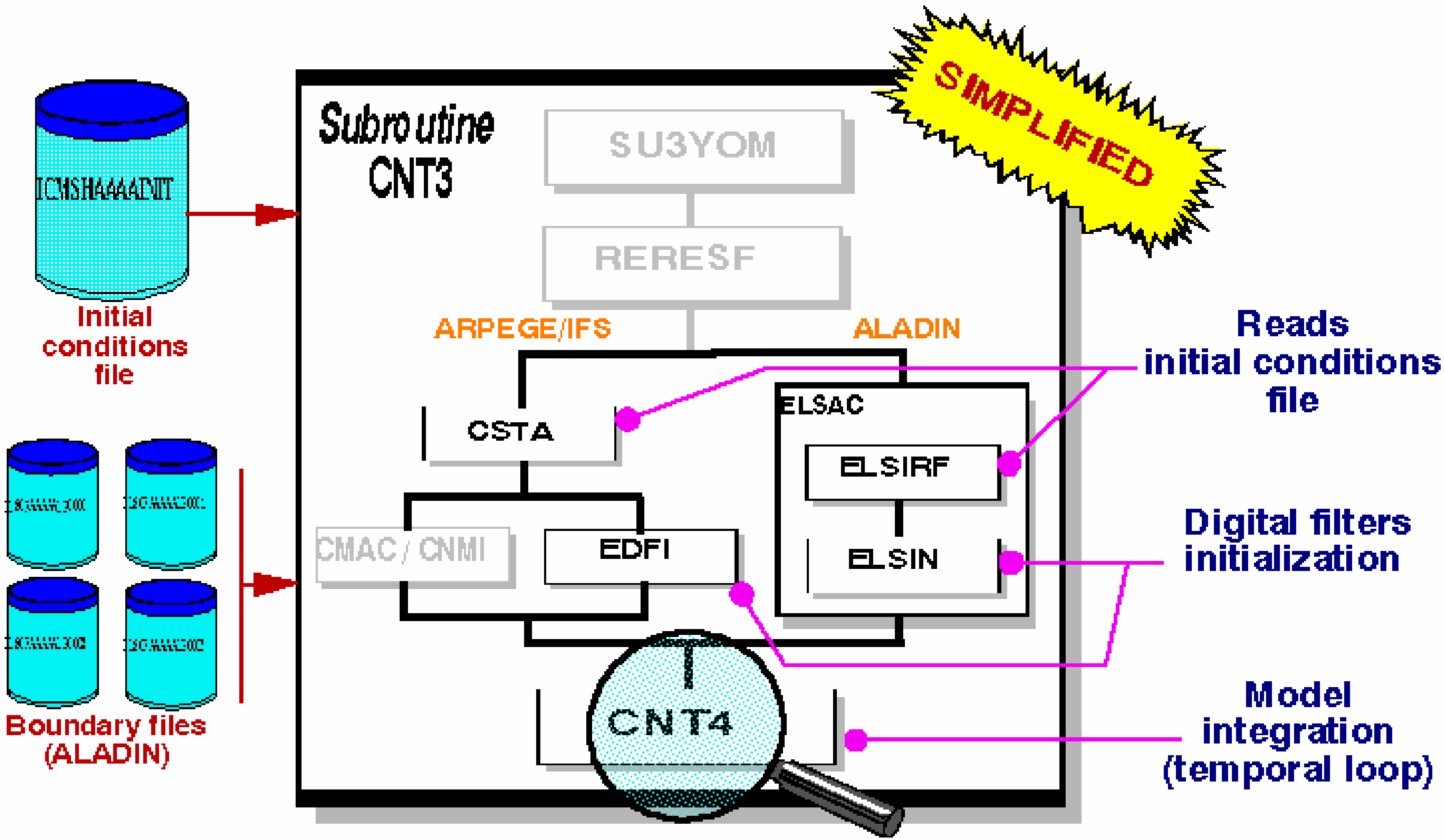
# The direct model : CNT3

## "CONTROL LEVEL 3" = READ AND INITIALIZE INITIAL FIELDS

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# Direct model integration : CNT4

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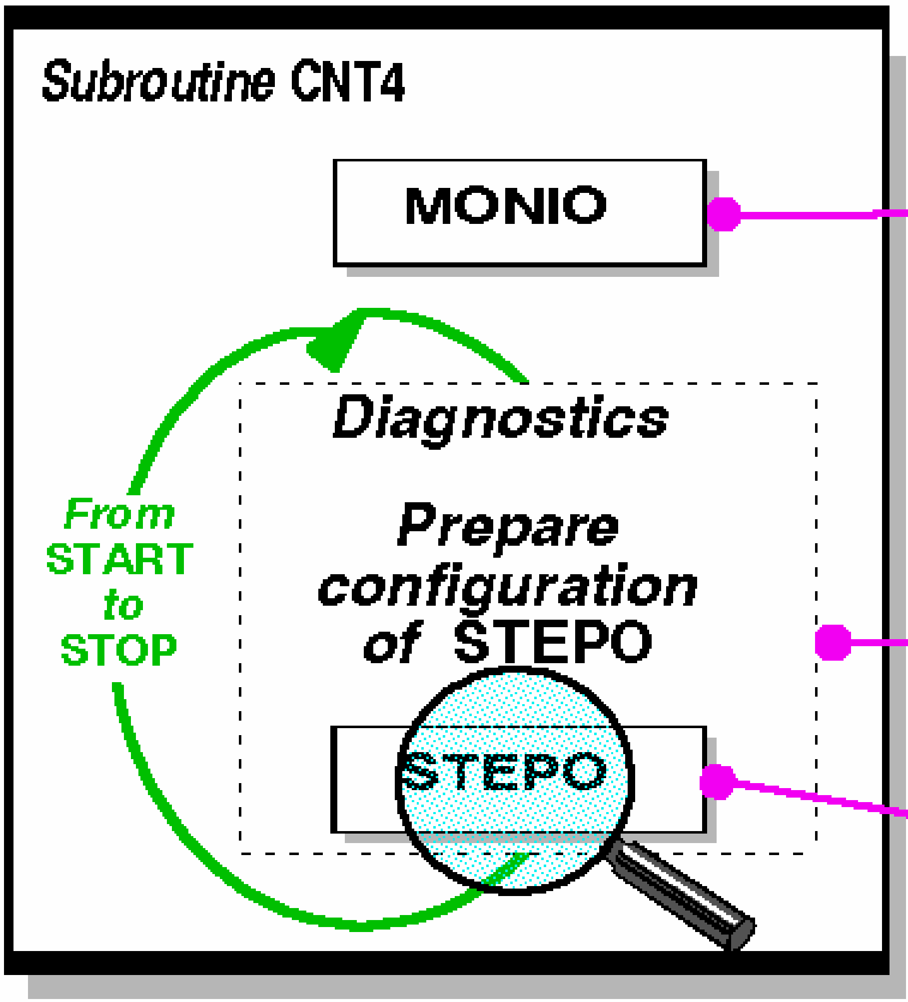
"CONTROL LEVEL 4" = TEMPORAL LOOP

HIGHLY SIMPLIFIED !




Monitoring of input/output events (diagnostics, post-processing, back-ups, etc)

TEMPORAL LOOP

STEPO *is the heart of the model!*

# STEPO

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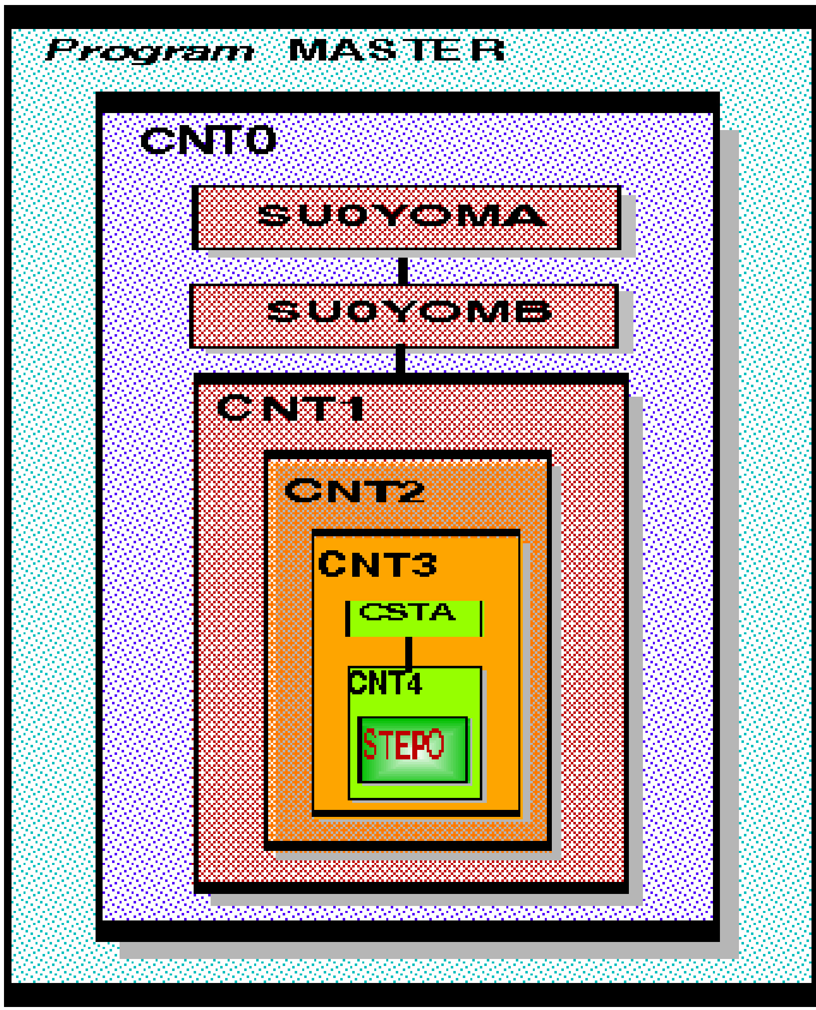
STEPO *IS*
*AN ELEMENTARY*
*STEP*
*OF THE MODEL*

STEPO
*IS INVOKED*
*WITH A*
*CONFIGURATION STRING*
*COMPOSED OF*
*9 CHARACTERS*
( Example : Call Stepo ('0AAA00AAA') )




# Organization of STEPO

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*Subroutine* STEPO

- Input/Output handlings
- Inverse spectral transforms
- Grid-point computations for model integration
- Grid-point computations for post-processing
- Grid-point computations for analysis
- Direct spectral transforms
- Spectral computation

CDCONF(1)
CDCONF(2)
CDCONF(3)
CDCONF(4)
CDCONF(5)
CDCONF(6)
CDCONF(7)
CDCONF(8)
CDCONF(9)

Argument of call to STEPO

***9 PARTS :***

***EACH PART IS CONTROLLED BY 1 CHARACTER OF THE CONFIGURATION STRING***

***CDCONF(n)='0'***
⇔
***Do not enter the part n***

*Example :*
*a "normal" time step of a forecast is :*

CALL STEPO('0AAA00AAA')

# Structure of the code of STEPO

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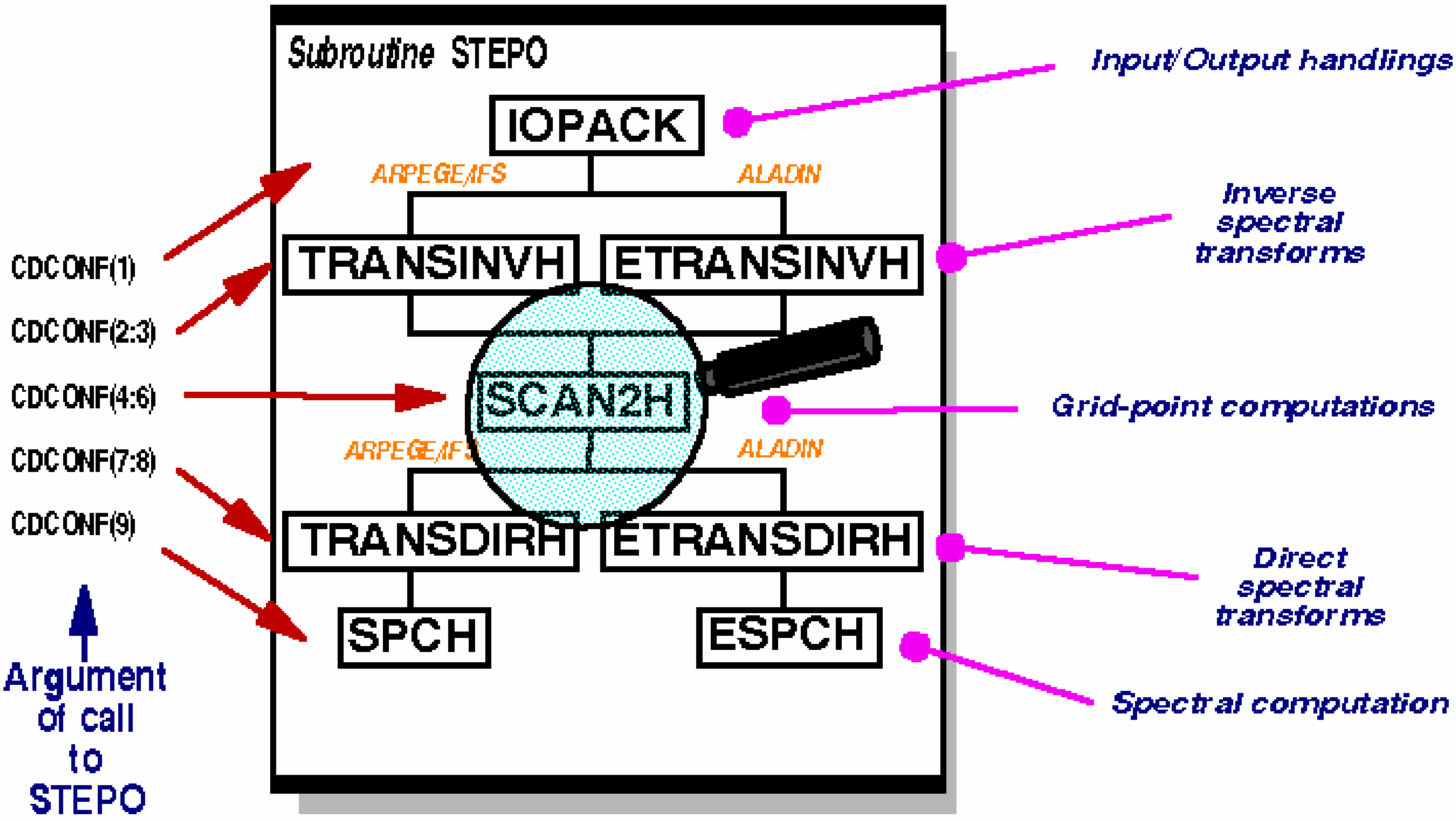
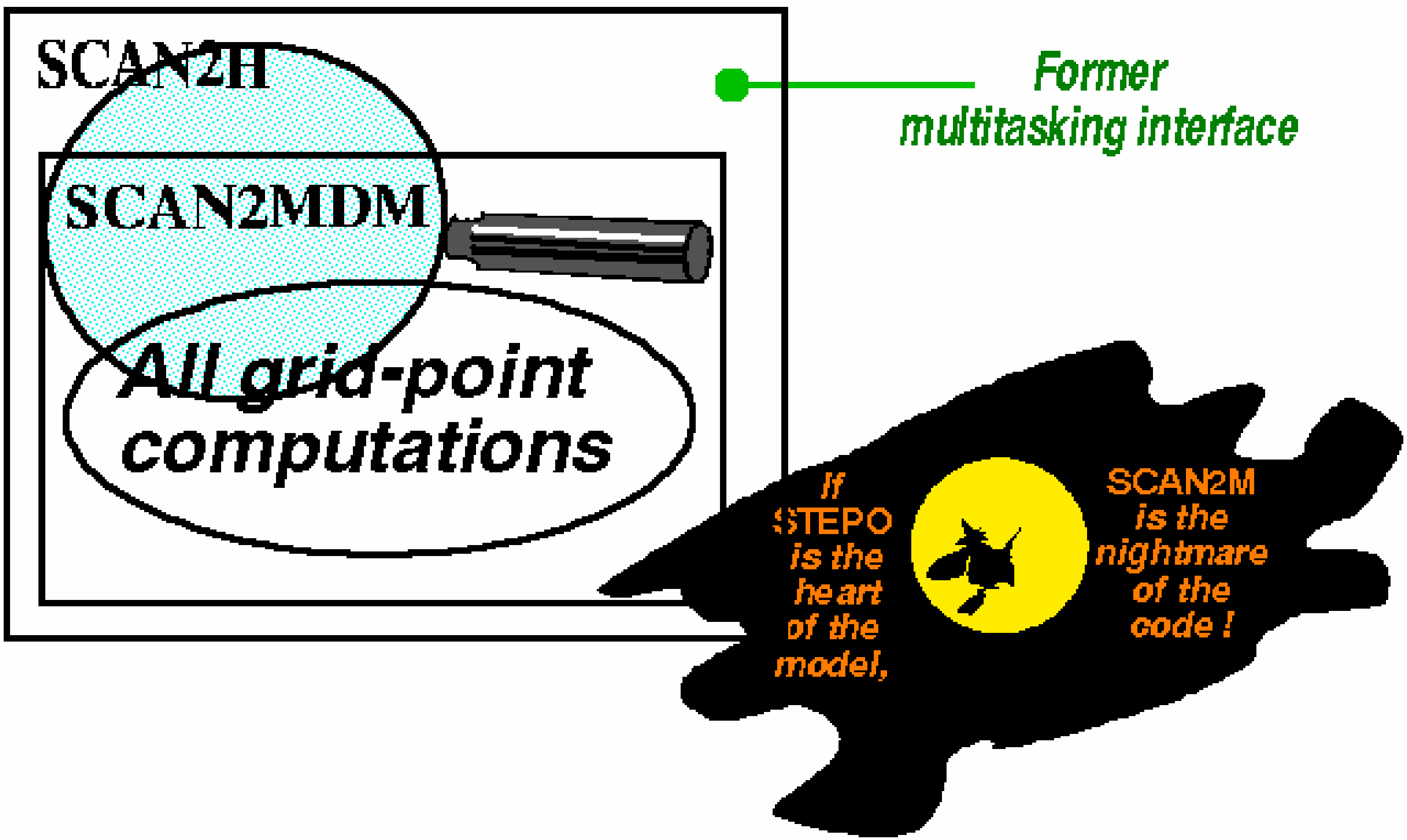
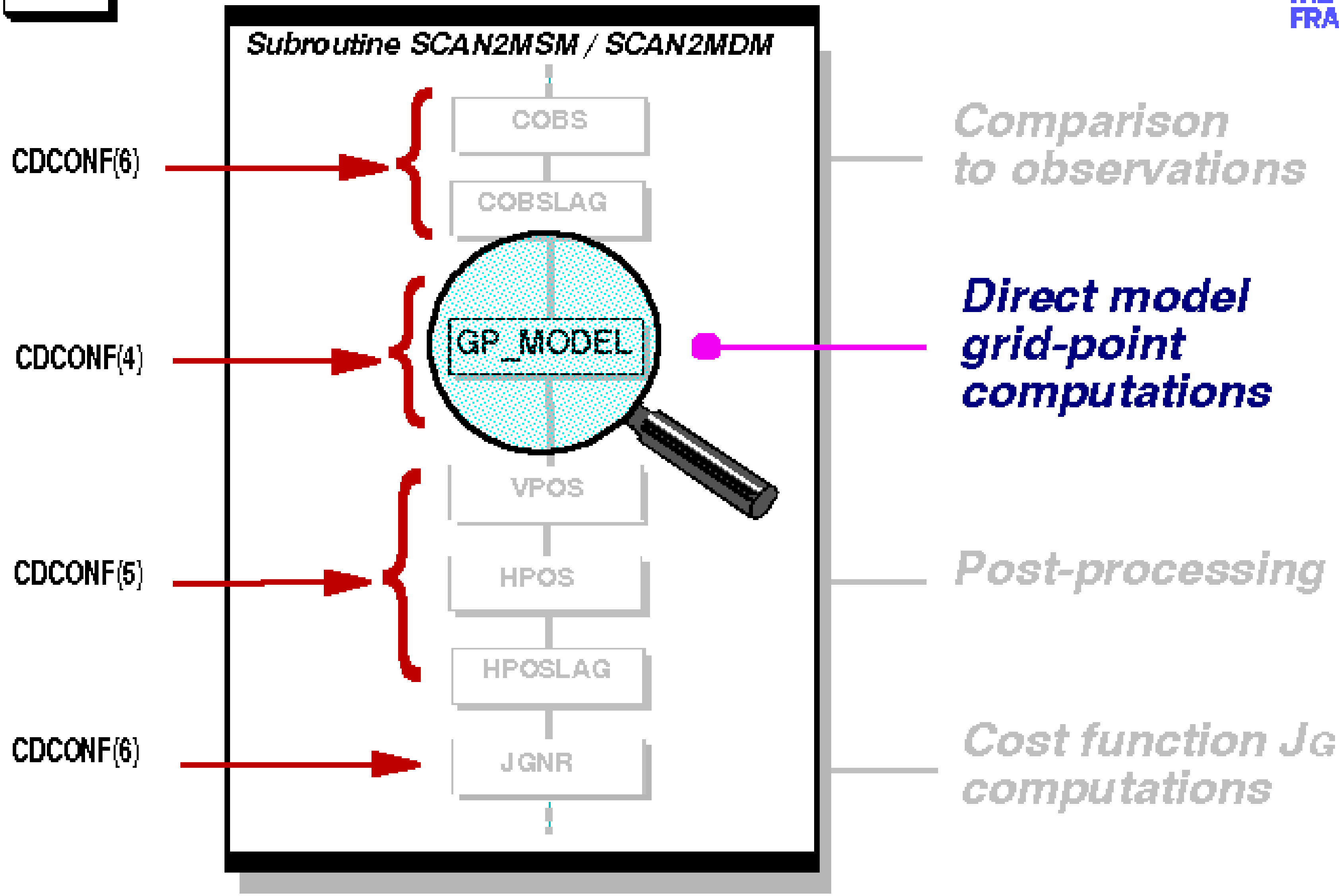


# SCAN2H & SCAN2MSM / SCAN2MDM



# Gridpoint computations

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# Grid-point computation

- Gp_model
  - CPG
    - cpg_gp
    - lacdyn
    - cpg_dyn
      - Lassie/lanhsi (Linear terms used in SI)
      - Lavent (wind to find SL traj)
      - Lattex (quantities to be interpolated)
    - cpg_end
  - CALL_SL (SL interpolations)
  - CPGLAG (Final t+dt values)

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# The data flow

- Spectral arrays
- Grid points arrays
- Data flow

# Spectral (distributed) arrays

Number of upper air spectral fields

SPA3(NFLSUR,NSPEC2,NS3D)

(over)-number of vertical levels (NFLEVL)

Number of spectral coefficient

SPA2(NSPEC2,NS2D)

Number of surface spectral fields

SPA1(NFLSUR,NS1D)

Number of 1D fields

SPGFL(NFLSUR,NSPEC2,YGFL%NUMSPFLDS)

Number of gfl fields with spectral representation

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# Spectral arrays are split:

(target <= pointers)

SPA3(:,:,1) <= SPVOR(:,:) Vorticity

SPA3(:,:,2) <= SPDIV(:,:) Divergence

SPA3(:,:,3) <= SPT(:,:) Temperature

SPA2(:,1) <= SPSP(:) (Ln) surf pressure

SPA2(:,2) <= SPOR(:) Surf geopotential

SPA1(:,1) <= SPUB(:) mean wind (U)

SPA1(:,2) <= SPVB(:) mean wind (V)

NH variables

Pressure departure

SPA3(:,:,:) <= SPSPD(:,:)

Vertical divergency

SPA3(:,:,:) <= SPSVD(:,:)

… And possibly

SPA3(:,:,:) <= SPGFL(:,:,YQ%MPSP) Specific moisture

SPA3(:,:,:) <= SPGFL(:,:,YL%MPSP) liquid water

SPA3(:,:,:) <= SPGFL(:,:,YI%MPSP) Ice

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# Ordering of spectral coefficients

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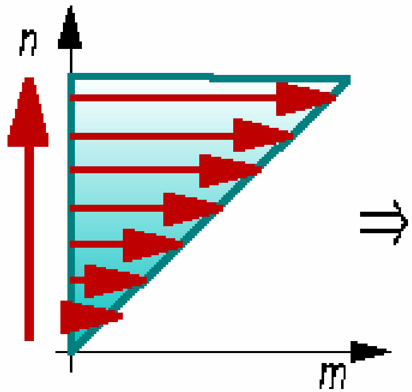
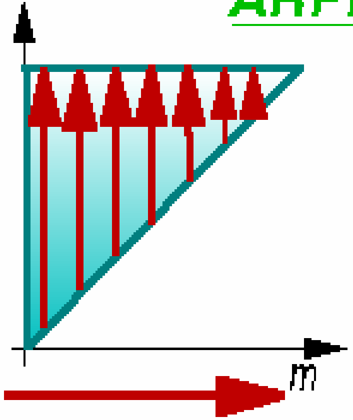
*In file ARPEGE :*

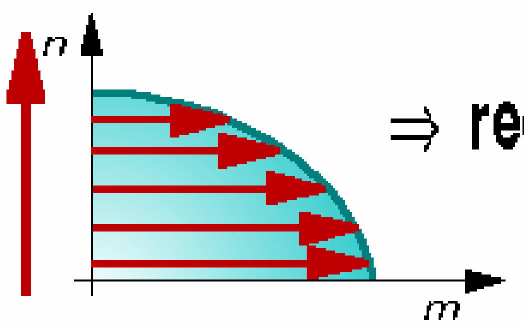



⇒ reordering ⇒

*In model ARPEGE/IFS :*

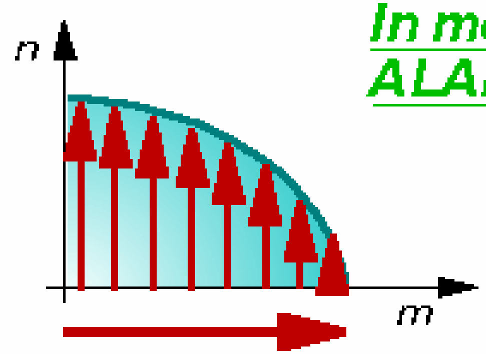



*In file ALADIN :*




⇒ reordering ⇒

*In model ALADIN :*




**... Initial ordering has been modified in order to enable an easy distribution of data**

# Grid point arrays

- 2 data structures :
  - GMV : prognostic variables involved in SI u,v,T,ps (pd,vd)
  - GFL : other variables such as q, ql, qi, …

# GMV(T1)(nproma,nflevg,nfields,ngpblks)
# GMVS(T1)(nproma,nfields,ngpblks)

Ex : GMV(:,:,YT0%MT,:)

Access to fields by pointers

YT0,YT9,YT1: pointers to T0,T9, T1 quantities

« Fields » pointers, ex: MU,MV, MDIV,MVOR, MT,

MSPD, MSVD

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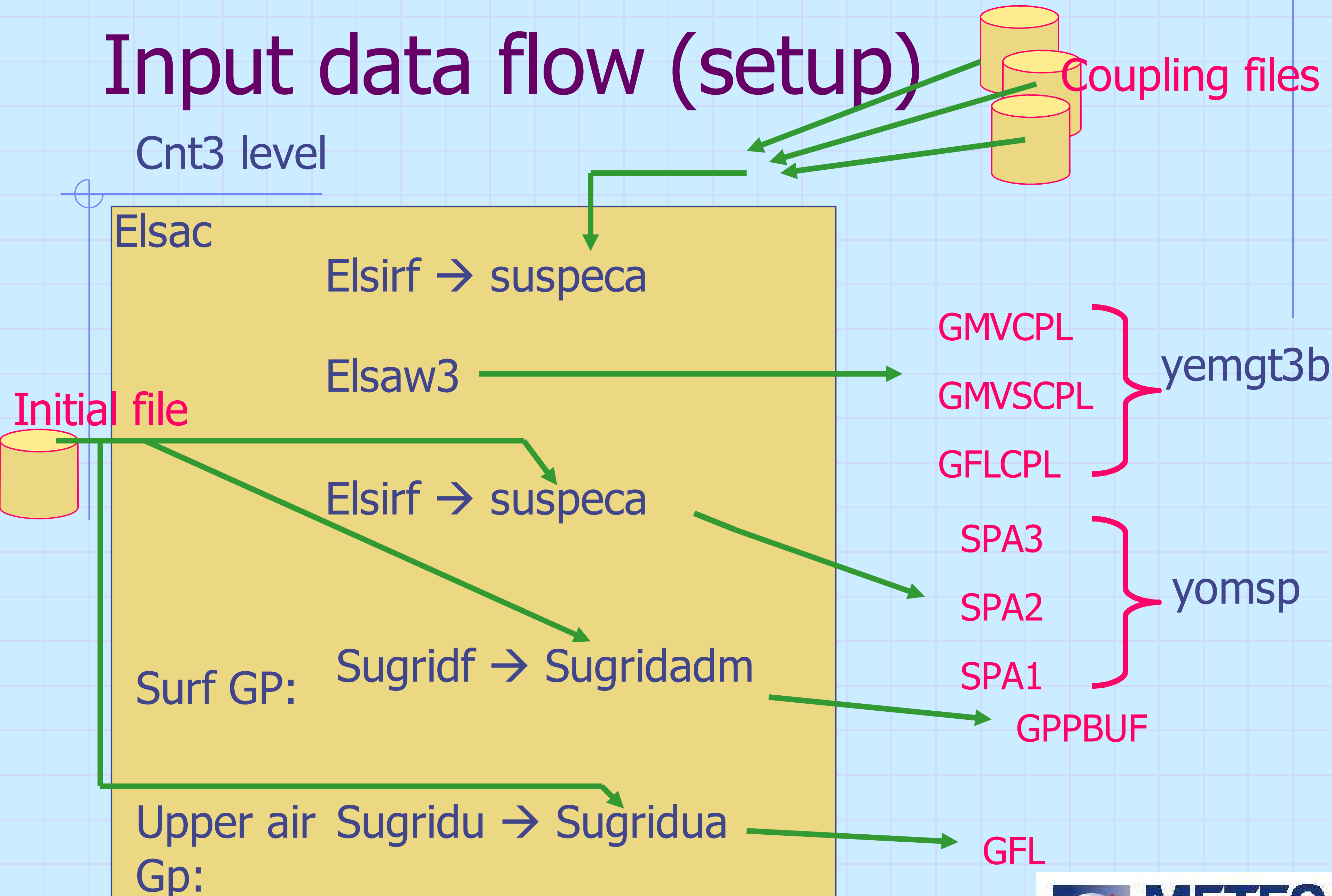
# GLF(T1)(nproma,nflevg,nfields,ngpblks)
# ex gfl(:,:,YQ%MPL,:)

« fields pointers » : YQ, YI, YL, …

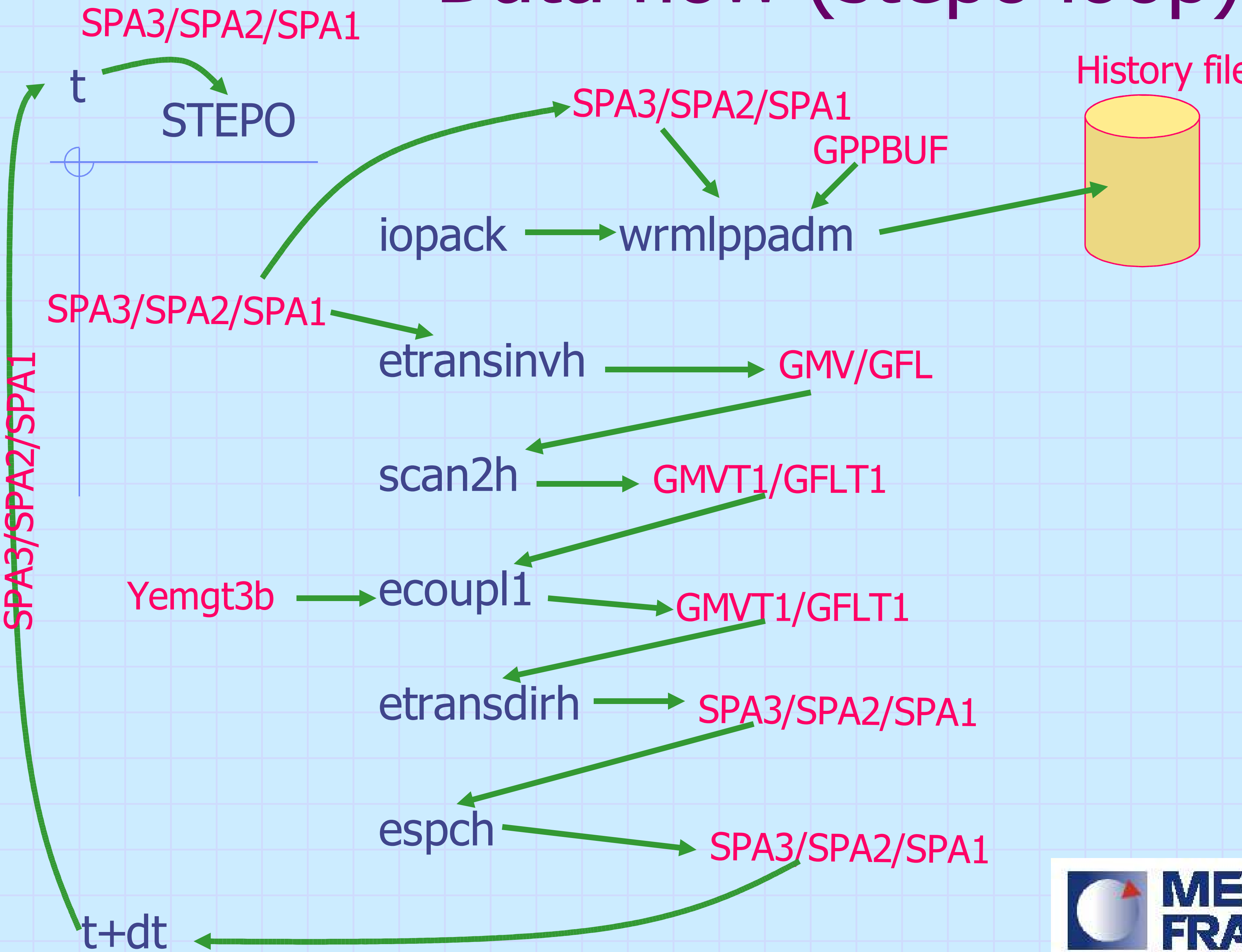
« attributes »:

- MP : basic field pointer
- MPL : zonal derivative
- MPM: meridional derivative
- MPSP: basic field spectral space
- Ladv (advec or not), Lsp (spectral representation or not), …

# Input data flow (setup)



# Data flow (stepo loop)



# NH specificities

2 prognostic additional variables: d4, p2

P2: the pressure departure « PD »

GMV(:,:,YT0%MSPD,:)

GMV(:,:,YT9%MSPD,:) GMVT1(:,:,YT1%MSPD,:)

D4: the vertical divergency « VD »

GMV(:,:,YT0%MSVD,:)

GMV(:,:,YT9%MSVD,:) GMVT1(:,:,YT1%MSVD,:)

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# The famous auxiliary variable

Activated in case nh+d4 by variable lvdaux (yomaux)

D4 = D3 + X

AUX variable

X term

GMV(:,:,YT9%MSVDAUX,:)

GMV(:,:,YAUX%MSVDAUX,:)

GMVT1(:,:,YT1%MSVDAUX,:)

# Setup-IO

In file : « PD »→ p-pi

« VD »→-gdw

The conversion is done on gnhpdvdconv

The X term (needed often is computed un GNHX)

# ICI or PC scheme

- Predictor part « CDCONF(4)='A' », corrector part « CDCONF(4)='S' »,
- It is needed to store terms to communicate between predictors (a) and between predictor and correctors (nsiter >=1) (b)
  - (a) when t+dt/2 is needed (2 tl extrapolation) => PXNLT9 arrays : YT9%MXNL
  - (b) PXT9 , PCXNLT9 and PCXNLT99 (pseudo-second order decentered); YT9%MX, YT9%MCXNL, last one is store in a buffer