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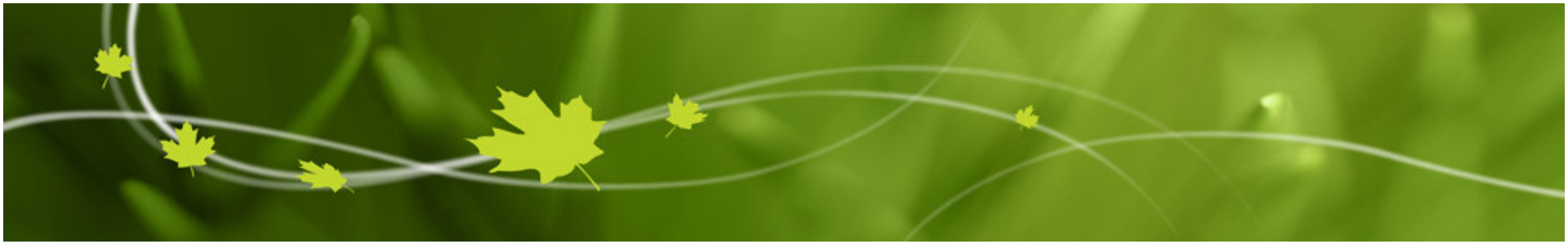


The Polar Communications and Weather Mission (PCW) A new Mandate for Environment Canada

G. Szejwach and L. Garand

March 25, 2011

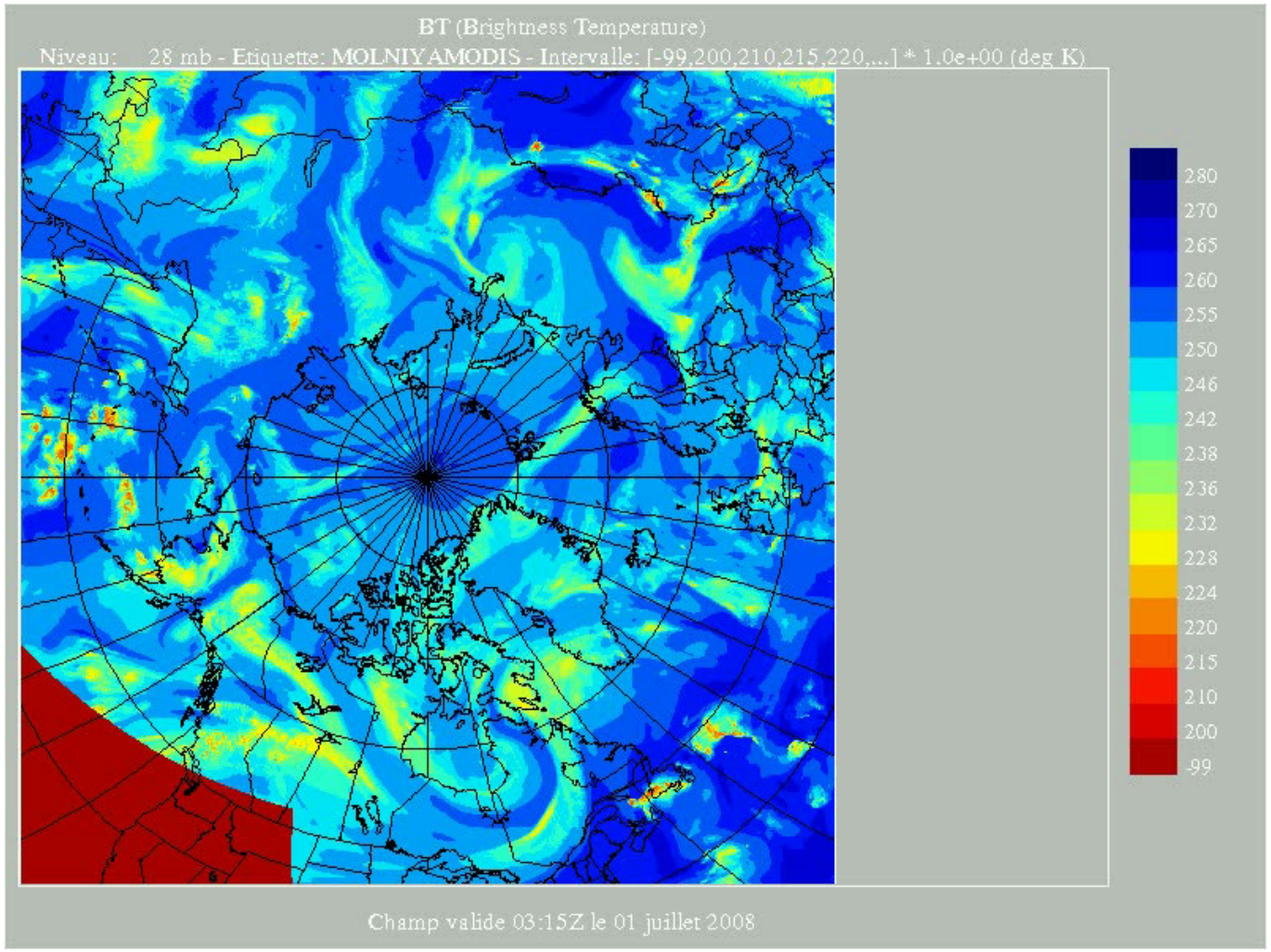
Contents

- PCW Mission Objectives
- Status and Major Milestones
- EC's Mandate within the PCW Mission
- Overall Ground Segment Concept
- Functions associated with the Application Ground Segment Facilities
- Baseline List of Products
- Data Volumes
- Creating the new PWC Data Processing Center
- Manpower Resources Estimates
- Suggestions and Recommendations
- Conclusion

PCW Mission Objectives

- 24/7 communications in Canadian Arctic in support of:
  - DND operations
  - air and marine traffic
  - communities
- 24/7 high spatial resolution meteorological data above 50º N in support of:
  - Numerical Weather Prediction (short to medium range)
  - Environmental monitoring, emergency response
  - Climate monitoring
- Space and Weather Monitoring

24-h animation, 2 satellites



Status and Major Milestones

Approved and Funded

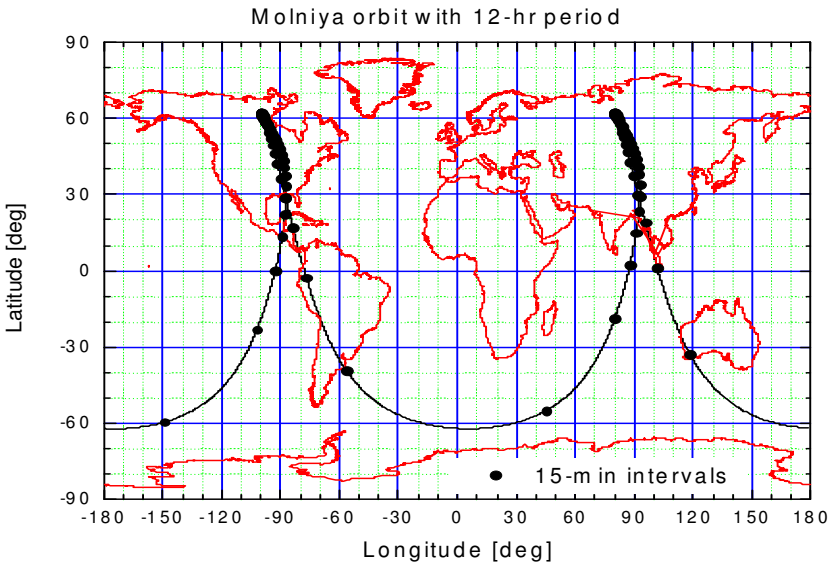
- Phase 0 completed: September 2008
- Phase A contract awarded: July 2009
- Phase A Major Milestones
  - **Technology Readiness Assessment Review: October 2009**
  - **Critical Technologies Development procurement: February 2009**
  - **Mission Requirements Review: February 25, 2010**
  - **Preliminary System Requirements Review: June 2010**
  - **Phase A closure: March 31, 2011**

Approval and Funding Still Required

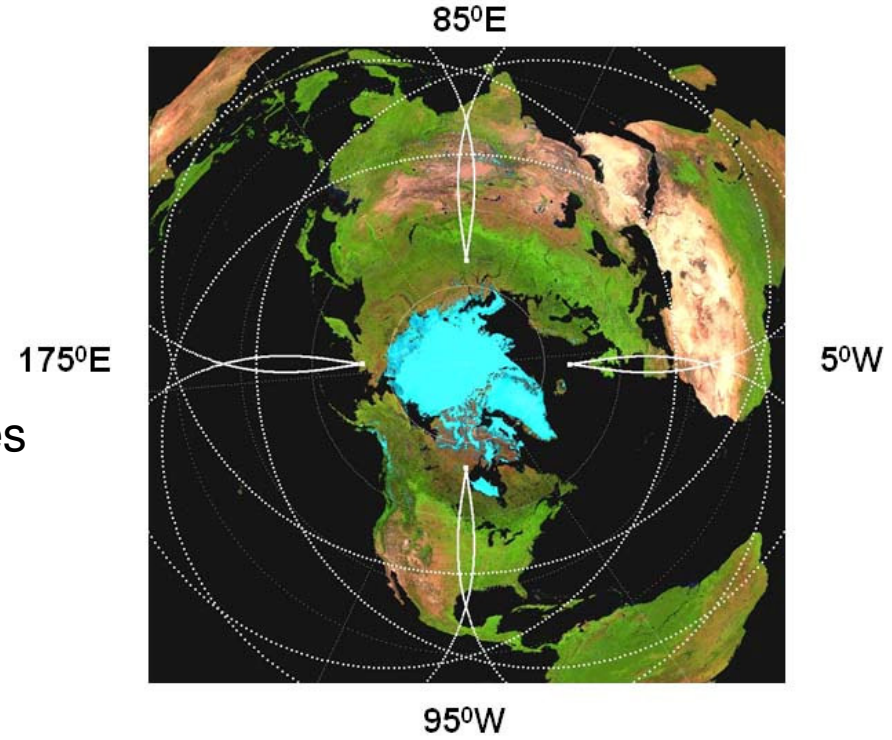
- Phase B contract award: late 2011, start mid 2012
- PPP approach likely
- Launch of Satellite 1: Q1 2017
- Launch of Satellite 2: Q2 2017

PCW is top priority program at CSA

Baseline12-h orbit concept



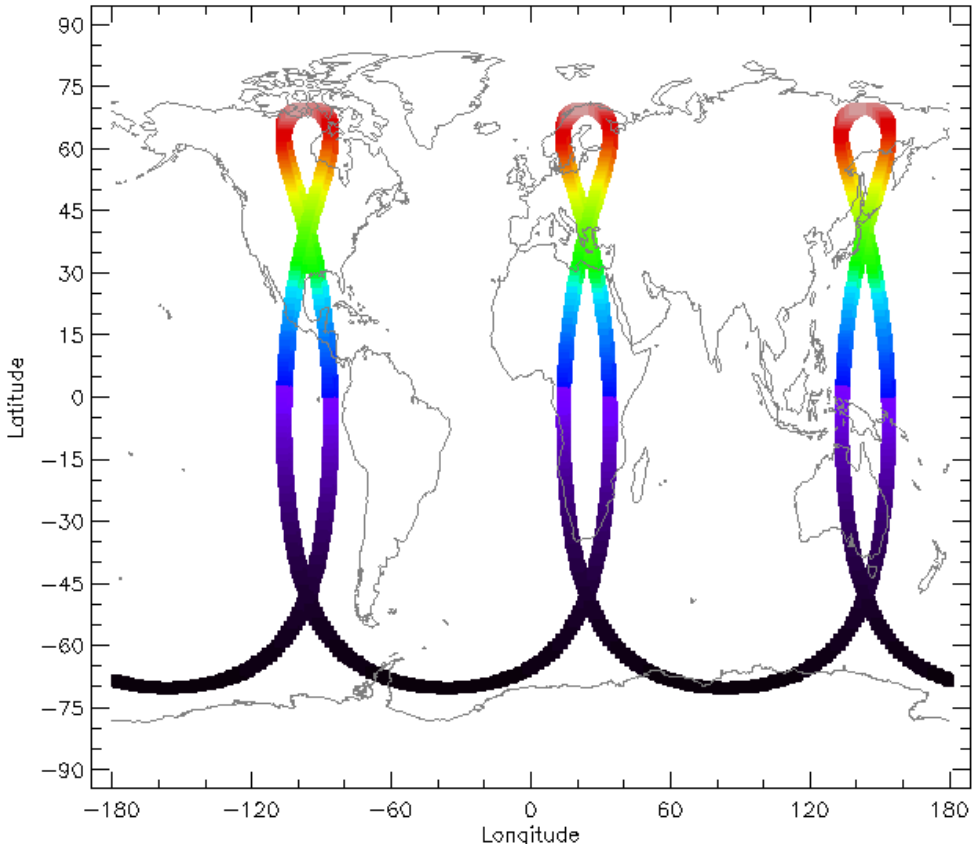
Apogee: 39,500 km
Perigee: 600 km

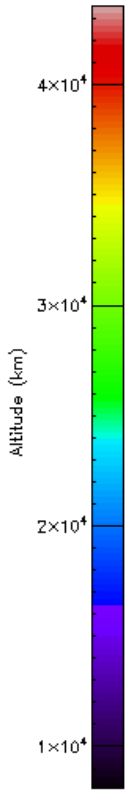


2 sats in one plane leading to 4 apogees separated by 90 deg

Ref: Trishchenko and Garand, Jtech, 2011

Revised orbital concept: 16-h orbit





Apogee: ~43,500 km
Perigee: ~8,100 km

Main advantage:
-Much less subject to damage from protons than 12-h orbit

Three **AP**ogee (**TAP**) orbit

Suggested apogees: 95^{0}W; 25^{0}E, 145^{0}E

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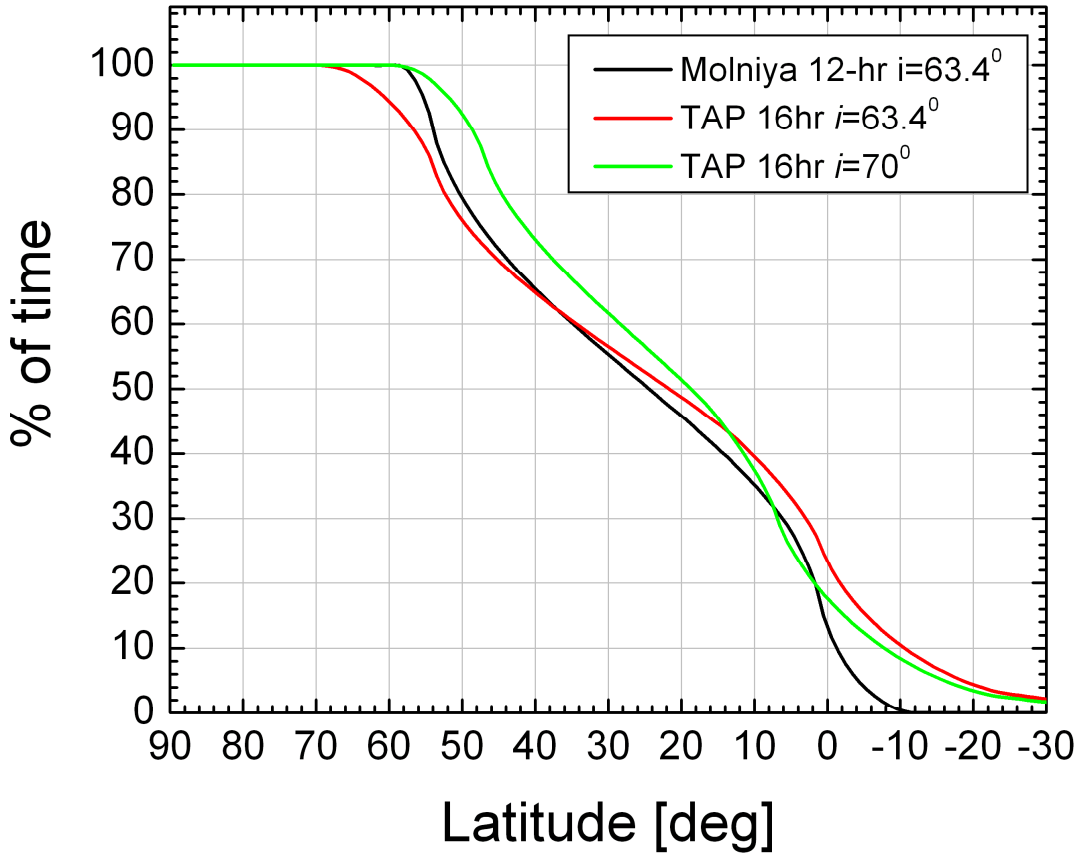
Zonal mean coverage: 12-hr vs 16-hr orbit



Better coverage with higher orbit inclination, but may Require more fuel for maintenance

From: Trischenko et al, 2011 (JTech)

PCW Imager Specifications

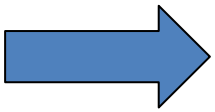
Band No.	subgroup	Wavelength (microns)	Heritage	Priority	GSD (km) Goal	GSD (km) Max	Main applications
1	VNIR	0.45-0.49	ABI, FDHSI	1	0.5	1.5	Surface, clouds, aerosols
2		0.59-0.69	ABI, FDHSI	1	0.5	1.5	Wind, clouds, ice mapping
3		0.704-0.714	MERIS-09	2	0.5	1.5	Water quality, chlorophyll
4		0.85-0.89	ABI, FDHSI	1	0.5	1.5	Wind, aerosols, vegetation
5	SWIR	1.04 – 1.06	SGLI SW1	2	1.0	3.0	Snow grain and clouds
6		1.37-1.39	ABI, FDHSI	2	1.0	3.0	Cirrus detection
7		1.58-1.64	ABI, FDHSI	1	0.5	1.5	Snow-cloud distinction, ice cover
8		2.22-2.28	ABI, FDHSI	1	1.0	3.0	Aerosol, smoke, cloud phase
9	MWIR	3.80-4.00	ABI, FDHSI	1	2.0	3.0	Fog, fires, ice/cloud separation, wind, cld.phase
10		5.77-6.60	ABI, FDHSI	1	2.0	3.0	Wind, high level humidity
11		6.75-7.15	ABI, MTSAT	2	2.0	3.0	Wind, mid level humidity
12		7.24-7.44	ABI, FDHSI	1	2.0	3.0	Wind, low level humidity,SO_2
13	LWIR	8.30-8.70	ABI, FDHSI	1	2.0	3.0	Total water, cloud phase
14		9.42-9.80	ABI, FDHSI	2	2.0	3.0	Total ozone
15		10.1-10.6	ABI, FDHSI	2	2.0	3.0	Cloud, surface, cirrus
16		10.8-11.6	ABI, HIRS	1	2.0	3.0	Cloud, SST, ash
17		11.8-12.8	ABI, FDHSI	1	2.0	3.0	Ash, SST
18	LIRCO2	13.0-13.6	ABI, FDHSI	1	2.0	3.0	Cloud height
19		13.5-13.8	MODIS,HIRS	2	2.0	6.0	Cloud height, low level temperature
20		13.8-14.1	MODIS,HIRS	2	2.0	6.0	Cloud height, mid level temperature
21		14.1-14.4	MODIS,HIRS	2	2.0	6.0	Cloud height, high level temperature

Science Team activities

- Orbital analysis
- Radiance simulations (RRTOV, CRTM)
- Import U. Wisconsin AMV software
- OSSE on PCW AMV impact
- Support proposals of additional atmospheric payloads (UV-VIS-NIR, FTS)
- Definition of future PCW Data Processing Center

EC's Mandate within the PCW mission

- Primary user of the meteorological mission
- Responsible for:
  - Operational processing
  - Product generation
  - Archiving & retrieval
  - Data distribution/dissemination: national & international



PCW has a mandate similar to that of NOAA, Eumetsat or GMA

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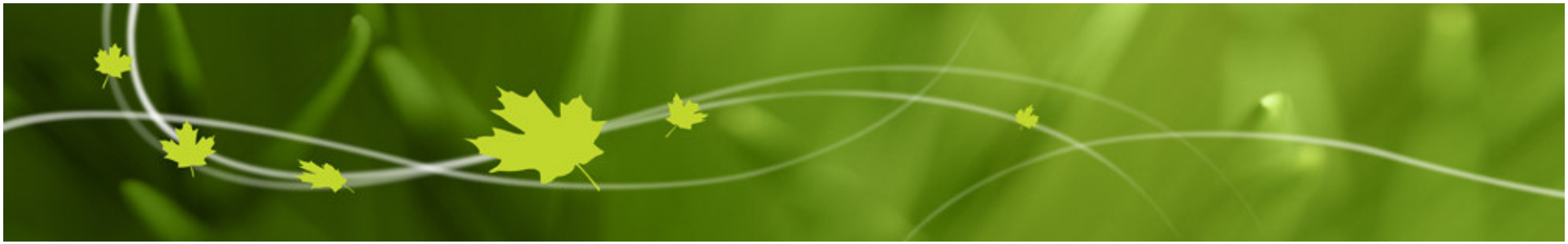


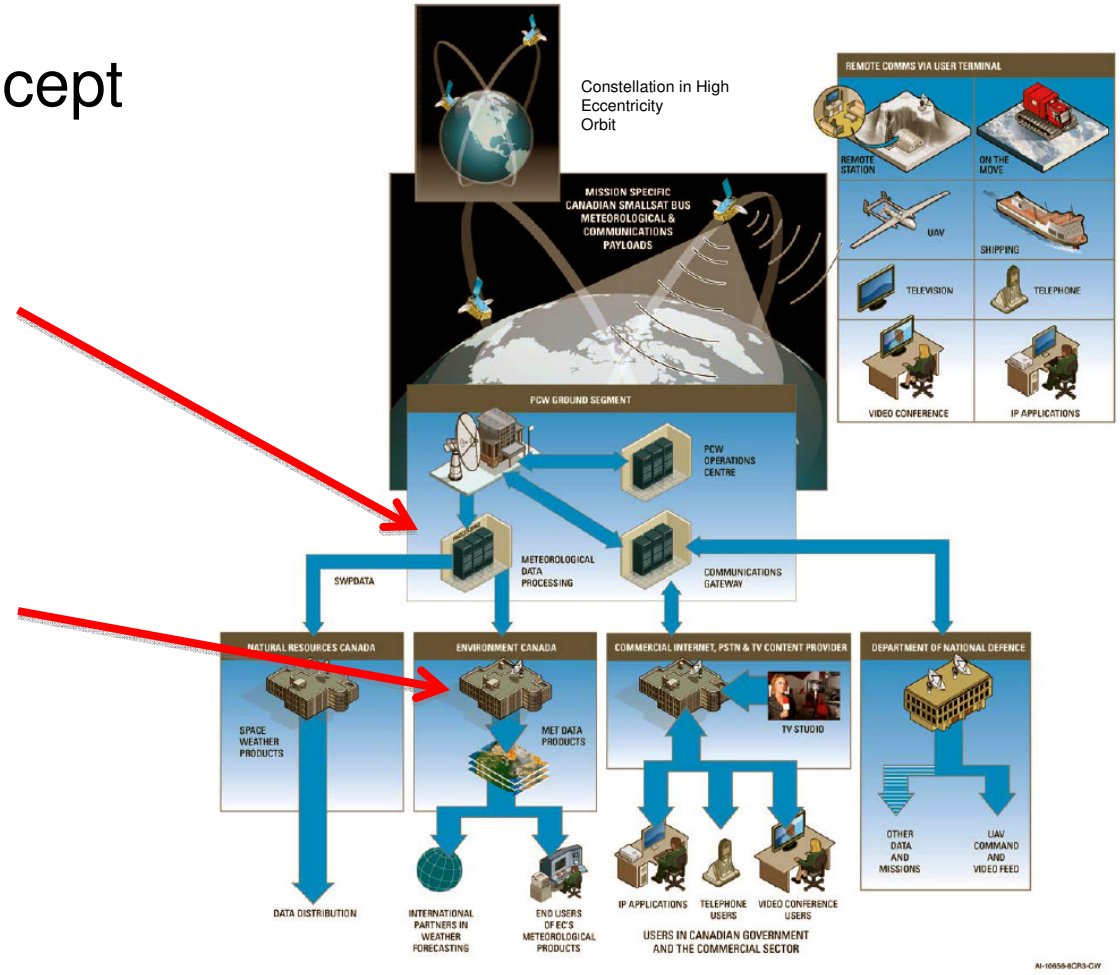
OVERALL
GROUND SEGMENT CONCEPT

Overall Ground Segment Concept

- Initial industrial concept

Data pre-processing
(Level 0 to Level 1c)

Meteorological
Products Generation
(Level 1 to Level 2)



PCW Meteorological Data Flow


Ground Station

Raw data

Met Primary Data Processing Facility (PDPF)

Raw data

Processed images

Products Archival & Retrieval Facility (PARF)

Archive Products

Archive Users

Processed images

Meteorological products

Met. Applications Processing Facility (MAPF)

Meteorological products

Products Acquisition & Distribution Facility (PADF)

microwave link

satellite

WWW & FTP

Other Users

Subset of Products

Near-real time Products

Foreign National Weather Services

Environment Canada
www.ec.gc.ca

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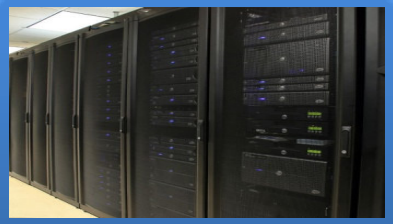
PCW Application Data Center

Ground Station

Raw data



Met Primary Data Processing Facility (PDPF)

Raw data

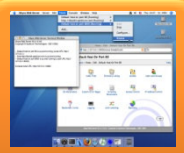
Processed images

Products Archival & Retrieval Facility (PARF)

Archive Products

Archive Users

Other Users



WWW & FTP

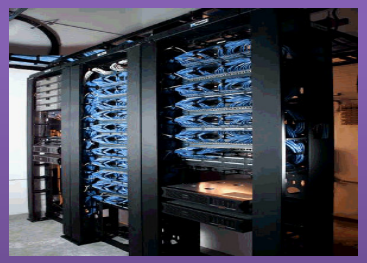
Subset of Products

Processed images

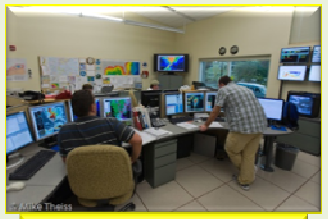
Meteorological products

Met. Applications Processing Facility (MAPF)

Meteorological products



Products Acquisition & Distribution Facility (PADF)



Foreign National Weather Services

Near-real time Products

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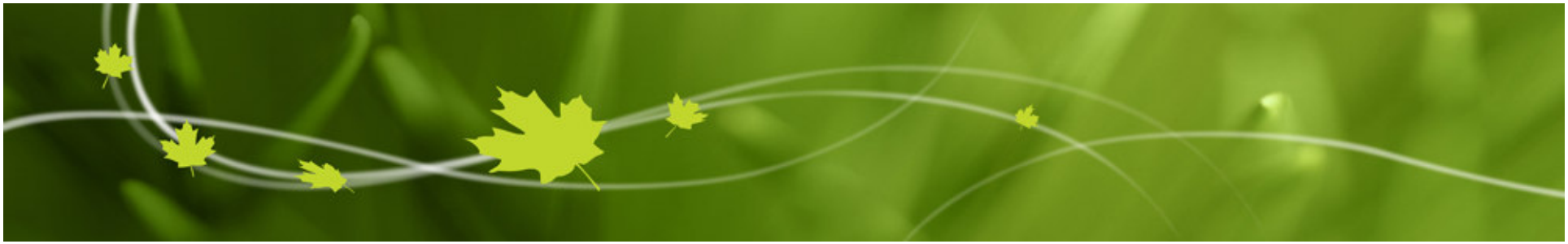
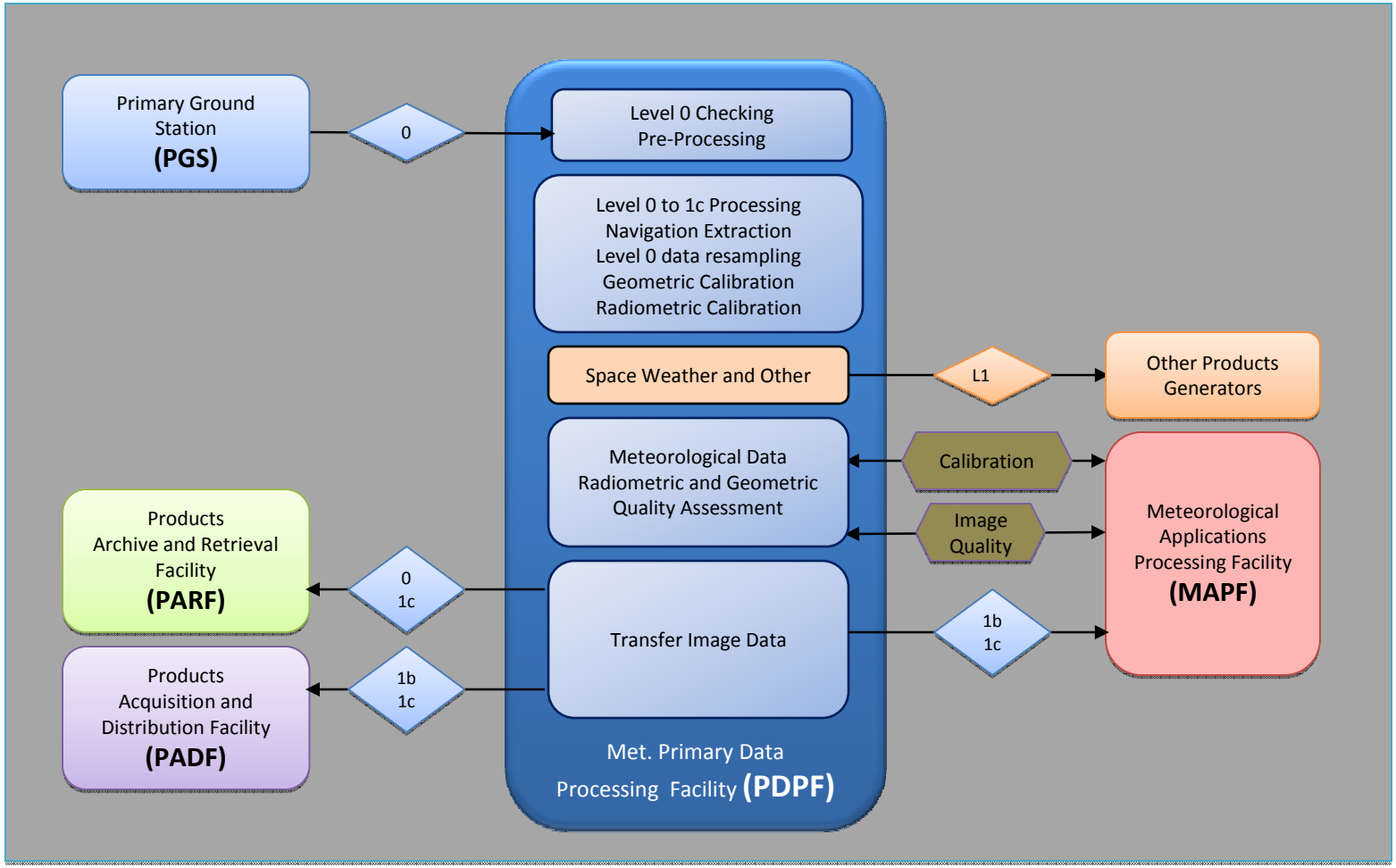


PCW DATA CENTER FACILITIES

Functions associated with Data Pre-processing
Primary Data Processing Facility (PDPF)

- Nominally developed by CSA, operated by EC
- Generate geometrically rectified and radiometrically corrected images from the level 0 (raw) data which enter the PDPF from the Primary Ground Station. This involves the following actions:
  - Data acceptance and Preparation
  - Level 0 Data pre-processing
  - Navigation extraction
  - Level 0 data resampling
  - Radiometric calibration processing
  - Geometric Calibration processing
  - Radiometric quality assessment
  - Geometric quality assessment

PDPF Functional Architecture and Interfaces



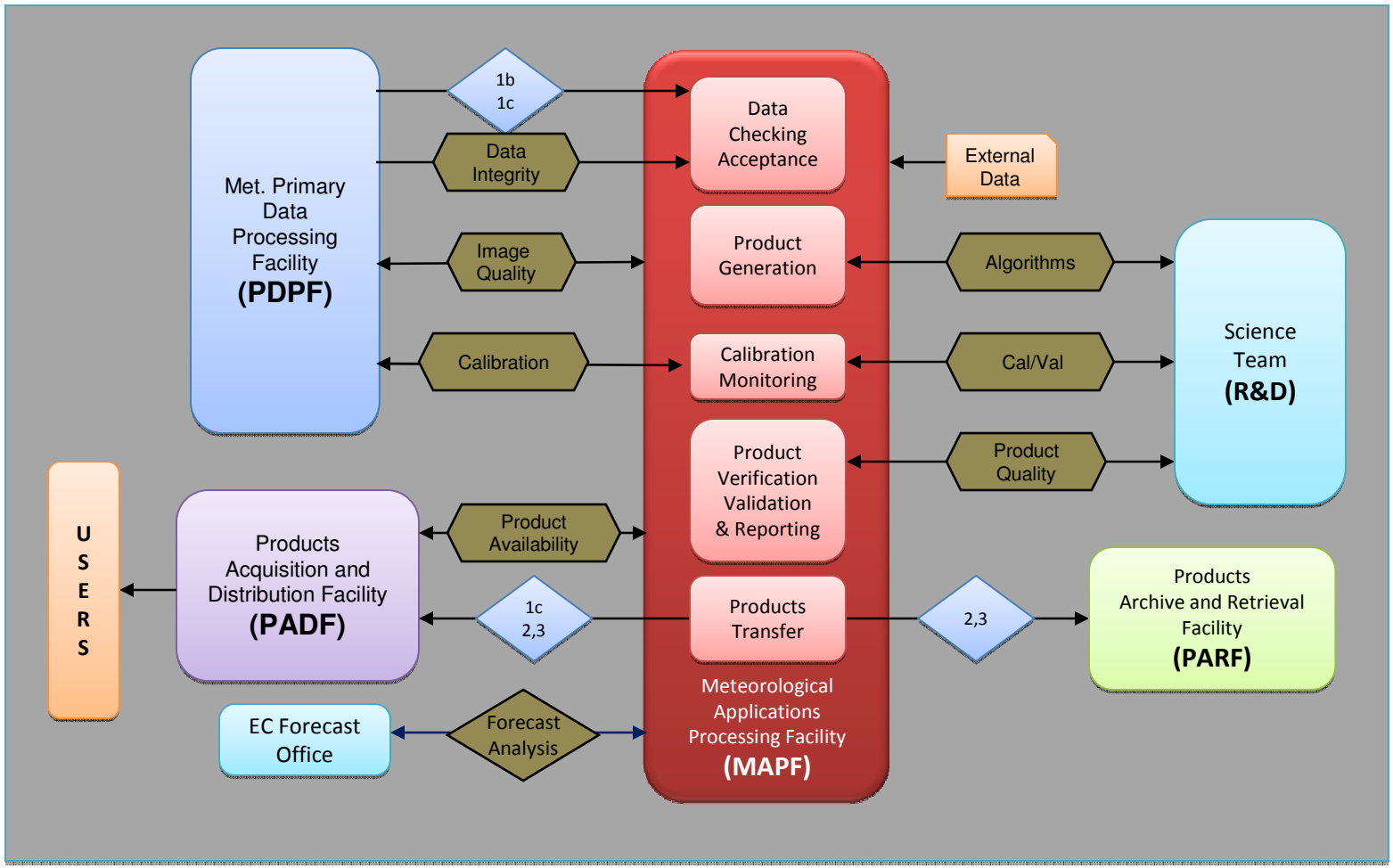
Functions associated with Product Generation
Meteorological Application Product Facility (MAPF)

- Meteorological Product generation is performed within the Meteorological Application Product Facility (MAPF) from Level 1 image data supplied by the Primary Data Processing Facility (PDPF).
- After quality control, encoded products are delivered to users and to the Product Archive and Retrieval Facility (PARF) for online and offline retrieval. MAPF functions include:
  - Reception of processed image data and associated auxiliary data from the Meteorological Primary Data Processing Facility (PDPF). These include all Level 1 data
  - Data checking and acceptance

Functions associated with Product Generation
Meteorological Application Product Facility (MAPF)

- MAPF functions (cont.)
  - Meteorological product (and other as required) generation (Level 2 and above)
  - Calibration monitoring
  - Product verification
  - Analysis and reporting
  - Visualisation and analysis
  - Monitoring and control
  - Distribution of products to the Product Acquisition and Dissemination Facility (PADF)

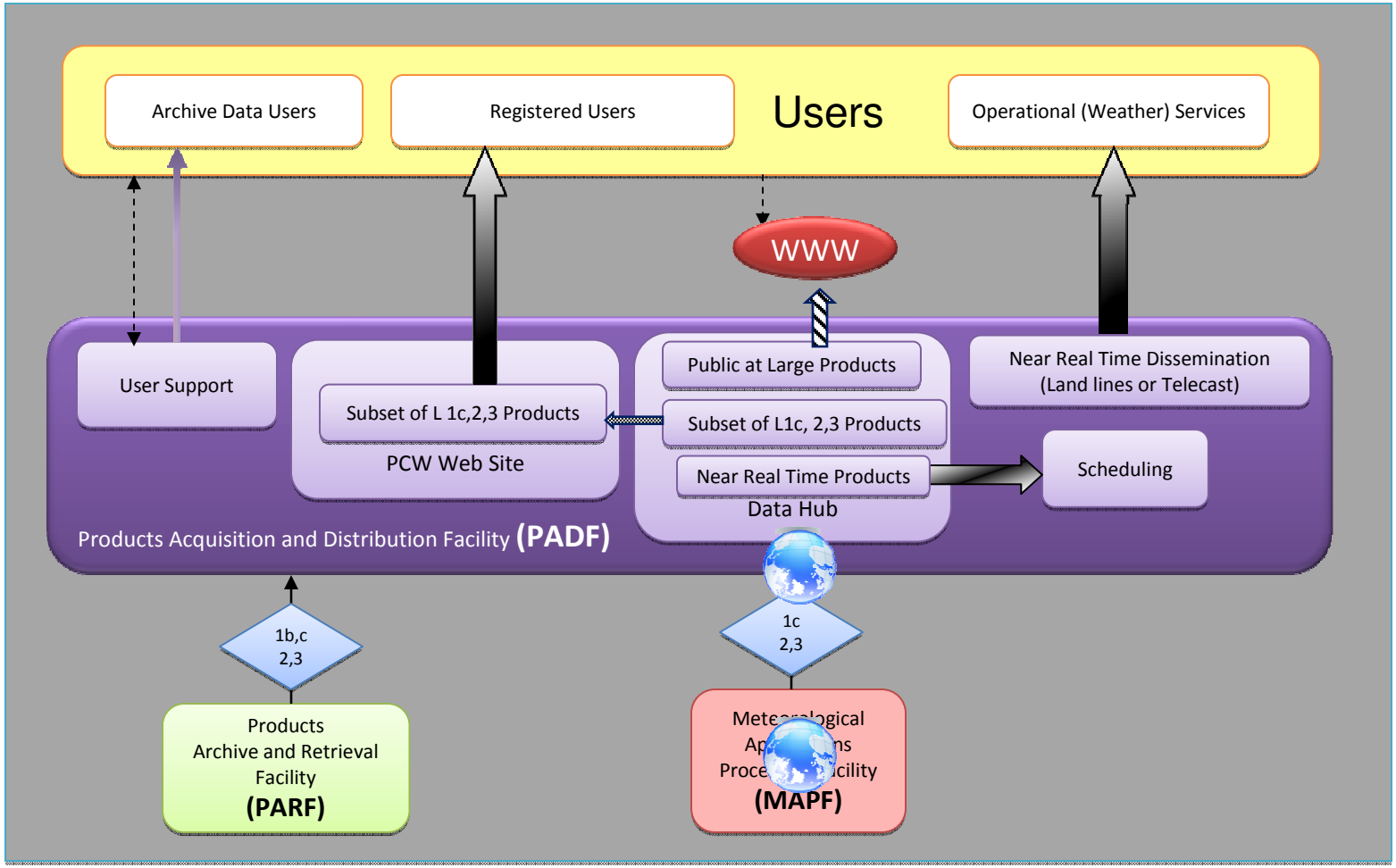
MAPF Functional Architecture and Interfaces



Functions associated with Product Distribution
Product Acquisition and Distribution Facility (PADF)

- The PADF performs the acquisition and the distribution of PCW image data and meteorological products generated by EC or by other entities (TBD).
- The data streams coming into the PADF will include:
  - Processed Image data from the Meteorological Primary Data Processing Facility (PDPF)
  - Meteorological products from the MAPF
  - Archive Products from the PARF and/or other entities (TBD)
  - Service messages (e.g. service or test messages)
  - Others (for future extension)

PADF Functional Architecture and Interfaces



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Functions associated with Archiving & Retrieval
Products Archive & Retrieval Facility(PARF)

- The Users Requirement Document (URD) [Ref.1] defines the archiving requirements as follows:
  - *PCW meteorological data must be archived. Details are to be developed, but the following are current requirements: Level 0, 1c and 2 data is required to be archived indefinitely, along with the accompanying metadata including satellite information. Level 1b data must be stored for 5 years after acquisition.*
- *The data archiving system should be able to generate any Level 1b data files on demand, starting from Level 0 data and corresponding metadata.*

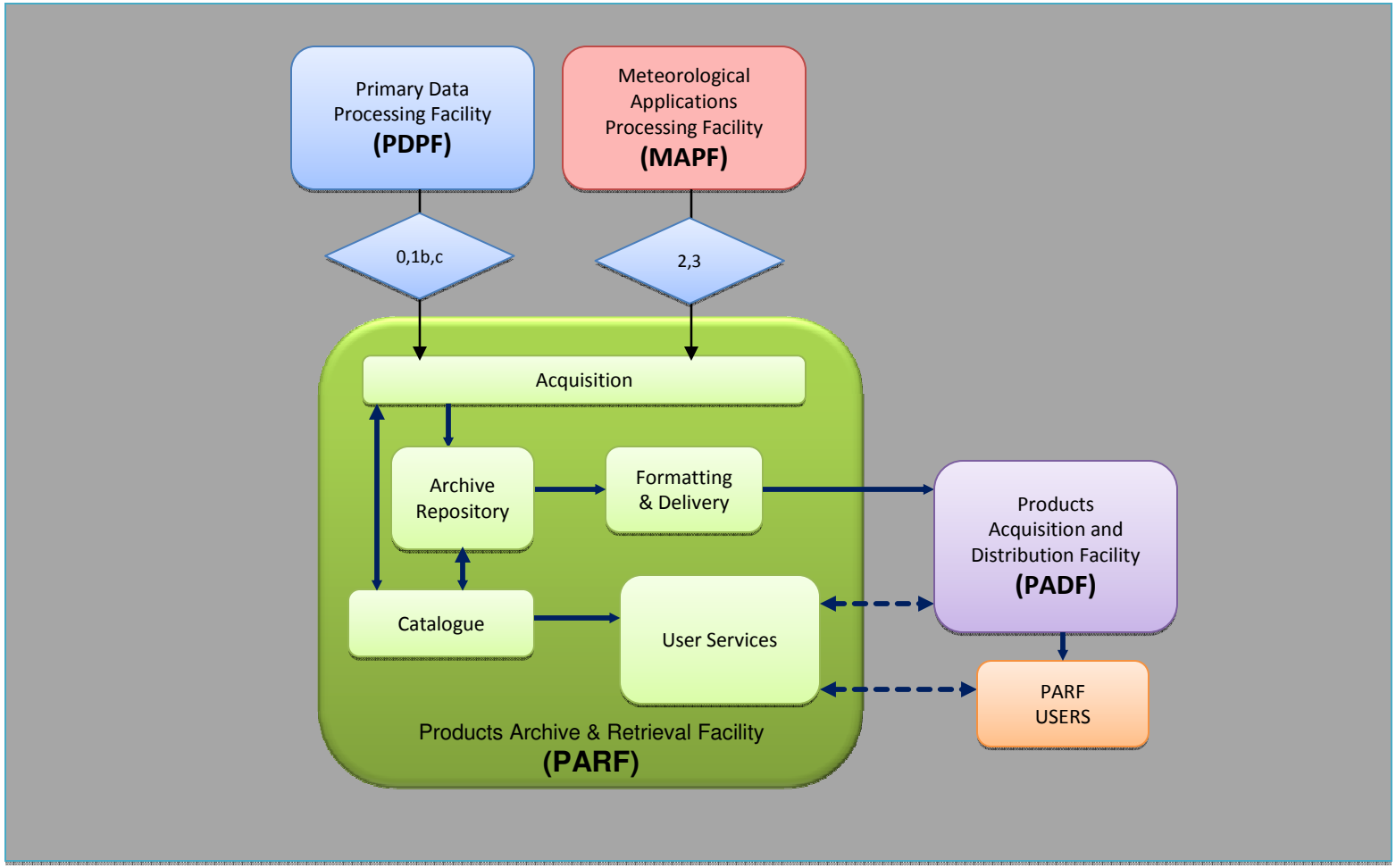
Functions associated with Archiving & Retrieval
Products Archive & Retrieval Facility(PARF)

- The Product Archive and Retrieval Facility (PARF) should provide the following functions:
  - Acquisition & archiving of images data up to Level 1c
  - Acquisition and archiving of Level 2 and above products elaborated by the MAPF
  - Acquisition and archiving of Level 2 and above products elaborated by other entities (TBD)
  - Generation and maintenance of catalogues covering the archived data sets
  - Provision of on-line catalogue query and product retrieval

Functions associated with Archiving & Retrieval
Products Archive & Retrieval Facility(PARF)

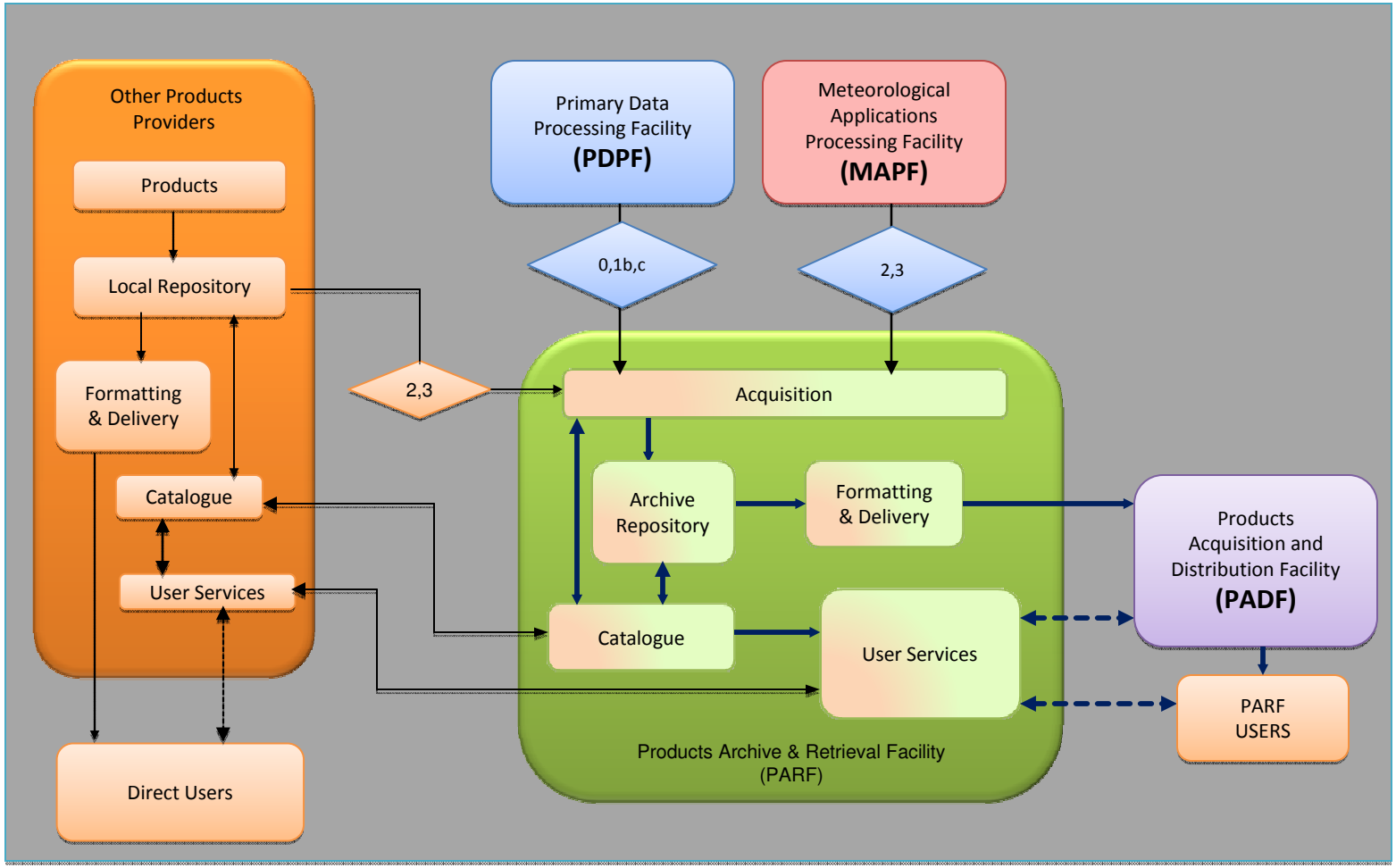
- Provision to the end users of a comprehensive set of services allowing access to the archived data sets and related information
- Provision of an information service giving access to PCW or PARF specific operations-related data
- Provision of an interface to the other facilities in the Ground Segment for generating/updating information of relevance to the end users covering operational aspects
- Distribution of products to the Product Acquisition and Dissemination Facility (PADF) (TBC)

PARF Functional Architecture and Interfaces



PARF Functional Architecture and Interfaces

Other Government Agencies (mixed option)



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Calibration, Validation, and Reprocessing

- CEOS WORKING GROUP on Cal/Val:
  - *Calibration:* The process of quantitatively defining the system responses to known, controlled signal inputs.
  - *Validation:* The process of assessing, by independent means, the quality of the data products derived from the system outputs.
- GSICS (Global Space-based Inter-Calibration System)
  - The PCW application ground segment should be designed to adhere to GSICS conventions on Cal/Val
  - Small impact on archive and reprocessing facilities

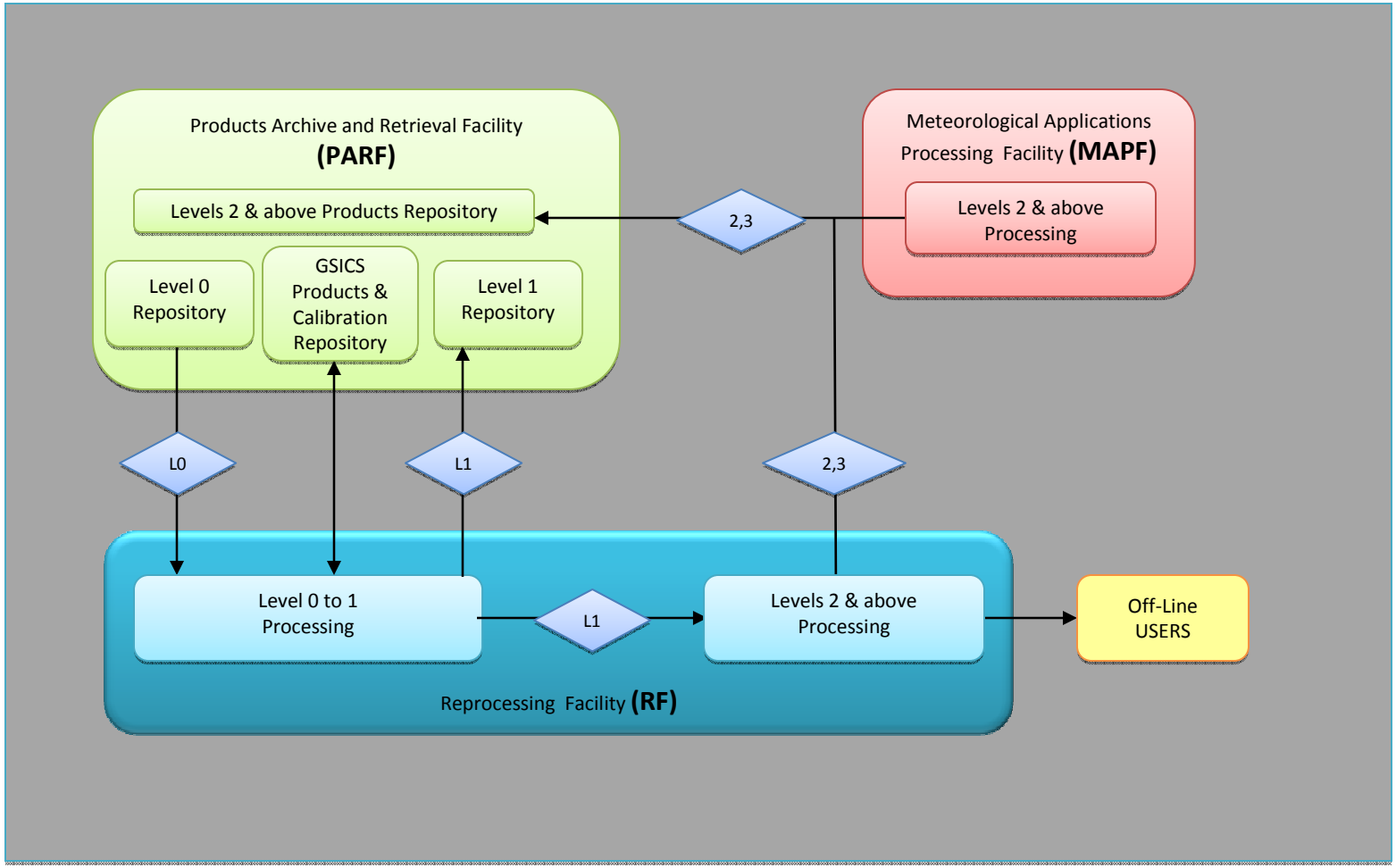
Functions associated with Calibration and Validation

- Within PDPF:
  - Perform routine modification of calibration coefficients (using on-board measurements)
  - Monitor and update the calibration values used to generate Level 1c images
  - Forward the calibration constants values to the Meteorological Product Application Facility (MAPF)

Functions associated with Calibration and Validation

- Within MAPF:
  - Assess the quality of the calibration coefficients using meteorological data
  - Propose recommendations to the PDPF in preparation for next image
  - Perform routine validation through inter-comparison as part of GSICS activities
  - Analyze historical calibration data to find out if a problem exists
  - Perform reprocessing of past products, as required, using the Reprocessing Facility

PCW Application Ground Segment Functional Architecture: Reprocessing Facility



Functions associated with Mission Monitoring, Reporting, & User Support

- Mission monitoring and reporting (within MAPF):
  - Product quality assessment
  - Provision of statistics on product delivery, timeliness, availability
  - Preparation of reports for users and management
- User support (within PARF and PADF):
  - Answer to queries
  - Interface with users for PARF and other products
  - Elaboration and distribution of information material (written form or web-based)

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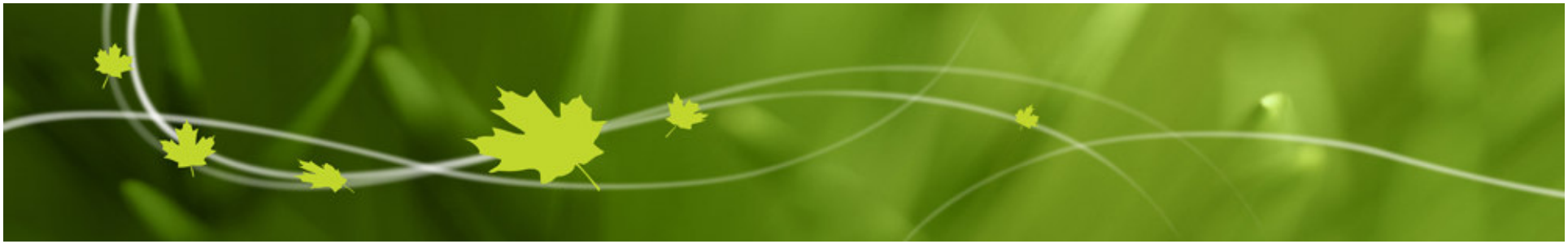

BASELINE LIST OF PRODUCTS

Baseline List of PCW Products (1)

PRODUCT	Repeat Cycle	Latency	COMMENT
Level 1c imagery	15 min	15 min	Calibrated, mapped to standard grid (15 min refresh)
Level 2 imagery	15 min	30 min	Composite of 2 satellites
AMV: Atmospheric Motion Vectors	1 hour	1 hour	Latency is w.r.t. oldest image of triplets/duos used for tracking
Cloud mask	15 min	30 min	Important for direct assimilation of radiances
Cloud height, amount, emissivity, temperature	15 min	30 min	Important for AMV
Volcanic ash height (optical depth)	15 min	30 min	When active. Done at Dorval volcanic ash advisory center. Could develop a SO2 product as well.
Fog and surface visibility	15 min	30 min	
Forest fires. Hot spots	3 hours	1 hour	Product elaborated either, or both at CCRS and CFC

Baseline List of Products from PCW Imager (as of 16 September 2010)
Imagery and Priority 1 Products
Note: Near real time products are derived from Level 1c

Baseline List of PCW Products (2)

PRODUCT	Repeat Cycle	Latency	COMMENT
Ice motion vector	TBD	TBD	To be defined (e.g. Canadian Ice Service)
Snow/ice mapping (cover and depth)	6 hours	6 hours	Derived from 15 min. Resolution 2 km. May include snow grain size.
SST: sea surface temperature	1 hour	2 hours	Resolution 4 km
LST: land surface temperature	1 hour	2 hours	Resolution 4 km
Surface albedo	6 hours	6 hours	Resolution 10 km. Could be done at CCRS
Aerosol optical depth	3 hours	6 hours	Resolution 10 km
Atmospheric stability index	1 hour	1 hour	Resolution 10 km
Aircraft icing threat	1 hour	15 min	Resolution 10 km
Total ozone	1 hour	1 hour	Resolution 10 km
Note: Level 2 products are retrievals made from Level 1c. Level 3 products defined at a coarser resolution. Surface parameters are only available in clear air (mask =0) or when the sun angle allows. In areas devoid of observations, the pixels are either left blank or replaced by a previously obtained value.			

Baseline List of Products from PCW Imager (as of 16 September 2010)
Priority 2 - Level 2/3 generated by EC

Baseline List of PCW Products (3)

PRODUCT	Repeat Cycle	Latency	COMMENT
Vegetation Index	1 day	1 day	Resolution 1 km
FPAR	1 day	1 day	Fraction of Absorbed Photosynthetically Active Radiation. Resolution 1 km
LAI: Leaf Area Index	1 day	1 day	Resolution 2 km
Radiative fluxes	1 hour	1 day	Resolution 10 km (SW, LW, PAR at surface and TOA)
Land surface emissivity	1 day	1 day	4km consistent with LST product
Archive Products: Levels 0, 1c and 2 are archived forever at CMC, and Level 1b for 5 years. In addition rotating archive of Level 0 at ground receiving station.			

Baseline List of Products from PCW Imager (as of 16 September 2010)
Priority 2 - Level 3 climate essential variables products and archive
Products can be elaborated by EC or Other Government Department

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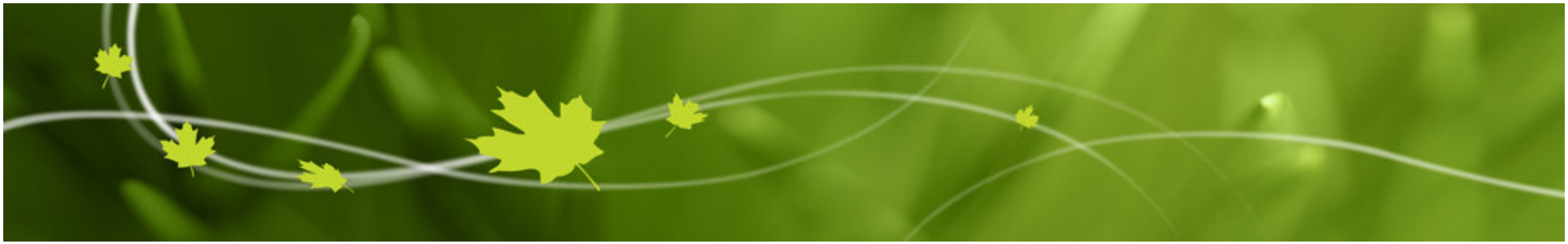

DATA VOLUMES

Near Real Time Data Volumes

- Level 0 data received by the Primary Data Processing Facility (PDPF)
- Level 1 data received, and Level 2,3 data transmitted, by the Meteorological Application Processing Facility (MAPF)
- Level 1,2,3 data distributed by the Product Acquisition and Distribution Facility (PADF)

Other Products Data Volumes

- Archive and Retrieval (PARF)
  - Level 0,1,2,3 data received by the Archive & Retrieval Facility (PARF)
  - Level 1,2,3 data processed by the PARF to Users
  - Level 0,1,2,3 data processed by the PARF for GSCIS (Cal/Val) and reprocessing purposes
- FTP/WEB Site for registered Users
- WWW Site for Public Users

Preliminary Data Volumes Estimates

Preliminary Data Volumes: Imagery		
Product	Daily (GigaBytes)	Yearly (TeraBytes)
Level 0	499	182
Level 1b	794	290
Level 1c	148	54
Level 2	70	26
Level 3	17	6

Preliminary Data Volumes: Imagery MDA Estimates		
Product	Daily (GigaBytes)	Yearly (TeraBytes)
Level 0	612	224
Level 1b	1102	403
Level 1c	735	269

Sounder		
Product	Daily (GigaBytes)	Yearly (TeraBytes)
All Channels	1686	616
Used by EC	63	23

Level 2,3 Products	Measures per day	Vol Scene Mbytes	Vol Day MBytes	Yearly Gbytes
Wind Low(>700 hPa)	2.43E+06	0.22	5.17	2
Wind Mid (400-700 hPa)	2.43E+06	0.22	5.17	2
Wind Upper <400 hPa)	2.43E+06	0.22	5.17	2
Cloud mask	3.50E+08	2.33	223.40	82
Cloud height	3.50E+08	7.76	744.68	272
Cloud amount	3.50E+08	7.76	744.68	272
Cloud emissivity	3.50E+08	7.76	744.68	272
Cloud top temperature	3.50E+08	7.76	744.68	272
Integrated Humidity	1.40E+07	0.31	29.79	11
Volcanic ash height	3.50E+08	7.76	744.68	272
Volcanic ash optical depth	3.50E+08	7.76	744.68	272
Fog	2.19E+09	48.48	4654.26	1699
Surface visibility	2.19E+09	48.48	4654.26	1699
Fire hot spots	1.83E+08	48.48	387.86	142
Ice motion vector	2.19E+07	1.94	46.54	17
Snow/ice cover	9.13E+07	48.48	193.93	71
Snow/ice depth	9.13E+07	48.48	193.93	71
SST: sea surface temp.	2.19E+07	1.94	46.54	17
LST: land surface temp.	3.50E+08	7.76	744.68	272
Surface albedo	9.13E+07	48.48	193.93	71
Total Aerosol optical depth	9.73E+06	0.86	20.69	8
Atmospheric stability index	8.76E+07	1.94	186.17	68
Aircraft icing threat	2.19E+07	1.94	46.54	17
Total ozone	1.40E+07	0.31	29.79	11
Vegetation Index	9.13E+07	193.93	193.93	71
FPAR	9.13E+07	193.93	193.93	71
LAI: Leaf Area Index	2.28E+07	48.48	48.48	18
Radiative fluxes	2.19E+07	1.94	46.54	17
Land surface emissivity	2.28E+07	12.12	48.48	18

Preliminary Data Volumes Estimates

INPUT VALUES: Imagery

Imagery Level 0 to Level 1c	Enter values below				99 = Place holder	
Spatial Resolution of a given Channel (km)	0.5	1	1.5	2	99	99
Number of channels with resolution X: Level 0	1	6		13	0	0
Number of channels with resolution X: Level 1b	1	6	0	13	0	0
Number of channels with resolution X: Level 1c	0	0	7	13	0	0
Number of bytes per pixel	10	10	10	10	10	10
Number of full Images per day (2 Satellites)	132	132	132	132	132	132
Side of Full Image (Square of Side X): Enter X (km)	13,000					
Formatting & other Overhead Level 0 (in %)	35%					
Data Overhead Level 1b (in %)	80%					
Data Overhead Level 1c (in %)	20%					
Ratio of Level 1c Scene over full disk (in %)	54%					

Imagery Level 2	Enter values below									
Number of bits per pixel Level 2	10									
Data Overhead Level 2 (in %)	100%						99 = Place holder			
Spatial Resolution X of a given Product Level 2	0.5	1	1.5	2	5	10	99	99	99	99
Ratio of Level 2 scene size S over full Image (in %)	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%
Level 2 Imagery Repeat Cycle (min) for given product	15	15	15	15	15	15	15	15	15	15

INPUT VALUES: Sounding Instrument

FTS	Enter values below
Spatial Resolution of a Measure	10
Number of Downlinked Channels	8000
Number of Bits per Measure	10
Size of Scene (km2)	9.E+07
Overhead per Scene (%)	40%
Number of Scenes per Orbit	33
Number of Orbits per Day (2 satellites)	4
Number of Channels used by EC	300

Preliminary Data Volumes Estimates

Level 2, 3 Products				
Enter values	R.C (min)	Res(km)	Bits	Overhead
Wind Low(>700 hPa)	60	30	10	70%
Wind Mid (400-700 hPa)	60	30	10	70%
Wind Upper <400 hPa)	60	30	10	70%
Cloud mask	15	5	3	70%
Cloud height	15	5	10	70%
Cloud amount	15	5	10	70%
Cloud emissivity	15	5	10	70%
Cloud top temperature	15	5	10	70%
Integrated Humidity	15	25	10	70%
Volcanic ash height	15	5	10	70%
Volcanic ash optical depth	15	5	10	70%
Fog	15	2	10	70%
Surface visibility	15	2	10	70%
Fire hot spots	180	2	10	70%
Ice motion vector	60	10	10	70%
Snow/ice cover	360	2	10	70%
Snow/ice depth	360	2	10	70%
SST: sea surface temp.	60	10	10	70%
LST: land surface temp.	15	5	10	70%
Surface albedo	360	2	10	70%
Total Aerosol optical depth	60	15	10	70%
Atmospheric stability index	15	10	10	70%
Aircraft icing threat	60	10	10	70%
Total ozone	15	25	10	70%
Vegetation Index	1440	1	10	70%
FPAR	1440	1	10	70%
LAI: Leaf Area Index	1440	2	10	70%
Radiative fluxes	60	10	10	70%
Land surface emissivity	360	4	10	70%

R.C = Repeat Cycle
Res = Spatial Resolution

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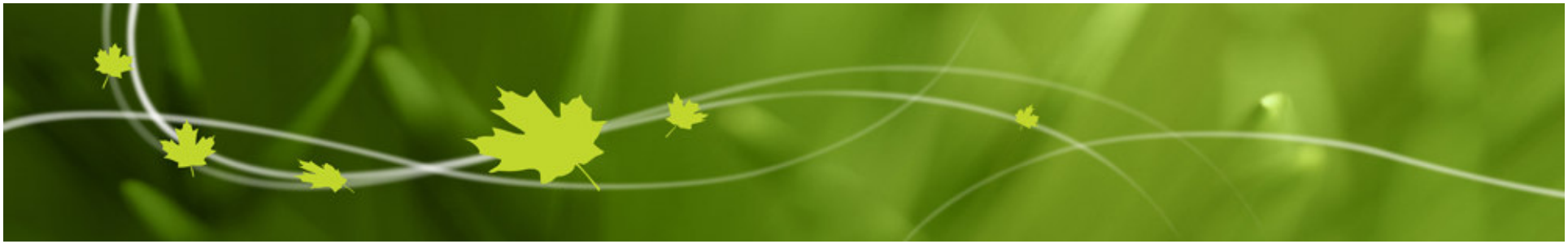
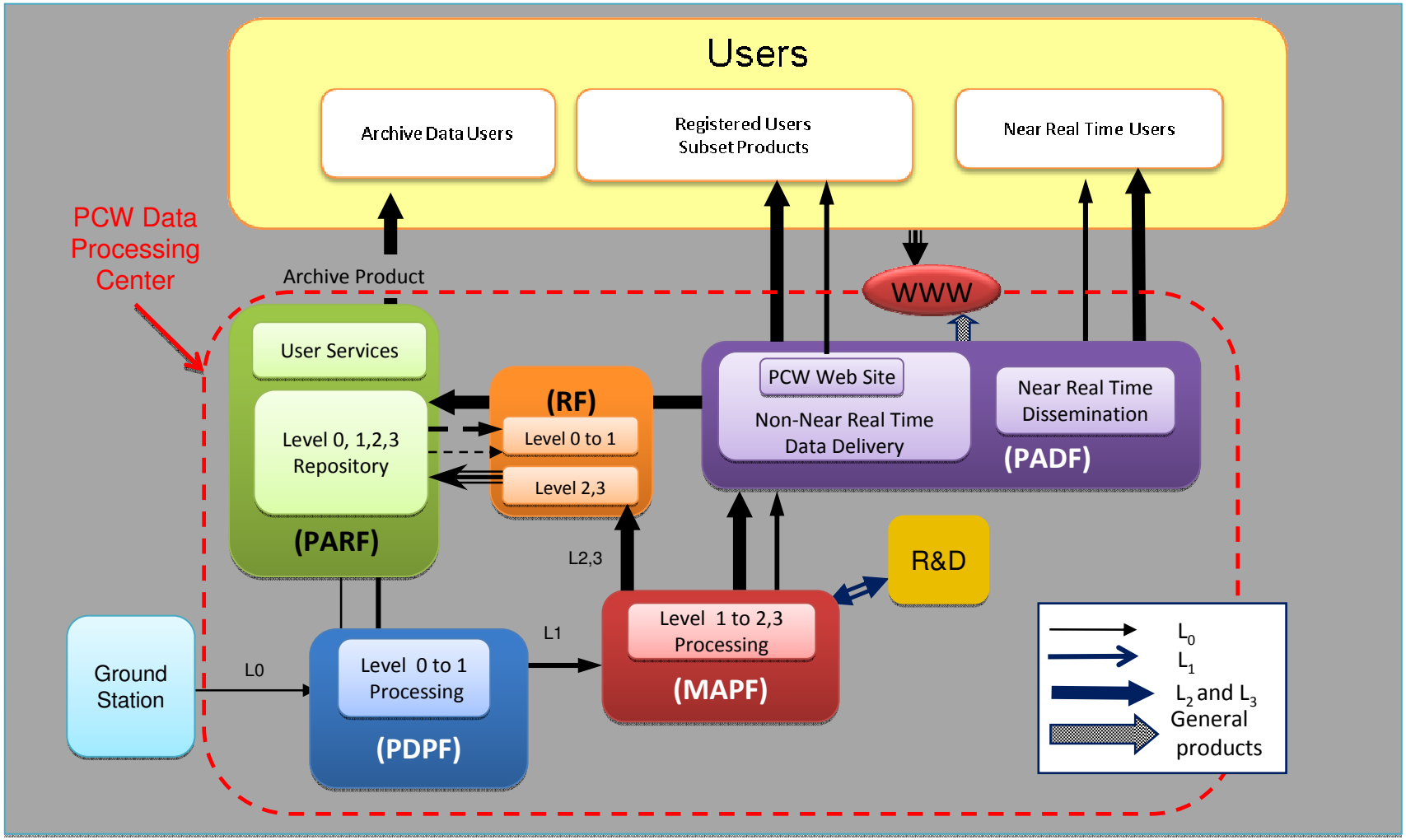


CREATING THE PCW DATA PROCESSING CENTER

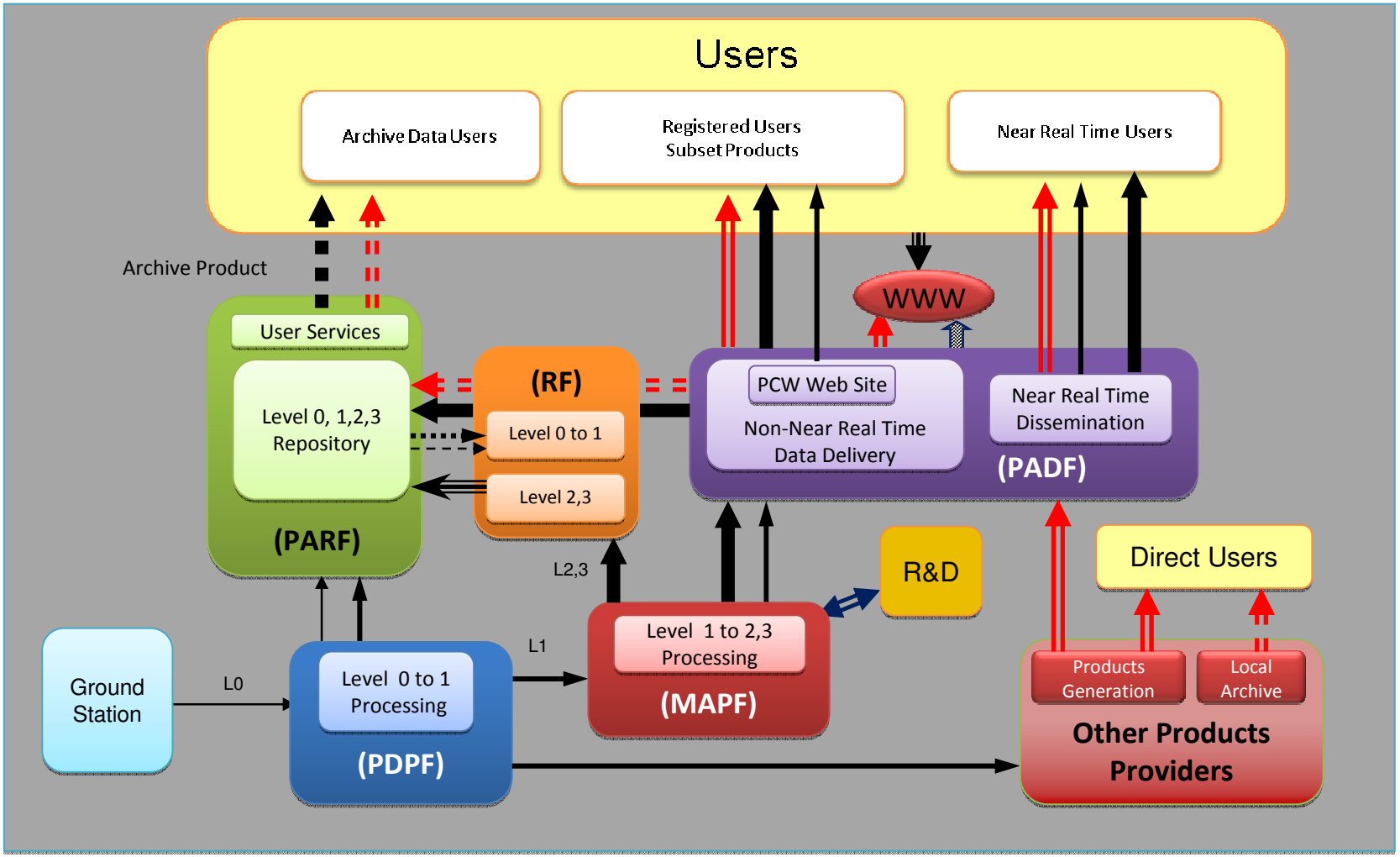
PCW Data Processing Center Functional Architecture

- The following slides present first concepts of the PCW Data Processing Center overall functional architecture for two cases:
  - A Baseline, with only meteorological products elaborated by EC
  - An option including products generated by other entities (Government Department, Universities etc…)
- Other options were studied but are not presented here

PCW Data Processing Center Functional Architecture (EC products only)



PCW Data Processing Center Functional Architecture (Other Providers- Balanced)



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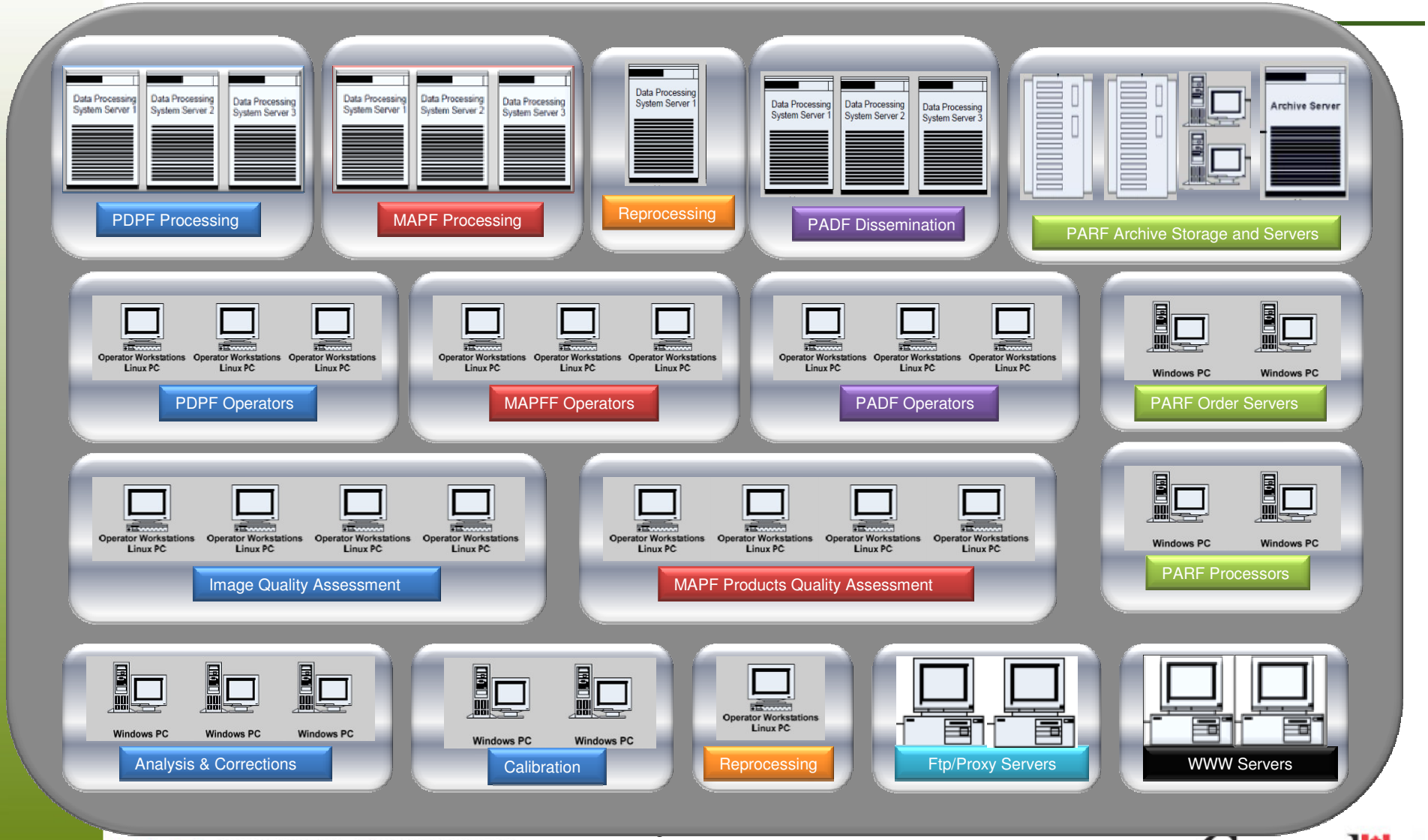
Building the PCW Data Processing Center: System Architecture



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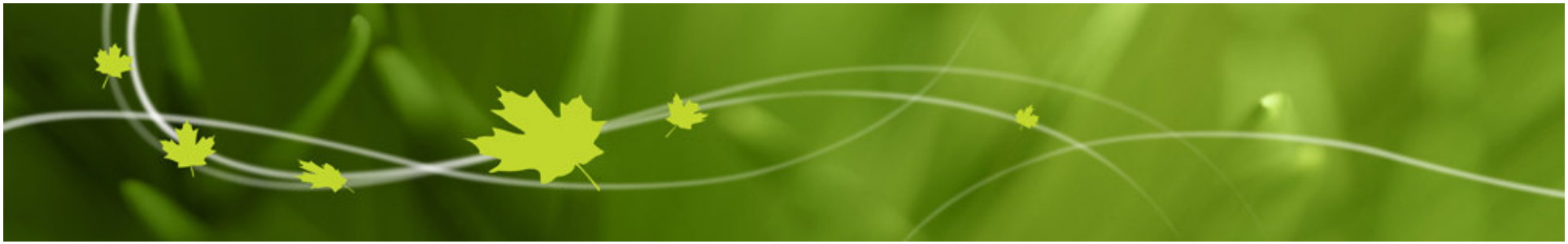
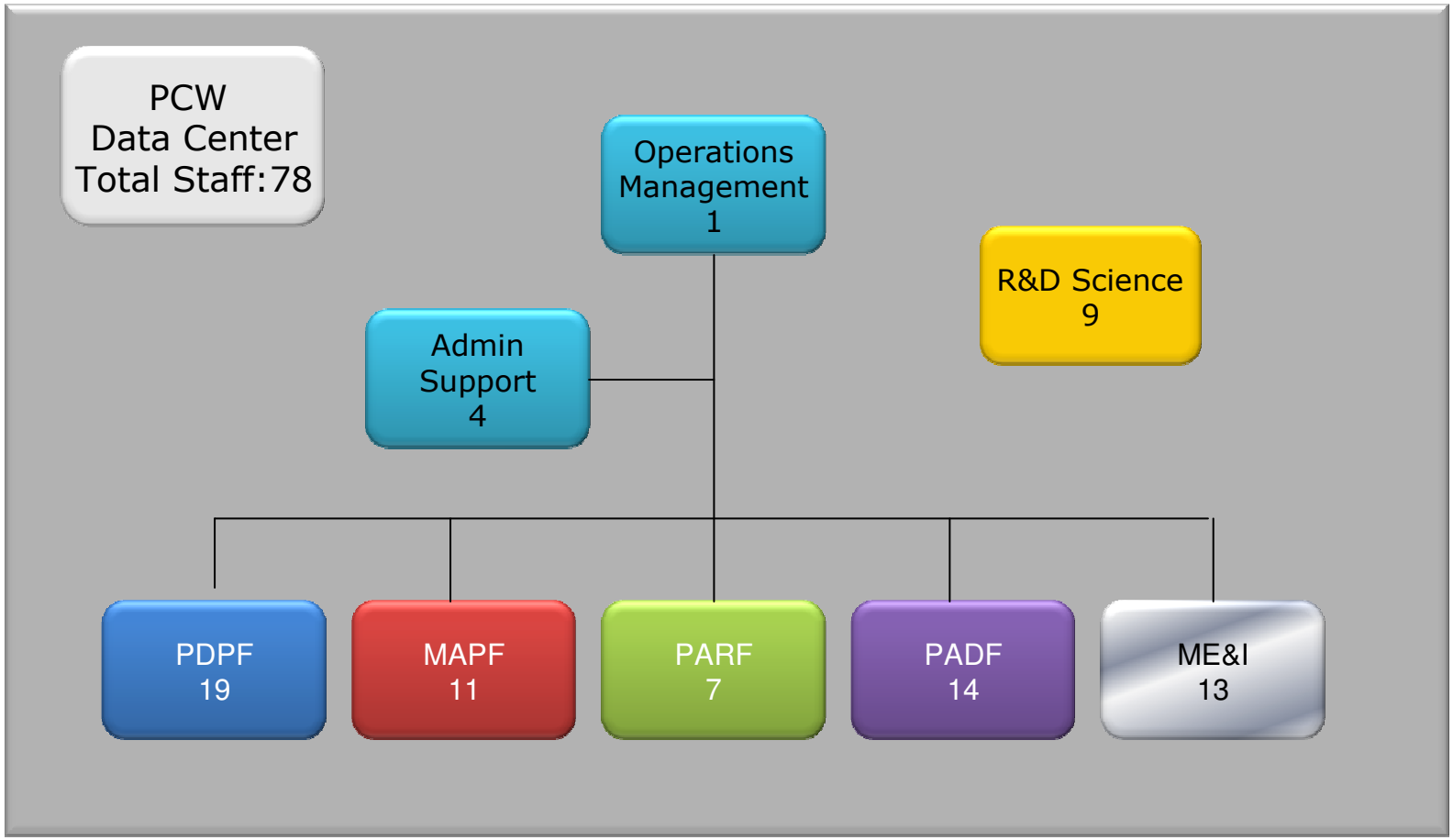


PCW DATA PROCESSING CENTER MANPOWER RESOURCES ESTIMATE

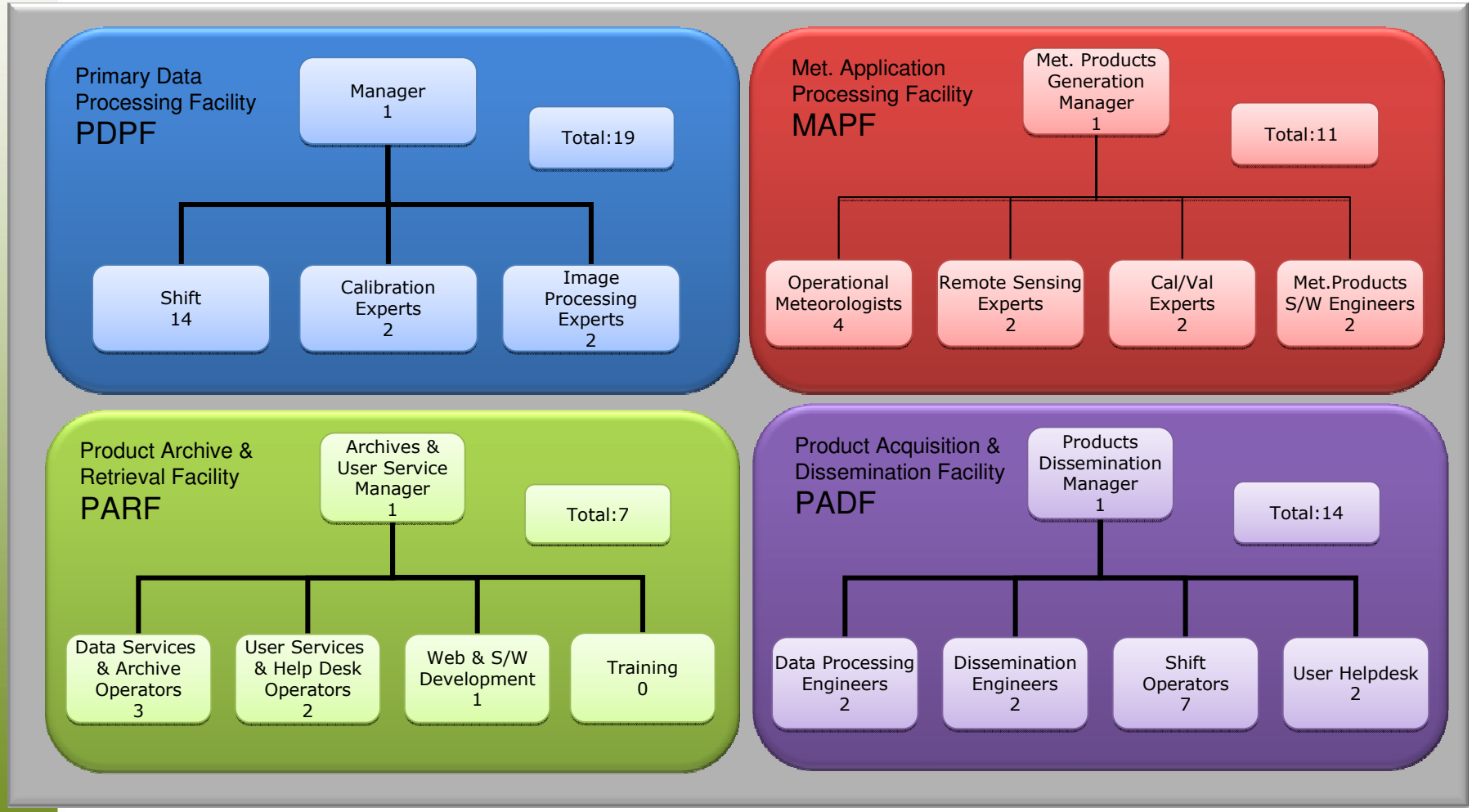
PCW Data Processing Center Manpower Resources Estimates

- Operational Staffing Needs
  - Data Processing and Product Generation
  - Archiving, Retrieval and User Services
  - Product Distribution and Dissemination
  - Maintenance, Engineering and Infrastructure
- Research and Development Staffing Needs
  - Algorithm Improvement
  - Product Validation
  - New Products Implementation

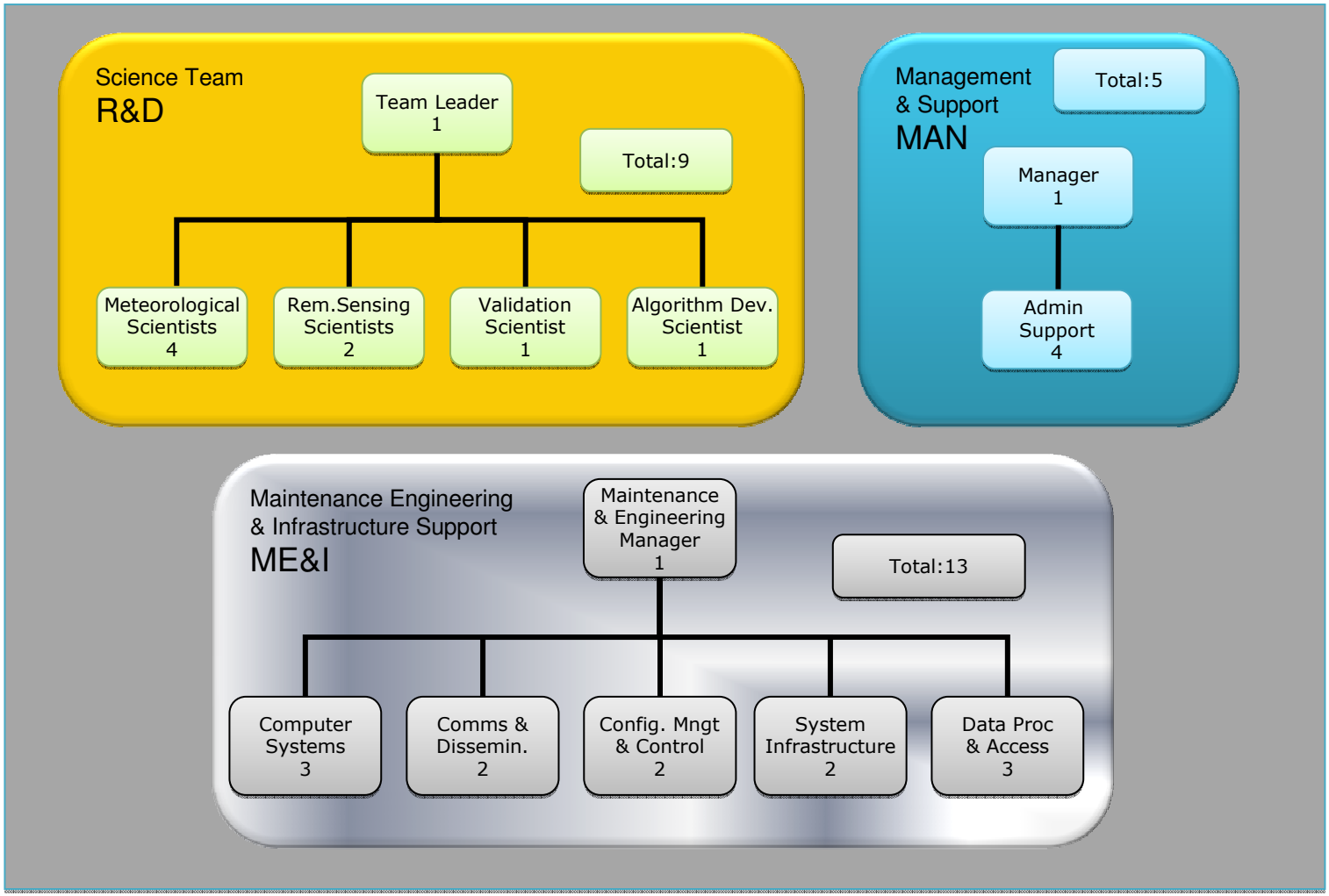
PCW Data Processing Center Manpower Resources (Summary)



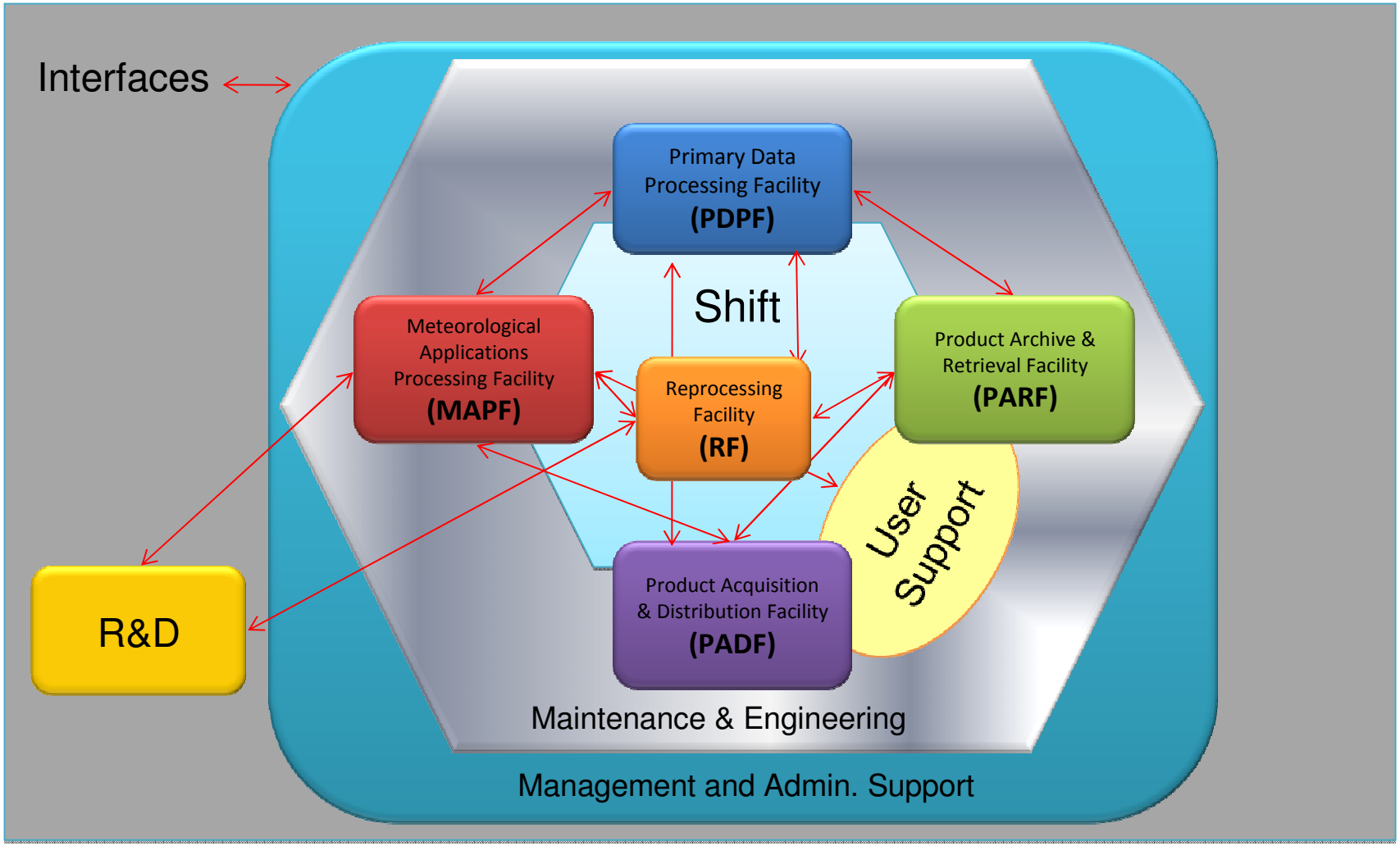
PCW Data Processing Center Manpower Resources



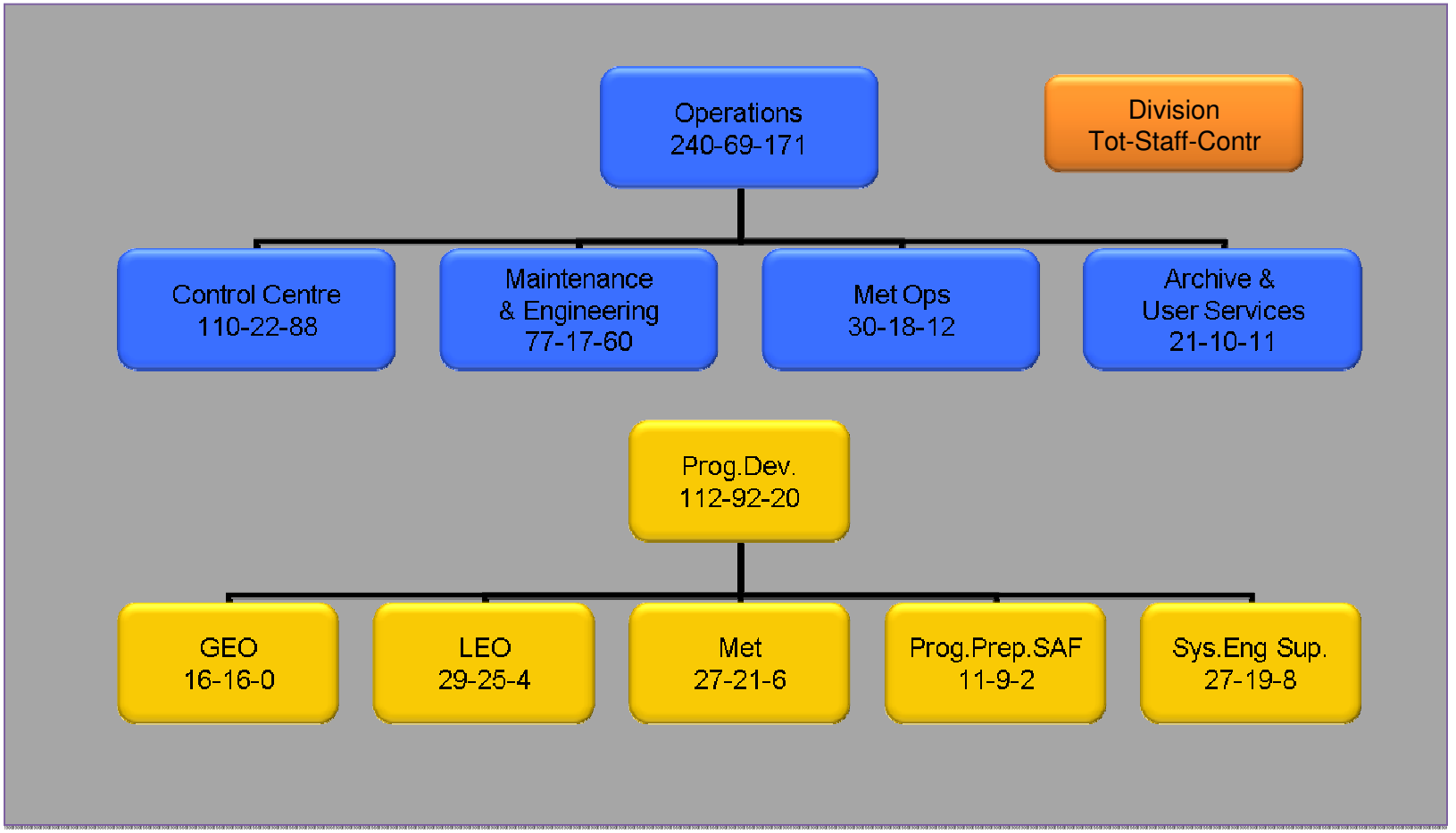
PCW Data Processing Center Manpower Resources (2)



Staffing Optimization



EUMETSAT Ground Segment Staffing: For Comparison



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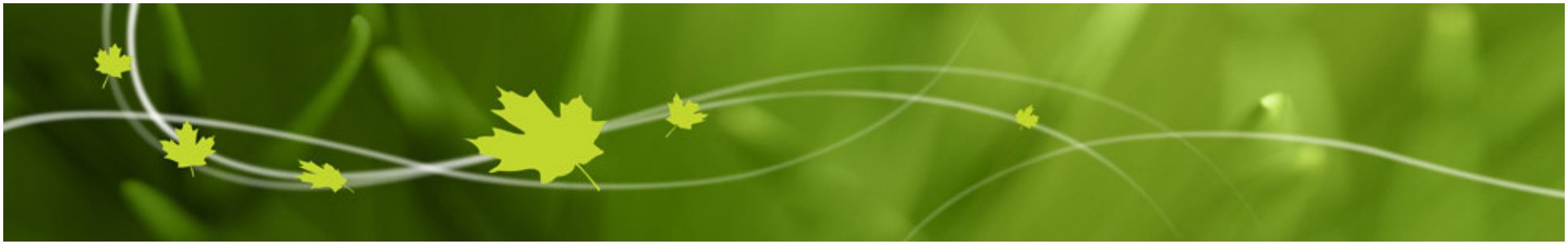

SUGGESTIONS AND RECOMMENDATIONS

Key Decisions by Management

- Respective roles and responsibilities between partners on PCW Programme development, implementation and operations
- Location of Ground Segment facilities
- Procurement strategy
- Recruitment strategy
- (Approval and funding of the PCW Programme)

Suggestions and Recommendations
General

- Aim: Elaborate strategies that will minimize risks, efforts, duplication, and costs during the different phases of the Programme
- Recommendations:
  - Develop in house expertise to ensure that EC can best fulfill its mandate
  - Seek and use existing, proven methodologies and end-to-end products developed by NOAA or others
  - Develop awareness and involve existing EC, University scientists in the project
  - Fund polar and remote sensing research

Suggestions and Recommendations
Space Segment

- Support CSA and ensure proper participation in relevant studies and in the decision process:
  - Preparation of documentation
  - Participate in industrial reviews, trade-off studies
  - Interface (Space/Ground Segments)
  - Meteorological sensor development and calibration
  - Additional sensors (e.g. choice, impact on Ground Segment)
  - Acquisition and dissemination schemes
  - Data Formats (adherence to GSICS conventions)

Suggestions and Recommendations
Ground Segment

- Perform a study to asses, and decide on, options for the location of the various elements of the Ground Segment
  - Co-locate all facilities (except the Primary Ground Station)?
  - Co-locate at EC-Dorval?
  - Co-locate at CSA?
  - Co-locate at another site (government or not)?
  - Do not co-locate some of the facilities?

Suggestions and Recommendations
Ground Segment

- Establish a joint (CSA-EC) Ground Segment team to ensure:
  - Efficient interfaces between Level 1 image products developed and delivered by CSA
  - Development and implementation of cost efficient and technically sound archiving and dissemination strategies
  - A “smooth” transition between development and operational phases

Suggestions and Recommendations
Ground Segment (cont.)

- Assess in-house vs. industrial development and implementation of some elements of the ground segment facilities
- Collaborate with providers of other PCW products, (Government Departments, Universities) and agree on product generation, archiving and distribution
  - "Space Weather" products
  - Science package (e.g. FTS)

Suggestions and Recommendations
Data Processing, Calibration/Validation

- Product software packages strategy
  - Collaborate with NOAA, EUMETSAT and assess the feasibility to re-use existing software packages developed for GOES-R, MTG, METOP
  - Request industry to develop “portable” software packages, independent of hardware choices
  - Develop and implement the reprocessing facility and use it for testing and validation purposes
  - Participate in CGMS and GSICS meetings to benefit from “know-how” and effort sharing

Suggestions and Recommendations
Recruitment (short term)

- Establish a team of full time EC staff plus consultancy support to:
  - Develop, study, and recommend strategies on programmatic matters (overall planning, procurement and implementation of the ground segment, recruitment)
  - Continue discussions with NOAA and other partners on product generation
  - Prepare documentation for Phase-B studies
  - Liaise with CGMS and GSICS participants

Suggestions and Recommendations
Recruitment and Training (longer term)

- Involve existing EC staff in the project
- Recruit and train post-docs who will participate in the development phases and would be natural candidates for new positions for Phase-E (operations)
- Assess the use of contractors for routine operational tasks whenever possible

Conclusion

- This presentation introduced:
  - The PCW mission objectives, its current status and major milestones
  - A preliminary Ground Segment concept, based on the functions associated with the application facilities
  - The current baseline list of products and corresponding data volumes
  - Estimates of manpower resources necessary to run the applications ground segment
  - A series of suggestions and recommendations

Conclusion: Key Recommendation

- EC is facing a new and exciting challenge
- EC should allocate enough internal resources to:
  - Support EC high level management, in the decision process, through pertinent studies
  - Collaborate with:
    - CSA on Program development and implementation
    - International partners on products software packages and calibration (e.g. NOAA, GSICS)
    - Other Canadian Government Departments and Universities on science instrument products