Latest Advancements in the ePRTC and cnPRTC

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Introduction

- Latest version of ePRTC (enchanced primary reference time clock) published (March 2024) by the ITU in G.8272.1
- First version of cnPRTC (coherent network primary reference time clock) published (March 2024) by the ITU in G.8272.2
  - Builds on the ePRTC in G.8272.1 by networking these ePRTC clocks (an ePRTC combines GNSS and atomic clocks)
  - Connections made with high-accuracy links for transporting accurate time and frequency, which are both required
  - Time scale produced in real time with this network of distributed clocks
  - Resilience provided by ePRTC autonomous atomic clocks and by networked ePRTCs
- Both can make use of UTC(k) such as that produced by national metrology laboratories in a number of ways
- Both are expected to have new versions completed mid 2025 and published late 2025

G.8272.1 ePRTC

ITUPublications
Recommendations

International Telecommunication Union
Standardization Sector

Recommendation

ITU-T G.8272.1 (01/2024)

SERIES G: Transmission systems and media, digital systems and networks

Packet over Transport aspects – Synchronization, quality and availability targets

Timing characteristics of enhanced primary reference time clocks

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G.8272.1 ePRTC

Page

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G.8272.1 ePRTC Future Release

Current:

8.2.1 Time error in holdover mode

For L > 40 days, the holdover period H is 40 days.

Draft:

8.3 Recovery from holdover

9.1.1 Input interfaces for phase and time

AppendixVI ePRTC used as a travelling clock

This appendix describes considerations for the use of an ePRTC as a travelling clock. One important application is for Disaster Recovery Management (DRM).

G.8272.2 cnPRTC

ITUPublications
Recommendations

International Telecommunication Union
Standardization Sector

Recommendation

ITU-T G.8272.2 (01/2024)

SERIES G: Transmission systems and media, digital systems and networks

Packet over Transport aspects – Synchronization, quality and availability targets

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Timing characteristics of coherent network primary reference time clocks

G.8272.2 cnPRTC

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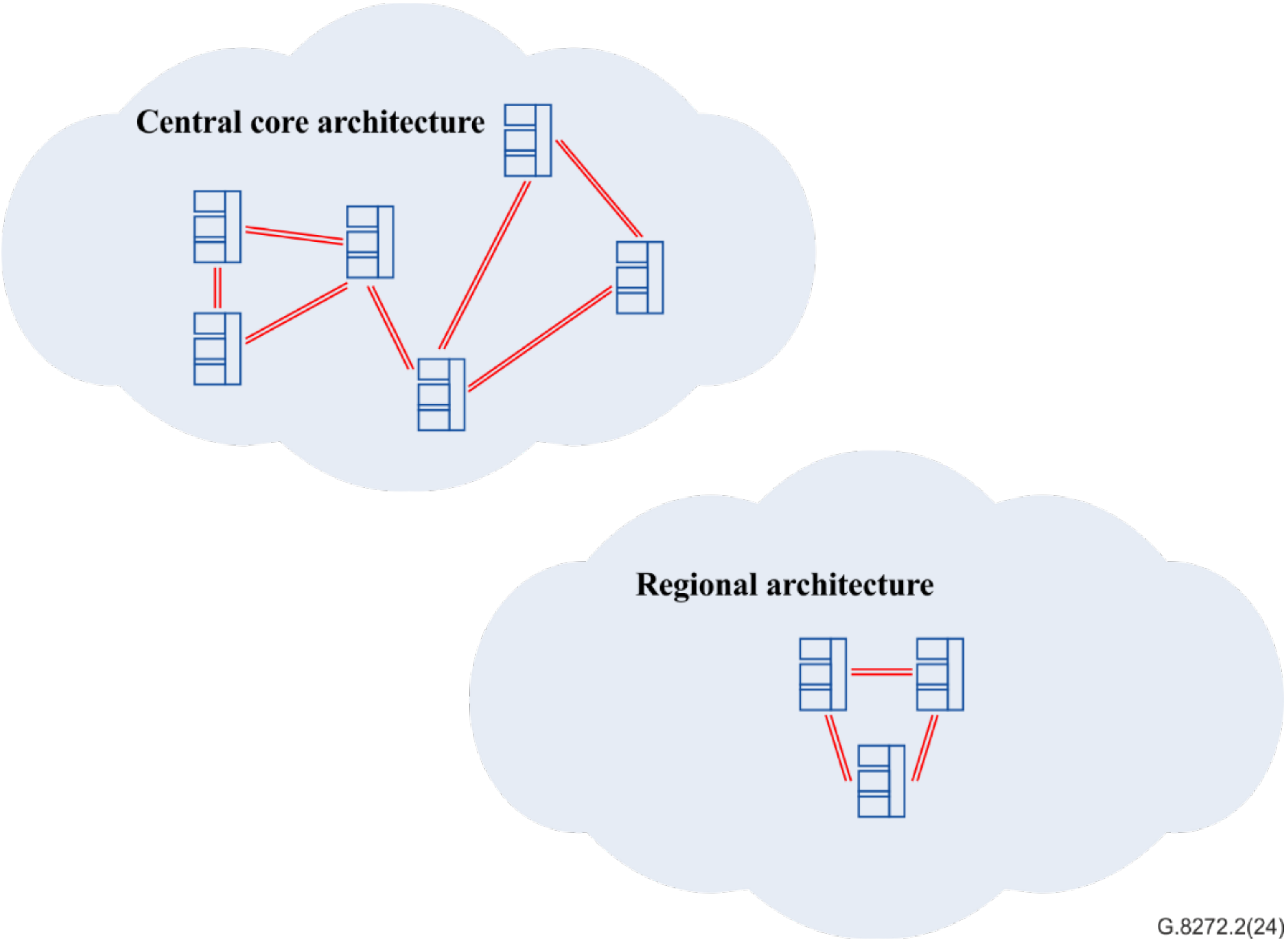
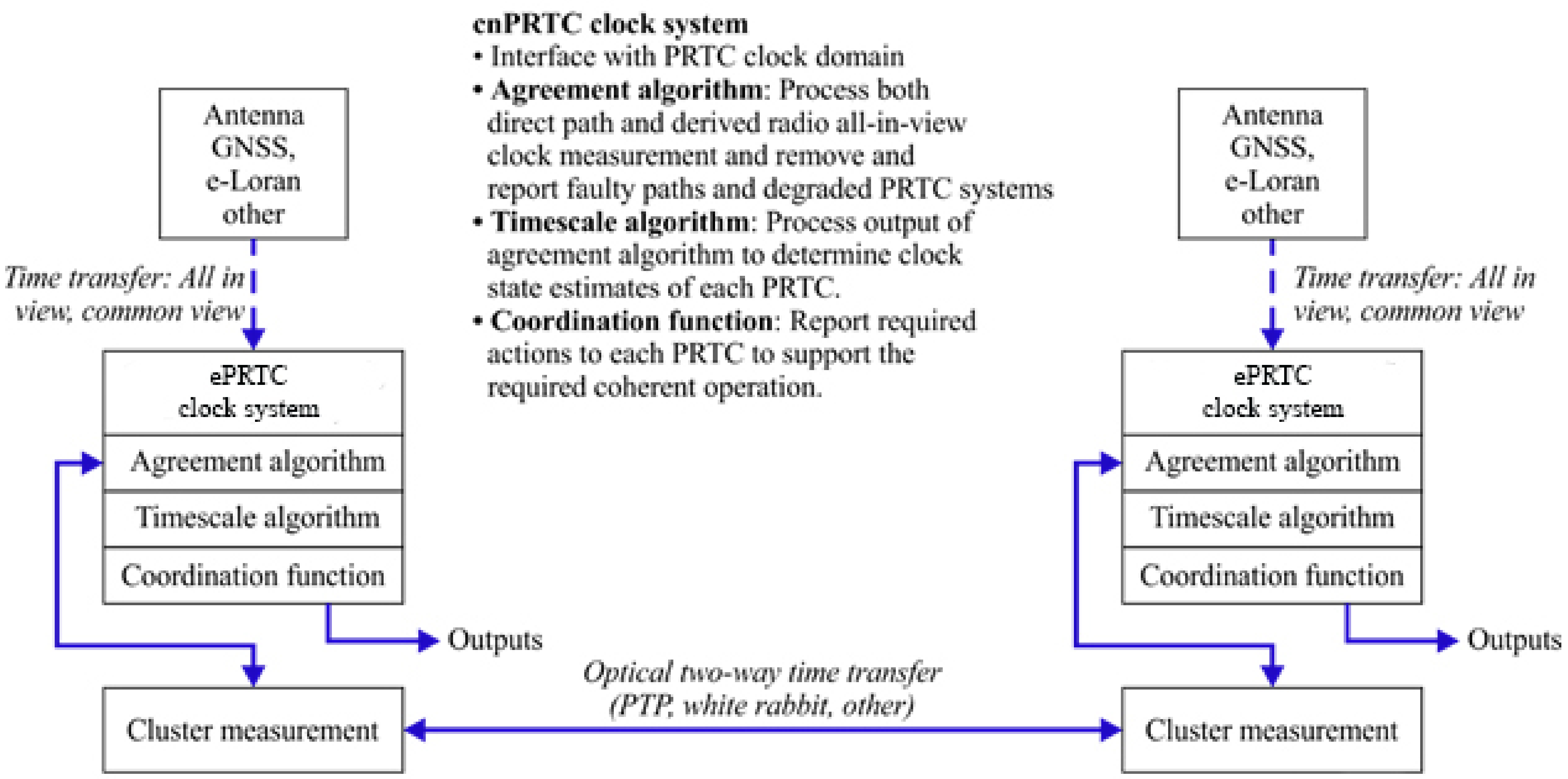
G.8272.2 cnPRTC in the Network



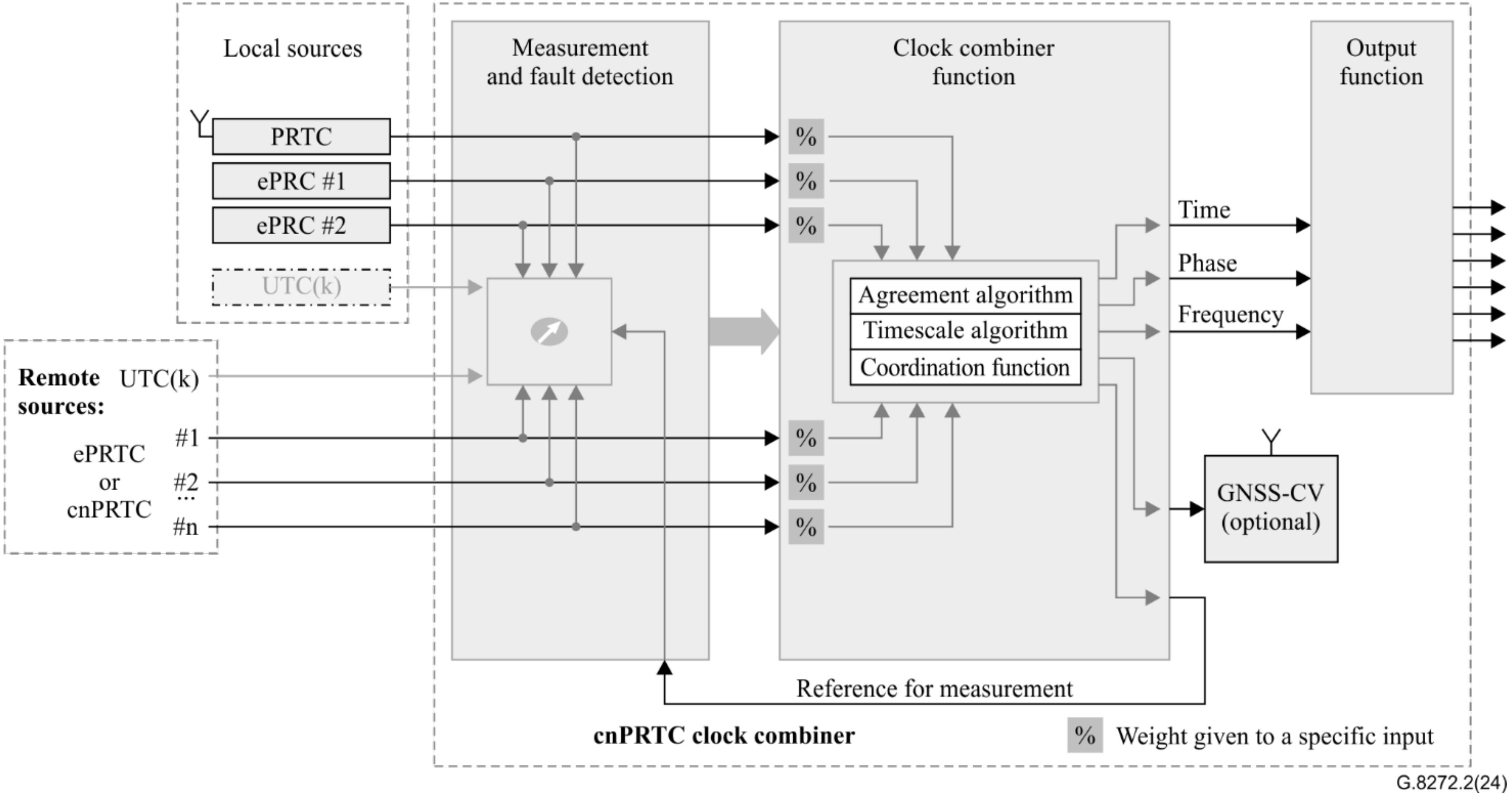
G.8272.2(24)

G.8272.2 cnPRTC Functional Architecture



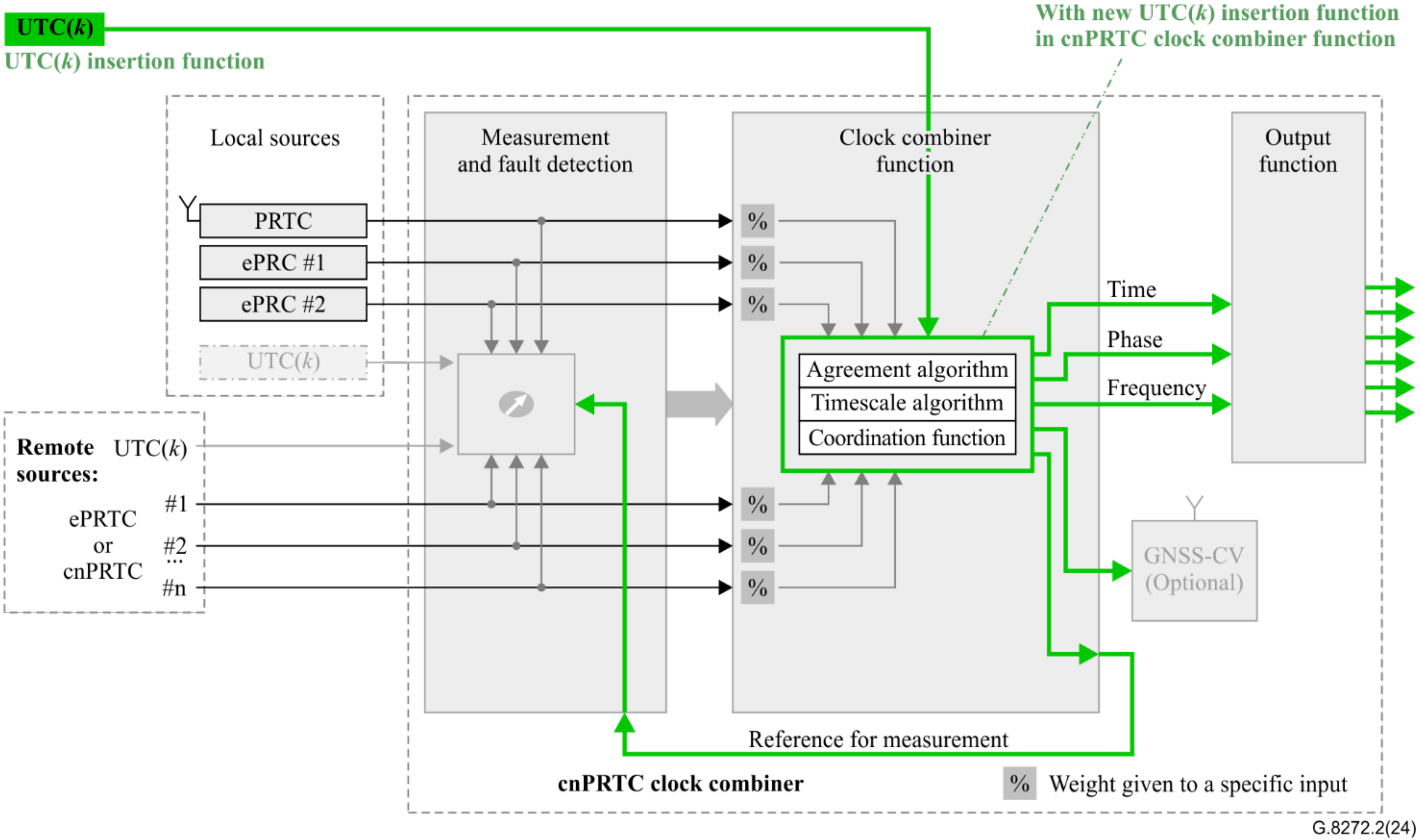
- High-accuracy connections include time transfer with PTP using fiber and common view using satellites

G.8272.2 cnPRTC Functional Block Diagram



- Input sources can include both local and remote sources. Local sources can be PRTC, atomic clock (e.g., ePRC) or a local UTC time laboratory
- Remote sources are delivered via a high-accuracy time-transfer from neighbouring cnPRTC nodes or UTC(k) sources

G.8272.2 Annex A: UTC(k) Usage for cnPRTC



The UTC(k) interfaces in the "remote sources" and "local sources" blocks are inputs to the measurement functions and are intended to be part of the clock combiner algorithm. The optional UTC(k) insertion function is intended to work differently. If the UTC(k) insertion function, highlighted in green in Figure A.1, is used, the clock combiner algorithm is superseded, and the UTC(k) insertion function is used directly.

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G.8272.2 cnPRTC Future Release

Current:

10 Coherency

Coherency performance for a cnPRTC is for further study.

Draft:

10 Coherency

10.1 Coherency requirement level 1

When the systems are operating in the normal, locked mode, the maximum relative time error shall not exceed 40 ns.

G.8272.2 cnPRTC Future Release

Deployment scenario #	Used sources and logical functions									Descriptions
	Local sources		Remote sources			Logical functions				
	PRC/ ePRC	PRTC	Time Transfer links from/to neigh-borhood e/cnPRTC nodes (e. g. IEEE1588v2.1 high-accuracy profile, or ITU-T PTP-FTS/SyncE) for measure-ment	Time Transfer links from/to neigh-borhood e/cnPRTC nodes (e. g. IEEE1588v2.1 high-accuracy profile, or ITU-T PTP-FTS/SyncE) for local ensem-bling	UTC(k) from a remote UTC(k) lab	Measure-ment function	Clock Com-biner function	Output function	GNSS Common view	
1	YES	YES	NO	NO	Optional	Optional	YES	YES	Optional	Stand-alone ePRTC according to G.8272.1
2	YES	YES	YES	NO		YES	YES	YES		Like cnPRTC, but monitoring the remote sources only
3	YES	YES	YES	YES		YES	YES	YES		Remote sources are used for frequency alignment only to contribute to local frequency
4	YES	YES	YES	YES		YES	YES	YES		Final cnPRTC architecture , remote sources are actively used to contribute to local time

Summary

- ePRTC increased holdover from 14 days to 40 days, and will add holdover recovery, time/phase inputs, and ePRTC as travelling clock; cnPRTC will add coherency requirement and deployment scenario for remote frequency alignment
- cnPRTC networks ePRTC clocks which are themselves comprised of GNSS for time and atomic clocks for stable frequency
- The cnPRTC can use UTC(k) in a number of ways:
  - As a local source into the clock combiner algorithm
  - As a remote source into the clock combiner algorithm
  - As the direct source for cnPRTC time and frequency
- The cnPRTC provides resilience in several ways:
  - ePRTC/cnPRTC node standalone autonomous atomic clock resilience
  - cnPRTC clocks elsewhere in the network providing accurate time and frequency via high-accuracy links

Thank you

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